National Aeronautics and Space Administration

NASA SOFTWARE

2023–2024 CATALOG

NASA **TECHNOLOGY**
TRANSFER PROGRAM

BRINGING NASA TECHNOLOGY DOWN TO EARTH

I am pleased to present the sixth edition of the NASA Software Catalog.

NASA's space exploration has come roaring back from the pandemic, with launches over the next year or so expected to send astronauts into lunar orbit and spacecraft to explore one of Jupiter's icy moons and an all-metal asteroid. These follow the launch of the flagship James Webb Space Telescope and the first flights of the Space Launch System. We proved we could change an asteroid's trajectory, and we're about to bring back samples from another asteroid.

But NASA also uses space to study Earth, looking down from orbit to get the big picture, often with sensors that can see what the human eye cannot. All of this work, from calculating spacecraft trajectories to wringing valuable information from mountains of satellite data, requires constant technological innovation, but it's not all thrusters and spectrometers. More and more, advancing technology means writing new or improved software.

Our biannual software catalog lets us share those programs with the nation and the world. The codes within these pages have been essential to keeping astronauts healthy in space, landing rovers on the Red Planet, and monitoring details and trends across this planet's surface and atmosphere.

The 2023-2024 catalog contains more than 1,000 codes written by NASA engineers, organized by discipline, and available free of charge. They were created to meet the space agency's needs but often prove useful for diverse applications. Tools for modeling Earth's atmosphere to plan spacecraft reentry, for example, are also useful not only to commercial space companies but to businesses designing drones or studying the climate. Here are a few more popular examples:

GeoCam is a geospatial system for disaster response

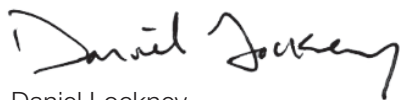**Data Cube Platform** provides a computational infrastructure to use Earth-observation data

Lightning Forecasting estimates an area's total lightning flash rate density

Landslide Hazard Assessment identifies areas of moderate to high landslide hazard

EarthKit provides a framework for collaboration among researchers in Earth science

Tax dollars spent on space and aviation have always resulted in technologies that improve everyday life here on the ground. NASA's innovative software codes help the private sector overcome technical challenges, generate or improve commercial products, and get startups off the ground.

NASA software code might be just what you or your company needs. Take a look to see what NASA has for you.

Daniel Lockney
Technology Transfer Program Executive
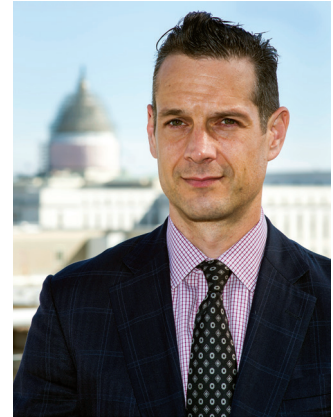Space Technology Mission Directorate
NASA Headquarters

Table of Contents

Using the Catalog

Offering an extensive portfolio of software products for a wide variety of technical applications, the NASA Software Catalog is organized into 15 broad subject matter categories.

The codes within each category are listed alphabetically. All catalog entries include the software title, the product ID number (known internally as the NASA case number), a short description, and the software's specified release type. Some software descriptions contain links to additional information or downloading options.

Each code listed in the catalog is available at no cost and has been evaluated for access requirements and restrictions:

- **General Public Release:** For codes with a broad release and no nondisclosure or export control restrictions

- **Open-Source Release:** For collaborative efforts in which programmers improve upon codes originally developed by NASA and share the changes

- **U.S. Release Only:** For codes available to U.S. persons only, with no further transfer of the software allowed without the prior written approval of NASA

- **U.S. and Foreign Release:** For codes that are available to U.S. persons and (under special circumstances) persons outside of the U.S.

- **U.S. Government Purpose Release:** For codes that are to be used on behalf of the U.S. government

  - **Project Release:** For use under a contract, grant, or agreement
  - **Interagency Release:** For use by U.S. government agencies
  - **NASA Release:** For use only by NASA personnel and contractors

The software catalog is continually updated. Please visit the NASA Technology Transfer Portal for the latest updates and revisions:
technology.nasa.gov

Requesting Software

NASA software may be requested through the NASA Software Catalog website:

software.nasa.gov

1. Select the Request Software button below the item description for the catalog entry. Many open-source software codes and mobile apps provide a URL link so that the requester can download the software directly; it is not necessary to use the Request Software button for these codes.

2. Complete the request form. All required fields must be filled in before you can submit your request. Requests will automatically be routed to the appropriate center's Software Release Authority (SRA) for processing.

Points of Contact

Each NASA center has a Software Release Authority (SRA) representative ready to assist you with your software requests. Contact information is provided below:

Case Number	NASA Center	Contact Information
ARC-XXXXX	Ames Research Center	arc-sra-team@mail.nasa.gov
DRC-XXX-XXX	Armstrong Flight Research Center	afrc-ipo-softwarecatalogue@mail.nasa.gov
GSC-XXXXX	Goddard Space Flight Center	gsfc-softwarerelease@mail.nasa.gov
HQN-XXXXX	NASA Headquarters	hq-sra-team@mail.nasa.gov
NPO-XXXXX	Jet Propulsion Laboratory	jpl_ott@jpl.nasa.gov
KSC-XXXXX	Kennedy Space Center	ksc-dl-software-request@mail.nasa.gov
LAR-XXXXX	Langley Research Center	larc-sra@mail.nasa.gov
LEW-XXXXX	Glenn Research Center	grc-sra-team@mail.nasa.gov
MFS-XXXXX	Marshall Space Flight Center	msfc-sra-team@mail.nasa.gov
MSC-XXXXX	Johnson Space Center	jsc-ttco-software-request@mail.nasa.gov
SSC-XXXXX	Stennis Space Center	ssc-technology@nasa.gov

NASA Software of the Year Awards

Each year NASA recognizes development teams that have set high standards for software that is creative, usable, and transferable. An advisory panel with representatives from across the agency reviews entries and recommends winners to the Inventions and Contributions Board.

2021

Copernicus Spacecraft Trajectory Design and Optimization System

Planning a Path Through Space

Plotting a mission's path through space depends on a complicated mix of factors including destination, fuel, and the number of spacecraft involved.

The Copernicus Spacecraft Trajectory Design and Optimization System streamlines that process. Copernicus lets teams model, design, and optimize paths through space for each mission – from simpler flights to more complicated missions that might involve several spacecraft with different propulsion systems.

Copernicus also allows teams to look at how gravity from multiple celestial bodies – for example, Earth and the Moon – might influence mission design. Engineers at NASA's Johnson Space Center in Houston are using Copernicus as their primary tool for designing trajectories for Artemis missions using Orion.

Copernicus, a project of Johnson, was selected as the 2021 NASA Software of the Year. Copernicus was originally developed at the University of Texas at Austin in 2001 by Dr. Cesar Ocampo with NASA support, and primary development was transferred to NASA Johnson in 2007, where it has been under continuous development ever since. At Johnson, the Copernicus project is led by Gerald Condon, and the lead developer is Jacob Williams. Organizations interested in obtaining Copernicus can request it from NASA Technology Transfer.
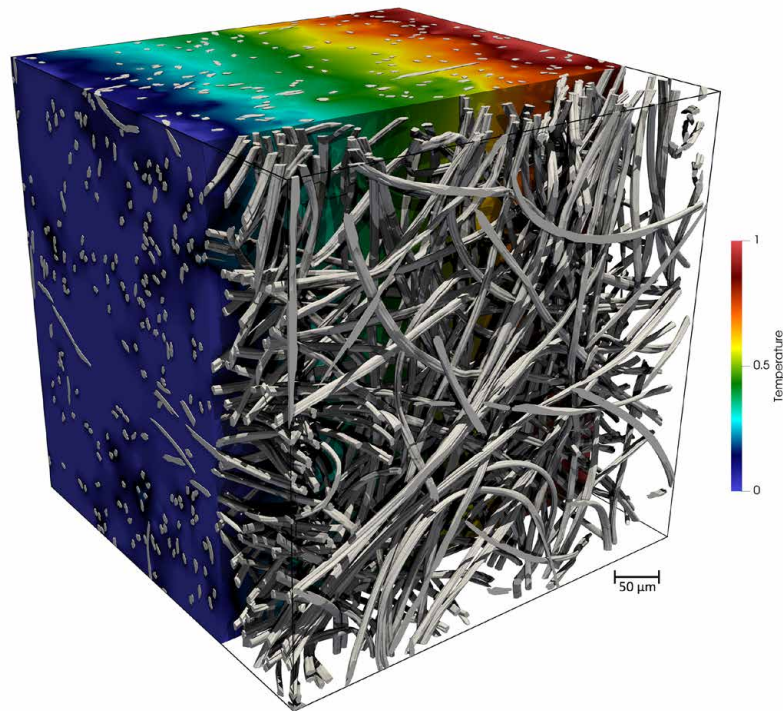
2022
Porous Microstructure Analysis (PuMA)

Studying Spacecraft Materials at a Microscale

For decades, doctors have used CT scans – a series of X-ray images – to locate and assess injuries inside the brain and body. More recently, NASA's Ames Research Center in California's Silicon Valley has utilized CT imaging for an otherworldly application: Researchers have applied this technology to study how spacecraft are structurally and materially impacted by the extreme temperatures and aerodynamic forces of atmospheric entry when preparing to touch down on a planet's surface.

PuMA – an open-source software package developed by researchers at Ames – uses micro-CT imaging to assess on a miniscule scale how heat and pressure can affect the lightweight composite structures designed to protect a vehicle during entry, descent, and landing. Material behavior at the microscale is important to generate a physics-based understanding of material performance, empowering engineers to design systems with higher reliability. Looking beyond thermal protection materials, PuMA's development team has also made significant advancements that enable PuMA to analyze a wide array of materials like parachutes, batteries, and meteorites.

PuMA is the 2022 Software of the Year winner. It was developed under the NASA Entry Systems Modeling project, which is funded by the Game Changing Development Program within NASA's Space Technology Mission Directorate.

Top 20 Software Codes

1

Debris Assessment Software (DAS), Version 3.2.3

Operations

JSC MSC-26690-1 Pages 150, 153

2

Chemical Equilibrium Applications (CEA)

Propulsion

GRC LEW-17687-1 Pages 162, 164

3

Orbital Debris Engineering Model (ORDEM), Version 3.2

Environmental Science

JSC MSC-25457-1 Pages 128, 137

4

Project Cost-Estimating Capability (PCEC)

Business Systems and Project Management

MSFC MFS-33187-2 Pages 28, 32

5

Chemical Equilibrium with Applications in MATLAB (CEAM)

Propulsion

MSFC MFS-33320-1 Pages 162, 164

6

FUN3D, Version 13.7

Aeronautics

LaRC LAR-19638-1 Pages 2, 7

7

WinPlot Graphical Display System

Data and Image Processing

MSFC MFS-31664-1 Pages 38, 82

8

Global Reference Atmospheric Model (GRAM) Suite

Environmental Science

MSFC MFS-33888-1 Pages 128, 133

9

Copernicus Trajectory Design and Optimization System, Version 5.2

Design and Integration Tools

JSC MSC-26673-1 Pages 98, 102

10

Failure Modes and Effects Analysis Tool (FMEA)

Design and Integration Tools

JSC MSC-25379-1 Pages 98. 103

Are these in your toolbox?

11 ✈

Flight Optimization System (FLOPS) Software, Version 9

Aeronautics

LaRC   LAR-18934-1   Pages 2, 7

12 ✈

OVERFLOW: Overset Grid Computational Fluid Dynamics Flow Solver with Moving Body Capability, Version 2.4

Aeronautics

LaRC   LAR-20095-1   Pages 2, 12

13 ▮▮▮

Schedule Test and Assessment Tool (STAT), Version 5.0

Business Systems and Project Management

MSFC   MFS-33362-1   Pages 28, 32

14 ◉

System IDentification Programs for AirCraft (SIDPAC)

System Testing

LaRC   LAR-16100-1   Pages 176, 185

15 ⌗

TetrUSS: Computational Fluid Dynamics Software

Design and Integration Tools

LaRC   LAR-16882-1   Pages 98, 115

16 ▮▮▮

NASA Root Cause Analysis Tool (RCAT)

Business Systems and Project Management

GRC   LEW-19737-1   Page 28, 31

17 🚀

ROCETS: Rocket Engine Transient Simulation Software

Propulsion

MSFC   MFS-31858-1   Pages 162, 166

18 ⌗

Chimera Grid Tools, Version 2.2

Design and Integration Tools

ARC   ARC-16025-1B   Page 101

19 ⌗

Automated Triangle Geometry Processing for Surface Modeling and Cartesian Grid Generation (Cart3D)

Design and Integration Tools

ARC   ARC-14275-1   Page 100

20 ⌗

FIAT: Fully Implicit Ablation and Thermal Analysis Program, Version 3

Design and Integration Tools

ARC   ARC-15779-1A   Page 104

Aeronautics

Air Traffic Management Tools, Modeling, and Simulation Tools

Notice anything different about the wings on this airliner? This conceptual truss-braced wing narrowbody is an aircraft with a 170-foot-span folding wing. By utilizing trusses, the aircraft can have longer, thinner wings with greater aspect ratios. This, in turn, translates into less drag and 5% to 10% less fuel burned. The Transonic Truss-Braced Wing aircraft originated from a joint effort by NASA and Boeing to develop subsonic commercial transportation concepts meeting NASA-defined metrics for reduced noise, emissions, and fuel consumption. The design is undergoing wind tunnel testing and other studies by NASA researchers.

Featured Software

FUN3D, Version 13.7   **LAR-19638-1**

FUN3D is a suite of computational fluid dynamics simulation and design tools that uses mixed-element unstructured grids in a large number of formats, including structured multiblock and overset grid systems. A discretely exact adjoint solver enables efficient gradient-based design and grid adaptation to reduce estimated discretization error.
U.S. Release Only

OVERFLOW: Overset Grid Computational Fluid Dynamics Flow Solver
with Moving Body Capability, Version 2.4   **LAR-20095-1**

OVERFLOW 2.4 is a computer code for simulating viscous, compressible fluid flow about complex aero-dynamic configurations. The technology solves the Reynolds-averaged Navier-Stokes equations using structured, overset computational grids. It includes the capability for simulating multiple moving bodies acting under prescribed or aerodynamically forced motion. OVERFLOW 2 is a merge of the previously developed OVERFLOW 1.8 and OVERFLOW-D codes.
U.S. Release Only

Flight Optimization System (FLOPS) Software, Version 9   **LAR-18934-1**

FLOPS is a multidisciplinary system of computer programs for conceptual and preliminary design and evaluation of advanced aircraft concepts. It consists of six primary modules: weights, aerodynamics, propulsion data scaling and interpolation, mission performance, takeoff and landing, and program control.
General Public Release

Aeronautics

ADOPT: Automatic Discovery of Precursors in Time series — ARC-18198-1

A data mining/machine learning algorithm that analyzes large volumes of historical data to find complex trends among several sensory variables simultaneously to find precursors. ADOPT's data mining approach captures real-world effects such as human factors, weather, geographic constraints, operating procedures, airline strategies etc. that are difficult to capture using first-principle models. ADOPT's capabilities include new functionality to discover precursors to events of interest by mining time series data, reduces the time required by subject matter experts to discover and analyze precursors from large volumes of data, detects the likelihood of the adverse event earlier to alert the operator on an impending failure, assists in explaining the event of interest with identified precursors.
Open Source

Advanced Geared Turbofan 30,000 (AGTF30) — LEW-19717-1

The Advanced Geared Turbofan 30,000 (AGTF30) is a geared turbofan simulation that utilizes the Toolbox for the Modeling and Analysis of Thermodynamic Systems (T-MATS) to create a steady-state and dynamic engine model within MATLAB/Simulink. The engine model is based upon an N+3 geared turbofan concept with a controller that allows dynamic operation throughout the flight envelope.
Open Source

AERO2S: Subsonic Aerodynamic Analysis of Wings With Leading- and Trailing-Edge Flaps In Combination with Canard or Horizontal Tail Surfaces — LAR-14458-1

Subsonic modified linear theory method providing estimates of the longitudinal aerodynamic characteristics of conceptual airplane lifting surface arrangements. The method is particularly well suited to configurations which, because of high speed flight requirements, must employ thin wings with highly swept leading edges. The code is applicable to wings with either sharp or rounded leading edges. The code provides theoretical pressure distributions over the wing, the canard or horizontal tail, and the deflected flap surfaces as well as estimates of the wing lift, drag, and pitching moments which account for attainable leading edge thrust and leading edge separation vortex forces.
U.S. Release Only

Aircraft NOise Prediction Program 2 (ANOPP2) — LAR-18567-1

The next-generation Aircraft NOise Prediction Program (ANOPP), called ANOPP2, provides the capability and framework to integrate acoustic approaches for aircraft noise component prediction, propulsion system installation effects, and overall sound propagation to the far-field. The predictions from ANOPP2 include the fidelity and flexibility required to predict outside the current experience base. A focal point of ANOPP2 is a combination of acoustic approaches; that is, to offer several options depending on requested fidelity and execution speed. This allows ANOPP2 to include fast prediction methods for design optimization, as well as the fidelity required to provide insight into controlling noise physics.
U.S. and Foreign Release

Airfoil Machine Learning Code and Dataset — LEW-20283-1

This is the supplemental code and dataset for a paper titled: Predicting 2D Airfoil Performance Using Graph Neural Networks
Open Source

Airspace Concepts Evaluation System (ACES) — ARC-15068-1

From gate departure to gate arrival, ACES is a dynamic, event-based computer simulation of aircraft operations in the National Airspace System (NAS). The technology's software-agent infrastructure provides flexibility in configuring custom simulations and enables explicit modeling of command and control entities operating within the NAS.
U.S. and Foreign Release

ANOPP and ANOPP2 — LAR-19861-1

The NASA Aircraft Noise Prediction Program provides a capability to predict noise from aircraft in flight. Since its inception, ANOPP has been relied upon to provide empirical methods for the source prediction, propagation, and calculation of aircraft noise. The second generation ANOPP (ANOPP2) provided the capability and a framework to integrate acoustic approaches for aircraft noise component prediction, propulsion system installation effects, and overall sound propagation to the far-field of varying degrees of granularity. While ANOPP provides a much needed empirical database that is continually relied upon by ANOPP2 for fixed wing aircraft prediction, ANOPP2 provides the flexibility to predict noise for unconventional aircraft in modern prediction environments. ANOPP and ANOPP2 are both required for most applications.
U.S. Release Only

Apparatus for Evaluating Software Decision Logic (ADEPT) — ARC-14928-1A

The ADEPT design tool integrates a graphical user interface with an automation decision-logic application. The software generates testable prototypes for traditional usability evaluations. Exportable products can be added to the base architecture.
U.S. and Foreign Release

ARC2D: Efficient Two-Dimensional Solution Methods for Navier-Stokes Equations — ARC-12112-1

ARC2D is a computational fluid dynamics program developed at the Ames Research Center specifically for two-dimensional airfoil and simply connected geometries. The program uses implicit finite-difference techniques to solve two-dimensional Euler equations and Navier-Stokes equations. It is based on the Beam and Warming implicit approximate factorization algorithm in generalized coordinates. The methods are either time accurate or accelerated non-time accurate steady state schemes. The evolution of the solution through time is physically realistic; good solution accuracy is dependent on mesh spacing and boundary conditions.
U.S. Release Only

BL2D: Two-Dimensional and Axisymmetric Boundary Layer Code — LAR-16713-GS

BL2D is an efficient and fourth-order-accurate method to compute two-dimensional and axisymmetric boundary layers on aerospace vehicle wings from low-speed to hypersonic speeds. Aerospace applications include boundary-layer stability analysis, transonic wing design, and laminar flow wing design.
U.S. Release Only

CAPE: Computational Aerosciences Productivity and Execution — ARC-18753-1

CAPE is software that provides an end-to-end framework for running large numbers of Computational Fluid Dynamic (CFD) simulations, extracting aerodynamic performance data, and building high-quality, complex aerodynamic databases. Computational Aerosciences Productivity & Execution (CAPE) is thus a software package that aims to dramatically improve the capabilities and productivity of CFD users. CAPE enables more complex run matrices and improved procedures for other CFD or Computational Aerosciences tools. Version 1.0 provides a common interface for Cart3D, FUN3D, and OVERFLOW. CAPE takes a tip-to-tail approach to the computational aerosciences process; its interface supports case set up, running the actual CFD solver in a supercomputing environment, report generation, data extraction, and creating high-quality databases. CAPE does NOT include any of the supported CFD solvers, which must be acquired separately. This tool is distributed as a Python package, which makes it easy to install. Within NASA, the CAPE package has an extensive history with large CFD run matrices and many terabytes of data. Examples in support of the Space Launch System Program include studies separately involving about 25,000 Cart3D cases, 1500 OVERFLOW cases, and 15,000 FUN3D cases.
U.S. Release Only

CFD Utility Software Library
ARC-14467-1B

This is a collection of ~200 software applications build upon two dozen subroutine libraries, mostly for manipulating the grids and flow solutions associated with computational fluid dynamics (CFD). These application programs, Fortran 90 modules, and library subroutines are generalized as far as possible with reuse and portability in mind. They are applicable to all flight regimes - subsonic, transonic, supersonic, and hypersonic. They operate on files in PLOT3D and/or Tecplot format, which represent de facto standards at many sites within academia, NASA, and industry. All such sites should have comparable utilities but typically lack this kind of comprehensive collection of well designed, well implemented and efficient utilities maintained for general use.
Open Source

COMDES-MELT: A Turbofan Engine Icing Risk Analysis Tool
LEW-20027-1

This engine icing risk prediction code is a mean-line compressor analysis code coupled with an ice crystal thermodynamic state code. COMDES-MELT computes the velocity, pressure, temperature, and flow angles at the leading edge and trailing edge of each blade row, at the hub, mean, and tip sections. This compressor code includes the ability to calculate the effects of water vapor on the fluid properties of the air – water vapor mixture. With inputted parameters as the precursors to ice accretion, the blade row within the compression system can be identified that is likely to experience ice buildup at a particular engine operating condition in the vehicle flight trajectory.
U.S. Release Only

Control Allocation Technique to Recover from Pilot-Induced Oscillations (CAPIO)
ARC-17115-1A

The CAPIO system is designed to operate within an aircraft's flight control system to alleviate pilot-induced oscillation tendencies in an aircraft without adversely impacting aircraft efficiency. The main idea behind the concept is to minimize the phase lag introduced to the system due to control surface rate saturation. The CAPIO system is designed specifically for multi-input/multi-output applications. This implementation utilizes: (1) online estimation of phase lag introduced by control surface rate limiting, (2) online adjustment of control allocation weighting terms, and (3) an optimization algorithm that calculates the optimal control solution.
U.S. Release Only

Coordinate Systems Class Library
LAR-19767-1

This library of classes represents various coordinate systems and provides the transformations between them. Coordinate systems represented are: East-North-Up (ENU), Downrange-Crossrange-Above (DCA), Latitude-Longitude-Altitude (LLA), Earth-Centered-Fixed (ECF), and Azimuth-Elevation-Range (AER).
Open Source

Core Flight Executive Version 6.7
GSC-18128-1

The Core Flight Executive (cFE) is a software framework designed for use on embedded systems. The cFE defines an Application Programmer Interface (API) to the following services: Software Bus, Time Services, Event Services, Executive Services, Table Services, and File Services. The cFE defines a portable application runtime environment that allows developers to rebuild the same applications code and run it on many different hardware/operating system platforms. The same application code can be developed and unit tested on a desktop environment then ported to the target-embedded processor for final verification and validation.
Open Source

CPR*: Formally Verified Compact Position Reporting Algorithm
LAR-19679-1

The Compact Position Reporting (CPR) algorithm consists of a set of functions defined in the standard RTCA-DO-260B/Eurocae ED-102A, Minimum Operational Performance Standards for 1090 MHz extended squitter Automatic Dependent Surveillance – Broadcast (ADS- B) and Traffic Information Services - Broadcast (TIS-B). These functions encode and decode aircraft positions. CPR* is a formally verified implementation of CPR's functions using computer arithmetic in fixed- and floating-point formats.
Open Source

DAA-Displays (Detect-and-Avoid Display Widgets)

DAA-Displays (Detect-and-Avoid Display Widgets) is an open-source framework for creating interactive cockpit display simulations. The framework includes widgets for typical Detect and Avoid applications such as maneuver guidance bands, alerting symbols, aircraft states, etc.
Open Source

Detect and Avoid Alerting Logic for Unmanned Systems (DAIDALUS)   LAR-18464-1

This is a software library that implements a detect-and-avoid concept for uncrewed aircraft systems. It includes algorithms for determining the current well-clear status between two aircraft and for predicting a well-clear violation within a lookahead time, assuming non-maneuvering trajectories. DAIDALUS implements algorithms for computing maneuver guidance, assuming a simple kinematic trajectory model for the ownship. Maneuver guidance is returned in the form of range of track, ground speed, vertical speed, and altitude values called bands. These bands represent areas in the airspace the ownship should avoid in order to maintain well-clear with respect to traffic aircraft. DAIDALUS implements a pair-wise alerting logic that is based on a list of increasingly conservative alert levels. It's implemented in C++ and Java. The functional requirements of the core DAIDALUS algorithms have been formally specified in the Prototype Verification System (PVS). The correctness of these algorithms has been formally verified in PVS, and the software implementations have been validated against the formal models using stressing test cases.
Open Source

Easy Aeroservoelasticity (EZASE): A Tool to Simulate Aircraft Wing Geometry   DRC-014-036

This is an easy-to-use MATLAB-based finite element modeling and simulation tool for aeroservoelastic analysis of rectangular wings with trailing-edge control surfaces. It includes a tutorial on structural finite element modeling (FEM_Tutorial.m) using elements such as 12-DOF plates and 6-DOF beams. The aero tutorial (DLM_VLM_Tutorial.m) shows how to code doublet lattice and vortex lattice (with symmetry capability). Together the tutorials can be used to compare to experimental studies such as ground vibration testing, cantilever beam analysis, as well as wind tunnel testing.
General Public Release

Evolutionary Mission Trajectory Generator (EMTG)   GSC-16824-1

EMTG is a global trajectory optimization tool intended for interplanetary mission design. The technology automatically searches for the optimal sequence of planetary flybys and propulsive maneuvers for maximizing payload delivery at a destination. Designed for minimal user oversight, EMTG requires only start location, destination, allowable launch-date range, allowable flight time, and minimal spacecraft hardware information.
Open Source

EZ4D   LAR-16798-GS

NASA's EZ4D software is a time-accurate, three-dimensional Navier-Stokes solver for unstructured meshes. The software framework utilizes generic template programming in C++ to allow users to extend the code for simulations of any general conservation laws. Shared-memory multi-thread, as well as distributed-memory MPI paradigms are implemented in EZ4D to facilitate efficient large-scale parallel numerical simulations.
U.S. Release Only

Finite-Rate Chemistry, Overset-Grid, Dual-Time Combustion-Reentry Code   ARC-15601-1

This technology modifies the OVERFLOW code for finite rate and equilibrium chemistry by substituting the perfect gas model built into the code with a model assuming a gas made up of a mixture of thermally perfect gases. Four extra field variables were added, corresponding to pressure, temperature, coefficient of thermal conductivity, and the new pressure derivative X.
U.S. Government Purpose Release

Flight Awareness Collaboration Tool (FACT)   ARC-17793-1

The Flight Awareness Collaboration Tool (FACT) is designed to assist airline dispatchers and others in managing winter weather events. It gathers all of the necessary weather, air traffic, airport, and other information onto one screen. FACT can be used by airline dispatchers to manage the airline fleet prior to and including the day of the winter weather event. It also has built-in automation tools that can predict the impact of winter weather on airport capacity.

U.S. Government Purpose Release

Flight Optimization System (FLOPS) Software, Version 9   LAR-18934-1

FLOPS is a multidisciplinary system of computer programs for conceptual and preliminary design and evaluation of advanced aircraft concepts. It consists of six primary modules: weights, aerodynamics, propulsion data scaling and interpolation, mission performance, takeoff and landing, and program control.

General Public Release

Floating-Point and Real ChecKer (FPRoCK)   LAR-19553-1

This tool decides the satisfiability of a set of mixed real and floating-point constraints. If this set of constraints has at least one solution, it returns one of the solutions, otherwise it returns UNSAT indicating that the set is unsatisfiable.

Open Source

FRET: Formal Requirements Elicitation Tool   ARC-18066-1

FRET is a framework for the elicitation, formalization, and understanding of requirements. FRET allows its user to enter hierarchical system requirements in a structured natural language. Requirements written in this language are assigned unambiguous semantics. FRET supports its user in understanding the semantics and reformulating requirements if applicable, by utilizing a variety of forms for each requirement: natural language description, formal mathematical logics, diagrams, and interactive simulation. FRET exports requirements into forms that can be used by a variety of analysis tools, such as Cocosim, Simulink Design Verifier, Kind, and SMV.

Open Source

FUN3D, Version 13.7   LAR-19638-1

FUN3D is a suite of computational fluid dynamics simulation and design tools that uses mixed-element unstructured grids in a large number of formats, including structured multiblock and overset grid systems. A discretely exact adjoint solver enables efficient gradient-based design and grid adaptation to reduce estimated discretization error. Perfect-gas air is the primary fluid model, but a subset of functionality is available for non-perfect, reacting gas mixtures.

U.S. Release Only

Generic Command and Telemetry Applications for the Core Flight Software Framework (CI-TO)   MSC-26175-1

This set of applications provides general purpose, configurable, and extensible spacecraft commanding and telemetry functionality supporting a wide variety of communications protocols and transports, and was designed, built, and intended for reuse.

U.S. Government Purpose Release

GFR: Glenn Flux Reconstruction   LEW-19709-1

GFR is a high-order computational fluid dynamics (CFD) Fortran code for large-eddy simulations. It is based on the simple and efficient flux reconstruction method and accurate to an arbitrary order through a user-supplied input parameter. It is currently capable of using unstructured grids containing quadrilateral or hexahedra elements.

Open Source

GlennOPT   LEW-20176-1

GlennOPT is a multi-objective optimization tool for CFD (Computational Fluid Dynamics) applications. It is specifically designed to handle optimization problems involving multiple objectives.
Open Source

Goddard Trajectory Determination System (GTDS), Release 2008.01   GSC-15539-1

This technology addresses minor software change requests written against the 2002 release of the Goddard Trajectory Determination System.
U.S. Government Purpose Release

Grid Express (GridEx): A Framework-Based Unstructured Grid Generation Tool   LAR-16423-1

GridEx is an interactive software system developed by Geometry Laboratory of the NASA Langley Research Center for the generation of unstructured meshes. The software integrates native CAD geometry access, multiple unstructured meshing algorithms, and interactive 3D computer graphics through a graphical user interface (GUI) resulting in a package that is both powerful and easy to use.
U.S. Release Only

High-fidelity Unmanned Multirotor Flight Dynamics Simulation for Off-nominal Conditions   LAR-19479-1

This innovation is a six degree-of-freedom modeling and simulation architecture and database for predicting the flight dynamics behavior of small/medium sized multirotor vehicles in off-nominal and/or extreme out-of-envelope conditions. The development of this technology was motivated by ongoing efforts to integrate small uncrewed aircraft system (sUAS) vehicles into the National Airspace System (NAS). These efforts include development of risk and safety analysis methods that will enable autonomous, beyond-visual-range operations and could include real-time flight monitoring systems, trajectory prediction during off-nominal or failure scenarios, and probabilistic safety analyses. The modeling and simulation architecture comprises aerodynamic and propulsion models that are valid for all-attitude flight conditions such as extreme relative wind angles (e.g. high angle of attack and sideslip angles), very high vehicle angular rates typical of loss-of-control events, vortex ring state conditions, and onboard system or component failures. The aerodynamic and propulsion models are derived using specialized wind tunnel test methods that replicate extreme off-nominal flight conditions.
U.S. Government Purpose Release

Higher-Fidelity Conceptual Design and Structural Optimization (HCDstruct), Version 2.0   LAR-18901-1

HCDstruct now includes an aerostructural modeling and optimization capability for generalized tube and wing aircraft configurations. This tool permits the rapid, parameterized creation of aeroservoelastic finite-element models for general tube and wing aircraft configurations and constructs all files required to perform the subsequent aerostructural optimization using NASTRAN software. The methods employed offer a novel physics-based sizing capability for unconventional aircraft configurations for conceptual design environments.
U.S. Release Only

Higher-Order Design Environment (HOrDE): A Geometry-Centric, Multi-Disciplinary, Multi-Fidelity Process for Conceptual Aircraft Analysis and Design   LAR-19572-1

The purpose of this software is to facilitate the creation of analysis and design processes for conceptual-level aircraft configurations. At its core, the software contains a set of Java classes for defining the geometry, handling the analysis data associated with the geometry, executing external analysis methods, and pre- and post-processing analysis results. Users of the software can use the API to create wrappers for their own analysis methods, and to use both built-in and custom wrappers to create their own process models for the analysis and design processes used by their organization.
U.S. and Foreign Release

HyperSolve AD Mini-App — LAR-19476-1

This is an in-house developed AD tool that is based on operator-overloading to compute linearizations of a given function.
Open Source

Improved Human Ear AuRal Detection Implementation Tool (IHEARDIT) — LAR-19879-1

The Improved Human Ear AuRal Detection Implementation Tool (IHEARDIT) determines the ability for the average human to detect a tonally dominated signal in a given background noise. The software compares the input signal at a human receiver location, and background noise level at that location. It models the auditory response, including filtering, internal noise, and signal detection theory to predict human audibility.
U.S. Government Purpose Release

Inverse Heat Conduction Solver Using MATLAB (IHC Solve) — LAR-18924-1

This MATLAB software reads in temperature data measured from two thermocouples embedded in a heat-conducting specimen. The software then reads in the thermophysical properties for the heat-conducting specimen. After filtering noise from the measured temperature data, IHC Solve uses the filtered data and thermophysical properties to solve both a direct and inverse heat conduction problem to estimate both temperature and heat flux on the external surface of the specimen.
U.S. Government Purpose Release

Langley Stability and Transition Analysis Code (LASTRAC) — LAR-16260-1

LASTRAC is a C++ code that analyzes compressible boundary-layer stability and performs transition prediction using the state-of-the-art Linear Stability Theory (LST) or Parabolized Stability Equations (PSE) methods.
U.S. Release Only

LAngley Stability and TRansition Analysis Code (LASTRAC) Version 3.0 — LAR-19464-1

LASTRAC3.0 is the first US release of the LASTRAC series of software for chemically reacting flows. The code is designed to be backward compatible to the original LASTRAC release since 2004. Users of the original release are strongly encouraged to upgrade to LASTRAC3.0 as the new software has improved functionality and new Python utility scripts are available for either perfect or reacting gas applications. In short, LASTRAC3.0 can handle boundary layers or shear layers with perfect, equilibrium, chemical nonequilibrium, or thermal nonequilibrium (two-temperature) chemistry effects. Users can choose between the default publicly available widely-used five-species air and any user-defined chemistry compositions/models in a table or dynamically-linked-library format. Solution methods allowed for the user-provided perfect or reacting mean flows include Linear Stability Theory (LST), linear/nonlinear Parabolized Stability Equations (PSE) for 2D/axisymmetric/infinite swept wing, or full 3D boundary layers. Nonlinear PSE functionalities in this release is restricted to perfect gases only. Future release will include that for reacting flows.
U.S. Government Purpose Release

LAURA 5.6: Langley Aerothermodynamic Upwind Relaxation Algorithm — LAR-19734-1

The Langley Aerothermodynamic Upwind Relaxation Algorithm (LAURA) has been updated to version 5.6. This is a computational fluid dynamics simulation software code. The new technologies regard techniques for modifying the computational grid, for modeling rough walls, and for interpreting simulations that incorporate a shock layer radiation model.
U.S. Release Only

Loudness Code for Asymmetric Sonic Booms (LCASB) — LAR-16954-1

LCASB is a computer code to calculate the loudness of a sonic boom time history. Calculations of several noise metrics are provided. The code can calculate the loudness of the front and back parts of the sonic boom separately.
U.S. Release Only

Macro for an Apriori Grid NUmerics Metric (MAGNUM)　　　　　　　LAR-17662-1

The Macro for an Apriori Grid NUmeric Metric (MAGNUM) software is a Tecplot macro that computes a grid quality metric, or number, for structured surface and volume grids that identifies how good the grid is for computational science applications. A good measure ranges from 0.7 to 1.0, where 0.7 is acceptable and 1.0 is excellent quality. See AIAA paper 2004-0612 for additional information.
U.S. Release Only

Mesh_Tools:
Automated Unstructured Grid Shock Fitting Scripts Mesh Extrusion for CFD　　　MSC-26648-1

This is a collection of tools and scripts that create shock-fitted unstructured grids in a mostly automatic manner, similar to those created for structured grids. The scripts have been tested with several unstructured grid solvers, LociCHEM, FUN3D, and US3D, and can be made to work with most other unstructured CFD solvers. The script help to improve numerical stability and convergence when solving hypersonic cases with unstructured CFD solvers.
U.S. Release Only

MFSim: Multi-Fidelity Simulation　　　　　　　　　　　　　　ARC-17449-1

MFS (Multi-Fidelity Simulator) is a pluggable framework for creating an air traffic flow simulator at multiple levels of fidelity. The framework is designed to allow low-fidelity simulations of the entire U.S. Airspace to be completed very quickly (on the order of seconds). The framework allows higher-fidelity plugins to be added to allow higher-fidelity simulations to occur in certain regions of the airspace concurrently with the low-fidelity simulation of the full airspace.
Open Source

Mode shape interpolation via radial basis functions (RBF)　　　　　　LAR-19607-1

Preprocessing software to prepare a finite element structural model for use with the modal structural solver within the FUN3D CFD code. Mode shapes are interpolated from a NASTRAN FEM to the FUN3D CFD surface mesh.
Open Source

Mphys: Library for Coupling High Fidelity Codes in OpenMDAO　　　　LEW-20246-1

This is a modular multi-physics coupling library, built on OpenMDAO, for use with design optimization. This software can compute coupled analytic derivatives for multi-physics models built from a series of PDE solvers, for applications such as aeropropulsive, aerothermal, or aerostructural design.
Open Source

Modified Vortex Lattice (MVL-15)　　　　　　　　　　　　　　LAR-18774-1

MVL-15 is a Modified Vortex-Lattice (MVL) aerodynamics analysis code. The primary modification is the incorporation and assignment of viscous aerodynamics data associated with the wing section geometry to the inviscid vortex-lattice solution via iterative computational procedures. The strategy essentially converts an inviscid and purely analytic linearized method to a semi-empirical blend that retains the rapid execution speed of the linearized method while empirically characterizing the viscous aerodynamics at all spanwise lattice points. For the analysis of airplane configurations consisting of more than one wing, the resulting spanwise section aerodynamics can be integrated to determine the aerodynamics of each wing, both separately and combined. As implemented, the methodology inherently provides the capability to determine the non-linear viscous effects on lift and drag at relatively high angles of attack to identify the maximum lift coefficient and characterize the onset of stall.
U.S. Release Only

Multi-Level Monte Carlo with Python (MLMCPy)　　　　　LAR-19515-1

This code was written in Python to solve uncertainty propagation problems. Multi-level Monte Carlo (MLMC) is an efficient alternative to standard Monte Carlo simulation for estimating expectations of outputs to computational models with uncertain input parameters. MLMC greatly reduces computational cost by performing most simulations with low accuracy at a correspondingly low cost, with relatively few simulations being performed at high accuracy and high cost.
Open Source

Multiphysics Algorithm with Particles (MAP)　　　　　LAR-18801-1

MAP is a multidimensional adaptive Cartesian implementation of the direct simulation Monte Carlo (DSMC) method with parallelization capabilities using MPI. The DSMC method is widely used for modeling of gas flows through the computation of motion and collisions of representative molecules. The software achieves a quality solution with minimal user input and control by performing dynamic adaptations of the grid, local time step, and surface temperature.
U.S. Release Only

NASA Design and Analysis of Rotorcraft (NDARC)　　　　　ARC-16265-1

NDARC software is an aircraft system analysis tool that supports both conceptual design efforts and technology impact assessments of rotorcraft that meet specified requirements. The architecture of the NDARC code accommodates configuration flexibility, a hierarchy of models, and ultimately multidisciplinary design, analysis, and optimization.
U.S. Release Only

"NASA Glenn Research Center: The Early Years" for iPad　　　　　LEW-18993-1

This application contains imagery and descriptions from the Glenn Research Center image archive. Photos and data cover the period from 1941–1979. The software has been compiled and bundled as an iOS app for the iPad and intended for release through the Apple App Store.
Open Source

NASA Internships App　　　　　MSC-26652-1

The app was created using free app development software from glideapps.com. The information in the app was collected from public domains using google, nasa.gov public sites, Wikipedia, and YouTube. It is a repository of information so that students can learn about NASA, it's mission, where the Centers are located, how they can connect NASA internships on social media platforms, and answer frequently asked questions about NASA internships.
General Public Release

NASA World Wind Java (WWJ) Software Development Kit (SDK), Version 2.2　　　　　ARC-15166-1E

A free software development kit (SDK) for assisting developers in the creation of geographical information systems (GISs). Common use cases for the WorldWind SDK are monitoring weather patterns, visualizing cities and terrain, tracking ground vehicles, analyzing geospatial data, flight tracking, satellite tracking and geographical education.
Open Source

OpenMDAO V2　　　　　LEW-19994-1

This is a high-performance computing platform for systems analysis and multidisciplinary optimization, written in Python. It enables you to decompose your models, making them easier to build and maintain, while still solving them in a tightly coupled manner with efficient parallel numerical methods.
Open Source

Operating System Abstraction Layer
GSC-18370-1

The OS Abstraction Layer (OSAL) project is a small software library that isolates embedded software from the underlying operating system. The OSAL does this by providing an Application Program Interface (API) to an abstract real time operating system. The OSAL then provides implementations of this API for two Real Time Operating Systems: vxWorks and RTEMS. In addition, an implementation is provided for Linux/POSIX for embedded Linux projects, and desktop development and testing. To facilitate the use of these APIs, the project also includes a directory structure and set of makefiles that facilitate building a project for a particular OS and hardware platform. Unit tests and several examples are included.
Open Source

Orbit-Determination Toolbox
GSC-15728-1

Based on MATLAB and Java, the flexible Orbit-Determination Toolbox is intended primarily for the advanced mission analysis that might be performed in the concept exploration, proposal, and early design phases. Visit the following URL for more information: http://opensource.gsfc.nasa.gov/projects/ODTBX/
Open Source

Orion Optical Navigation Image Processing Software Version 1.5
MSC-27122-1

The Orion emergency return system utilizing optical navigation has matured in design over the last several years, and this second revision is currently undergoing the final implementation and test phase in preparation for Exploration Mission 2 (EM-2). A key component is this software, which processes the images and produces navigation measurements and attitude measurements. The software development is being worked as a Government Furnished Equipment (GFE) project delivered as an application within the Core Flight Software of the Orion camera controller module.
U.S. Release Only

OVERFLOW: Overset Grid Computational Fluid Dynamics Flow Solver with Moving Body Capability, Version 2.4
LAR-20095-1

OVERFLOW 2.4 is a computer code for simulating viscous, compressible fluid flow about complex aerodynamic configurations. The technology solves the Reynolds-averaged Navier-Stokes equations using structured, overset computational grids. It includes the capability for simulating multiple moving bodies acting under prescribed or aerodynamically forced motion. OVERFLOW 2 is a merge of the previously developed OVERFLOW 1.8 and OVERFLOW-D codes.
U.S. Release Only

Ozone: Ordinary Differential Equation and Optimal Control Solver
LEW-19703-1

Ozone is a Python software package that facilitates the solution of ordinary differential equations (ODEs) and optimal control problems. It is unique among similar libraries because of its capability to compute derivatives of the ODE-integrated outputs with respect to parameters, initial conditions, and time interval. The software allows Ozone-based ODE models to be integrated into larger, potentially multidisciplinary models while using adjoint-type methods to compute derivatives for the larger model. In terms of the ODE integration, Ozone adopts the general linear methods (GLM) equations, allowing it to easily support a large library of Runge-Kutta and linear multistep methods. Ozone also supports multiple integration formulations consisting of time-marching, solver-based, and optimizer-based approaches to solving the ODE. Ozone is built on top of NASAs OpenMDAO software framework.
Open Source

Parallel Dantzig-Wolfe Decomposition
ARC-16432-1

This implementation of the Dantzig-Wolfe decomposition is built upon the GNU Linear Programming Kit. The technology provides a command-line tool for solving properly decomposed linear programs.
Open Source

PCBoom, Version 6   LAR-19926-1

PCBoom 7.3.0 is a sonic boom propagation suite of programs that applies a full three-dimensional ray tracing based on geometrical acoustics in real atmospheres. It has a very efficient Burgers solver used to predict sonic boom ground waveforms and footprints from supersonic flight vehicles performing arbitrary maneuvers. It also computes loudness metrics and ground signature locations, with algorithms on turbulence effects.

U.S. and Foreign Release

Pegasus 5.2: Software for Automated Pre-Processing of Overset CFD Grids   ARC-15117-1A

The Pegasus software is used as a pre-processor for overset-grid computational fluid dynamics (CFD) simulations. It provides the hole-cutting and connectivity information between structured overset grids. The main features of the software include automated hole-cutting algorithms, a projection scheme for fixing small discretization errors in overset surface; efficient interpolation search methods; hole-size optimization based on adding additional layers of fringe points; and an automatic restart capability. The code can run in parallel using the Message-Passing Interface (MPI) standard. The parallel performance provides efficient speed-up of the execution time utilizing dozens or even hundreds of processors. Additional capabilities in version 5.2 include: support for cell-centered grids; a triple-fringe option; automated domain decomposition into multiple hole-cutters; an improved parallel execution load-balancing algorithm; and additional minor enhancements.

U.S. Release Only

PLOT3D, Version 4.1   ARC-14400-1

PLOT3D is a computer graphics program designed to visualize the grid and solutions of structured computational fluid dynamics (CFD) datasets. Version 4.1 uses the OpenGL/GLUT graphics library. Several new features have been added to the code. These include: automatic computation of grid coordinate minimum/maximum; an orphan point plotting function; the ability to read double-precision unformatted data; negative grid index processing; random specification of colors for different walls; and simultaneous specification of walls and subsets for all zones.

U.S. Release Only

PLOT3D PreProcessing and PostProcessing Libraries in Julia and Python   LEW-20282-1

PLOT3D is a widely used format for storing grid data for numerical computation particularly in CFD. This free open-source python library enables researchers to have programmatic access to read, write, combine, PLOT3D files to build a 3D domain. One of the main challenges with simulations using PLOT3D is finding the connection of blocks of I,J,K indexing representing X,Y,Z coordinates in space. This tool contains functionality to automatically find matching faces of each block and exports the results as a human readable dictionary or JSON format.

Open Source

PRECiSA with Instrumented Code Generation   LAR-19739-1

PRECiSA (Program Round-off Certifier via Static Analysis) is a fully automatic static analyzer for floating-point valued functions. It computes an over-approximation of the round-off error of a given floating-point expression, along with a formal certificate that ensures the correctness of the estimated error.

Open Source

PyTurbo: A Python Framework for Aero-thermal Gas Turbine Component Design   LEW-20175-1

This is a NASA Turbomachinery design tool capable of going from a 2D Airfoil Design to a 3D design of a blade and a blade row. This design tool can wrap heatpipe paths inside the airfoil. PyTurbo is a turbomachinery design tool focused on the development of 3D blade rows consisting of 3D Airfoils. This enables fundamental research into transition, tip leakage passive flow control, cavity flows, and nature inspired shapes.

U.S. Government Purpose Release

Quad-Channel Transport Class Model Simulation (Quad TCM)　　　　DRC-014-004

Quad TCM is a non-proprietary, non-sensitive aircraft Simulink model derived from Langley Research Center's Transport Class Model (TCM). Quad TCM is a flight control system (FCS) oriented simulation with multi-channel (FCS) components, including flight control computers (FCCs), sensors, actuators, and interconnects.

General Public Release

RACE: Runtime for Airspace Concept Evaluation　　　　ARC-17749-1

RACE is a software architecture and framework for configurable, highly concurrent, and distributed message-based systems. It can be used to rapidly build simulations that span several machines (including synchronized displays), interface existing hardware simulators and other live data feeds, and incorporate sophisticated visualization components such as NASA's WorldWind viewer. RACE is implemented as a distributed actor system that runs within Java virtual machines.

Open Source

RCOTOOLS: Rotorcraft Optimization Tools　　　　ARC-18184-1

RCOTOOLS provides utilities and application wrappers for the conceptual design of rotorcraft using an optimization framework. It currently has application wrappers for NDARC (NASA Design and Analysis of RotorCraft), CAMRAD II (Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics II), NPSS (Numerical Propulsion System Simulation), IXGEN (Intelligent Cross-section Generator) and CHARM (Comprehensive Hierarchical Aeromechanics Rotorcraft Model). These wrappers can be used independently or within an optimization using NASA's OpenMDAO optimization framework.

U.S. and Foreign Release

Real-Time Background Oriented Schlieren Software Package Update, 2022　　　　LEW-20407-1

Background Oriented Schlieren (BOS) is an optical technique for measuring density gradients in flow fields, in quiescent air or even liquids. Advances in computer processing hardware enable the implementation of real-time processing and display of the BOS image data. Two different approaches to implementing the real-time BOS (RT-BOS) processing capability have been implemented. First, a traditional multicore central processing unit (CPU) based approach using scheduled parallel threads is used to build a RT-BOS processing engine. In the second approach, a graphical processing unit approach is used to construct a RT-BOS processing engine. Generally, high-core count CPU processors can provide a useful processing rate for RT-BOS.

U.S. Release Only

sBOOM: An Advanced Sonic Boom Propagation Tool　　　　LAR-18012-1

Very useful in the development of supersonic cruise aircraft, this NASA-developed propagation tool predicts sonic-boom ground signatures by numerically solving the Augmented Burgers equation. Efficient and accurate, sBoom can predict shock thicknesses, thereby improving the frequency spectrum of ground signatures. Because shock rise times are computed and not empirically adjusted or corrected, the tool affords more accurate loudness calculations than comparable linear-theory methods.

General Public Release

sBOOM2: An Advanced Sonic Boom Propagation and Design Tool　　　　LAR-18477-1

This innovation presents an approach to not only predict sonic boom ground signatures by numerically solving the Augmented Burgers' equation, but it also allows the crucial step of efficiently computing the sensitivities of various sonic boom metrics, both at the ground level and mid-field levels with respect to the aircraft outer mold line parameters. This unique new functionality represents a major milestone in sonic boom mitigation literature and offers a game-changing design methodology for commercial supersonic aircraft design.

U.S. Release Only

Sector 33 App
ARC-16853-1

Offering a single user interface, Sector 33 is an air traffic control simulator game for Apple and Droid mobile devices. The technology includes introductory videos, an interactive air traffic control simulation of up to five airplanes, problem scoring, and integrated solution hints. The game can be downloaded at: http://www.nasa.gov/connect/apps.html

General Public Release

Shape Parameterization Algorithm (MASSOUD)
LAR-15968-1

The MASSOUD and/or Bandaids software packages are geometry parameterization tools that may be used to perform design optimization with NASA's FUN3D and other CFD codes.

U.S. Release Only

SMS/SDSS STBO Data Fuser
ARC-17917-1

This is a mechanism that combines multiple sources of air traffic, airline, and airport data that contain many overlapping or similar types of data and creates a unified set of data that can be used for Surface Trajectory Based Operations (STBO) air traffic management systems.

Open Source

SolFlyte
LAR-18203-1

SolFlyte enables the analysis of solar-electric (SE) HALE aircraft and airship concepts and missions by uniquely modeling the complex interactions of time-dependent astronomical, geographical, and atmospheric factors on key metrics such as energy balance, shadowing, performance, on-site persistence, and design size. Separate functional utilities are linked using the PHX ModelCenter v9.0 integration framework to create the SolFlyte-HTA (airplane), SolFlyte-LTA (airship) analysis models, and the SolFlyte-WND wind data processing model. The flexible inputs and rapid execution of the SolFlyte models broaden the analysis scope and permit parametric design feedback.

General Public Release

Static Loader Library for Real-Time Embedded Systems
GSC-17810-1

The Static Loader Library for Real-Time Embedded Systems is a small software library written in the C programming language designed to allow individual software components to be linked to a specific memory location and loaded from an embedded file system. It is used as a lightweight replacement for the dynamic loader provided in many operating systems.

U.S. Government Purpose Release

StormGen Weather Editor
ARC-16827-1

The StormGen interactive editor facilitates the design and production of dynamic convective weather scenarios. The software exports weather data in formats compatible with widely used air- and ground-tool simulators.

U.S. Release Only

SUPKEM
ARC-16260-1

SUMKEM is fully implicit, parabolic, partial-differential equation solver that can be used for the integration of unsteady 3D turbulence kinetic energy and dissipation-rate equations. The technology enables any laminar computational fluid dynamics (CFD) solver to compute a given unsteady turbulent flow of interest.

U.S. Government Purpose Release

Support Libraries for Cart3D I/O Functions and Extensible Design Description Markup
ARC-18778-1

This is a collection of software libraries used for various I/O functions of the Cart3D aerodynamic analysis and optimization package. This includes reading and writing surface triangulation files, volume mesh files and files for aerodynamic shape optimization problems.

Open Source

Surface Operations Simulator and Scheduler (SOSS)   ARC-16808-1A

A simulation of air traffic movement on an airport surface, SOSS can be used in developing, analyzing, and testing runway schedulers and resolution algorithms.
U.S. Government Purpose Release

TLNS3D   LAR-16666-GS

This software was developed to solve Reynolds-averaged Navier-Stokes equations to simulate turbulent, viscous flows over three-dimensional configurations. A general multiblock grid is used to model complex configurations. A multi-stage Runge-Kutta pseudo-time stepping scheme is coupled with residual smoothing and multigrid acceleration techniques to form an efficient algorithm. TLNS3D-MB was the first CFD code to demonstrate grid-independent convergence rate for transonic viscous flows over wing/fuselage configurations.
Open Source

Tool for Turbine Engine Closed-Loop Transient Analysis (TTECTrA)   LEW-19177-1

TTECTrA is a tool, developed in the MATLAB/Simulink environment, intended to extend systems analysis by providing an estimate of the transient performance/capability of a conceptual engine design. The software is capable of designing a basic turbofan engine controller, with transient protection, based on the user's engine model and constraints. TTECTrA is built in the Mathworks Matlab/Simulink environment and relies on the Matlab Control Systems Toolbox to provide additional functionality and streamline the control design process.
Open Source

Traffic Situation Display (TSD)   ARC-16063-1A

The Traffic Situation Display (TSD) is an integrated display of air traffic, weather, terrain, and special-use airspace. TSD was designed to serve as a primary graphical interface for ground operators/dispatchers supporting research simulation of single-pilot and/or reduced-crew operations. One key feature is the seamless transitional flow between the ego-referenced and position-referenced frames.
U.S. Government Purpose Release

Trajectory-Based Route Analysis and Control (TRAC)   ARC-16433-1

TRAC is an extensible software platform that supports next-generation air traffic concept investigations. The software enables visualization of current-day airspace elements; graphical creation of new elements; and runway-to-runway agent-based simulation and analysis of air traffic concepts.
U.S. and Foreign Release

TURBO-AE: An Aeroelastic and Multi-Stage Aerodynamic Analysis Code
Based on Unsteady Three-Dimensional Navier-Stokes Equations   LEW-17514-1

An aeroelastic and unsteady aerodynamic analysis code has been developed for prediction of flutter, forced response, performance, and rotor-stator interaction effects. The analysis provides a high-fidelity modeling of subsonic, transonic, and supersonic flow regimes with attached and separated flow fields. The code calculates performance quantities such as efficiency, mass flow, pressure ratio, temperature ratio, distribution of flowfield properties in the entire domain of calculation, aerodynamic damping to assess flutter stability and unsteady aerodynamic forces arising from rotor-stator interaction for calculation of forced response. This information can be used in high-cycle fatigue analysis of blade rows.
U.S. Release Only

Two-dimensional/Axisymmetric Nozzle Design Code Using the Irrotational Method of Characteristics (IMOCND)   LAR-16744-1

A program which can be used to design two-dimensional or axisymmetric nozzles having uniform or non-uniform (Mach number and/or flow angle) supersonic inflow. If possible, the computer program generates a nozzle contour which produces supersonic, shock-free, uniform flow at the nozzle exit. It also gives the user control over the geometry at inflow and in the expansion region of the nozzle.
U.S. Release Only

Upwind Parabolized Navier-Stokes Solver (UPS) for Supersonic and Hypersonic Flow Simulation, Version 6.1   ARC-15250-1

This software provides a means for simulating supersonic and hypersonic flows efficiently and accurately (under certain restrictions). The parabolized Navier-Stokes (PNS) equations are solved using an upwind finite-volume algorithm that is implicit in the marching direction. The solver includes models for turbulent flow and equilibrium-rate and finite-rate air chemistry.
U.S. Release Only

view2space: A tool for computing view factors to space for CFD grids   MSC-27263-1

The standard radiation equilibrium boundary condition used for computational fluid dynamics (CFD) simulations assumes a perfect view. In reality, surfaces within view of each other have a complex radiation interchange that need to be modeled to accurately capture the physics. The reduced view factor to space is simply the view of space visible from each face on the input CFD grid and varies from zero to one. The code models this by rendering a simple black and white image. The reduced view factor to space is computed by determining the percentage of black pixels (space) in the image. The view factors are then exported in a data file so that they can be used by a CFD code.
General Public Release

Volume Grid Manipulator (VGM)   LAR-15703

This code is specifically designed to alter or manipulate existing surface and volume structured grids to improve grid quality through the reduction of grid line skewness, removal of negative volumes, and adaption of surface and volume grids to flow field gradients, to name a few applications. The software uses a command language to perform all manipulations thereby offering the capability of executing multiple manipulations on a single grid comprised of a single or multiple block set during an execution of the code. The command language can be input to the VGM code by a UNIX style redirected file, or interactively while the code is executing.
U.S. Release Only

VULCAN-CFD   LAR-18512-1

VULCAN-CFD offers a comprehensive set of capabilities to enable the simulation of continuum flowfields from subsonic to hypersonic conditions. The governing equations employed include allowances for both chemical and thermal non-equilibrium processes, coupled with a wide variety of turbulence models for both Reynolds-averaged and large-eddy simulations. The software package can simulate two-dimensional, axisymmetric, or three-dimensional problems on structured multi-block meshes or unstructured meshes. It also allows one to invoke a parabolic (i.e., space-marching) treatment for any subset of a problem that can accommodate this solution strategy.
U.S. Release Only

WINGDES2: Wing Design And Analysis Code (WDES)   LAR-13995-1

Wing-design algorithm based on modified linear theory taking into account effects of attainable leading-edge thrust. Provides analysis as well as design capability and applicable to both subsonic and supersonic flow.
U.S. Release Only

X-Plane Communications Toolbox (XPC)   ARC-17185-1

The X-Plane Communications Toolbox enables users to (1) receive real-time information on one or more simulated vehicle's state from the X-Plane flight simulator and (2) control vehicles running in the X-Plane simulation environment. The toolbox can be used to record simulated flight data, visualize flight profiles, create out-the-window visuals, test autopilots, and test control algorithms. Additionally, the toolbox enables the display of ghost traffic flying predefined flight paths in the simulated airspace and the visualization of flight plans in the form of waypoints.
Open Source

Zappy: Load Flow Modeling Tool For Power System Design With Gradient Based Optimization
LEW-20150-1

Zappy is a software library build on top of the OpenMDAO framework written in the Python Programming language. It provides a modular software code enabling a user to perform standard power system studies, while also providing analytic derivative (sensitivity) calculations to the end user. These analytic derivatives make Zappy efficient when used by (or incorporated into) external software programs performing broader multidisciplinary optimization of electrical power systems.
Open Source

Autonomous Systems

Robotics, Automated Systems, Systems
Health Monitoring

The Astrobotic CubeRover traverses the terrain in the Granular Mechanics and Regolith Operations Laboratory regolith bin at NASA's Kennedy Space Center in Florida. The regolith bin simulates the mechanical properties of the Moon's surface. NASA and Astrobotic employees put the CubeRover through a series of more than 150 mobility tests over several days to evaluate and improve wheel design.

Featured Software

Smartphone Video Guidance Sensor (SVGS)   **MFS-33014-1**

The Smartphone Video Guidance Sensor (SVGS) allows for calculation of the distance and orientation of an object relative to the SVGS. A known retroreflective target pattern is mounted on the target object. The retrore-flectors are then illuminated by the camera flash on the smartphone and imaged by the smartphone camera. The resulting image is processed using photogrammetry algorithms running on the smartphone to extract the relative X, Y, and Z distance and relative orientation, expressed as a roll, pitch, yaw angle sequence.
U.S. Release Only

Hazards Analysis Management Tool (HAMT)   **GSC-16846-1**

HAMT uses a single software tool to increase the efficiency and effectiveness of hazard analyses. Composed of a Microsoft Access front end (that contains the user interface) paired with a Microsoft Access back end (that stores analysis data), the software can be used to enter, edit, and report information through-out the hazard analysis lifecycle.
U.S. Government Purpose Release

Bundle Protocol Core Flight System Application (BP)   **GSC-18331-1**

The BP cFS application uses the Bundle Protocol Library (bplib) to implement Delay Tolerant Networking. The application targets the cFE 6.5 release and provides out-of-the-box integration with the cFS CFDP application (CF), and a POSIX-compliant file system when provided. The implementation conforms to the CCSDS Blue Book recommendation 734.2-B-1 issued September 2015, which is based on RFC 5050.
U.S. Government Purpose Release

Autonomous Systems

AprilNav: Indoor Real-time Landmark Navigation System   MFS-33648-1

AprilNav uses printable 2D fiduciary markers, an HD camera, and software running on a single-board computer to create a scalable and accurate system for vehicular autonomous navigation and localization.
Open Source

Astrobee Robot Software (ARS)   ARC-17994-1

Astrobee is a free-flying robot that is designed to operate as a payload inside the International Space Station (ISS). The Astrobee Robot Software (ARS) consists of the embedded (onboard) software and simulator. ARS operates on Astrobee's three internal computers and uses the open-source Robot Operating System (ROS) framework to link multiple software modules. ARS performs localization and navigation of Astrobee, supports autonomous docking and perching, manages various sensors and actuators, and supports user interaction (via screen-based displays, light signaling, and sound).
Open Source

Automation Framework Designed for Flight Dynamics Products Generation (XFDS)   GSC-15618-1

This software framework automates the generation of flight dynamics products by providing a unified and consistent graphical interface to various tools. The technology coordinates the execution of applications such as Satellite ToolKit, FreeFlyer, and MATLAB; allows for the embedding of Perl code; provides a mechanism for passing messages between a collection of XFDS processes; and allows GMSEC messages to be sent and received. Automation configuration is stored in text files and can be edited directly or by using graphical editors implemented for each tool.
U.S. Government Purpose Release

Autonomous Operating System: Diagnostic Reasoner   ARC-18051-1

Diagnostic Reasoner (DR) is a research tool which uses a dependency matrix (D-matrix) approach to perform diagnosis on a target system. It is an app designed to run with NASA's Core Flight Software (cFS) system. DR uses a model-based approach to diagnosis and provides runtime fault detection and fault identification of systems.
Open Source

Autonomous Real-Time Requirements Tracing (ART)   MFS-33209-1

This NASA software offers the ability to directly trace the real-time execution of software to specific requirements, a unique capability that can only be performed with a Timeliner-TLX system, as no other computer languages directly report this data during execution. The tracing feature does not impose input/output requirements (e.g., print/write statements) on the targeted software because the tracing is performed by an outside program executing separately. The Timeliner-TLX language is currently used for auto-procedures on the International Space Station (ISS) and the Autonomous Mission Operations (AMO) project, and future manned deep-space missions will require the use of extensive auto-procedures to assist in remote intelligent operations.
U.S. Government Purpose Release

Bundle Protocol Library   GSC-18318-1

The Bundle Protocol Library (bplib) implements a subset of the RFC5050 Bundle Protocol necessary for embedded space flight applications. The library uses the concept of a bundle channel to manage the process of encapsulating application data in bundles, and extracting application data out of bundles. A channel specifies how the bundles are created (e.g. primary block fields), and how bundles are processed. Bplib contains no threads and relies entirely on the calling application for its execution context, and implements a thread-safe synchronous I/O model where no call-backs are necessary and requested operations will either block according to the provided timeout, or return an error code immediately if the operation cannot be performed.
Open Source

Bundle Protocol Core Flight System Application (BP) GSC-18331-1

The BP cFS application uses the Bundle Protocol Library (bplib) to implement Delay Tolerant Networking. The application targets the cFE 6.5 release and provides out-of-the-box integration with the cFS CFDP application (CF), and a POSIX-compliant file system when provided. The implementation conforms to the CCSDS Blue Book recommendation 734.2-B-1 issued September 2015, which is based on RFC 5050.
U.S. Government Purpose Release

core Flight Software (cFS) Stored Command Absolute (SCA) Application GSC-17537-1

This software is a core Flight System (cFS) application that allows a system to be autonomously commanded via files that contain sequences of commands. Each command has a time tag associated with it, permitting the command to be released for distribution over the cFS core Flight Executive (cFE) Software Bus at predetermined times. The application allows up to 5 absolute-time sequences to be run simultaneously.
Open Source

CRoss-Application Translator for Operational Unmanned Systems (CRATOUS) LAR-19533-1

CRATOUS is a software bridge that allows OpenUxAS to use some of the functionalities provided by the Independent Configurable Architecture for Reliable Operations of Unmanned Systems with Distributed On-board Services (ICAROUS) software.
Open Source

Detect and Avoid Alerting Logic for Unmanned Systems (DAIDALUS) with Dynamic Well-Clear Separation Volumes LAR-19282-1

DAIDALUS is a software library that implements a detect-and-avoid concept for unmanned aircraft systems. Functionality provided by DAIDALUS includes: detection logic, maneuver guidance logic (e.g., loss of well-clear recovery), and alerting logic.
Open Source

Extendable Uniform Remote Operations Planning Architecture (EUROPA), Version 2.1 ARC-15936-1

EUROPA is a general-purpose, reusable, artificial intelligence software system. The tool generates plans for performing complex activities in parallel. Functionality includes the capability of verifying that a plan satisfies all constraints.
Open Source

Generic Software Architecture for Prognostics (GSAP) ARC-17748-1A

A generic, extendable, flexible, modular framework for applying prognostics technologies. GSAP manages top-level control, communications, logging, configuration, integration, and other general activities. A simple, standard interface is provided for integrating prognostics algorithms and models, minimizing the work required to deploy prognostics technologies.
Open Source

Hazards Analysis Management Tool (HAMT) GSC-16846-1

HAMT uses a single software tool to increase the efficiency and effectiveness of hazard analyses. Composed of a Microsoft Access front end (that contains the user interface) paired with a Microsoft Access back end (that stores analysis data), the software can be used to enter, edit, and report information through-out the hazard analysis lifecycle.
U.S. Government Purpose Release

Independent Configurable Architecture for Reliable Operations of Unmanned Systems with Distributed On-board Services (ICAROUS-2)　　　LAR-19281-1

ICAROUS-2 enables the robust integration of mission-specific software modules and highly-assured core software modules for building autonomous unmanned aircraft applications. The core software modules are implemented as distributed onboard services that communicate using a publisher/subscriber communication layer. The ICAROUS-2 independent architecture provides support for integration with standard and open-source communication and computation layers, including Core Flight Systems (CFSs), Data Distribution Service (DDS), MAVLink, and Plan Execution Interchange Language (PLEXIL).
Open Source

Jet Propulsion Laboratory (JPL) Stereo Vision Software Suite (JPLV)　　　NPO-18593-1T

JPLV provides a set of libraries and utilities for basic robotic vision, including stereo ranging and camera calibration. Primarily intended for vision system users rather than vision system developers, the suite hides most implementation details behind a high-level application user interface. No specialized computer-vision knowledge is required.
U.S. Government Purpose Release

Lidar-Based Hazard-Relative Navigation (HRN) Algorithm for Safe Lunar Landing　　　NPO-47115-1

The purpose of HRN is to provide measurements to the navigation filter so that it can limit errors on the position estimate after hazards have been detected. Hazards are detected by processing a hazard digital elevation map (HDEM). The HRN process takes lidar images as the spacecraft descends to the surface and matches these to the HDEM to compute relative position measurements.
U.S. Government Purpose Release

Livingstone 2 (System for Automated Diagnosis and Discrete Control of Complex Systems) and Skunkworks (Suite of Supporting Development and Runtime Tools)　　　ARC-14725-1

Livingstone 2 is a reusable artificial intelligence (AI) software system designed to assist spacecraft, life support systems, chemical plants, or other complex systems in operating robustly with minimal human supervision, even in the face of hardware failures or unexpected events. The technology diagnoses the current state of a spacecraft or other system and recommends commands or repair actions that will allow the system to continue operations. A re-engineered version of the Livingstone diagnosis system that was flight-tested onboard the Deep Space One spacecraft in 1999, Livingstone 2 contains significant enhancements to robustness, performance, and usability. Skunkworks is a suite of software tools that supports the rapid deployment of model-based representations of complex systems for Livingstone2 via a visual model builder/tester and two graphical user interface tools that provide status information during testing.
Open Source

MAV: Modeling, analysis and visualization of ATM concepts　　　ARC-17874-1

A modeling and analysis framework that provides the ability to model humans, automation, the interactions between humans and between humans and automation for air traffic management and airspace design concepts.
Open Source

Mission Analysis Low-Thrust Optimizer (MALTO)　　　NPO-43625-1

MALTO is a software tool for preliminary design and optimization of low-thrust interplanetary trajectories. The tool is easy to use, has robust convergence, and can handle many intermediate encounters.
U.S. Government Purpose Release

Mission Simulation Toolkit (MST)   ARC-14932-1

MST offers a simulation framework to support research in autonomy for remote exploration. The system allows developers to test models in a high-fidelity simulation and then evaluate system performance against a set of integrated, standardized simulations.
Open Source

Model-Based Diagnosis Engine for Stochastic Hybrid Systems (HyDE)   ARC-15570-1A

HyDE is a model-based diagnostic engine capable of detecting and isolating discrete (possibly multiple) faults in physical systems. The current version of HyDE has been implemented in C++. Please visit the following URL for more information: https://ti.arc.nasa.gov/m/project/hyde/HyDE_Summary.pdf
U.S. Government Purpose Release

Mystic Low-Thrust Trajectory Design and Visualization Software   NPO-43666-1

Mystic provides very high-fidelity optimization of low-thrust spacecraft trajectories for mission design. The software can be used for general body-centered trajectories, interplanetary trajectories, and trajectories that combine body-centered and interplanetary trajectory legs. Mystic will also provide navigational/operational support for low-thrust spacecraft.
U.S. Government Purpose Release

NASA Tensegrity Robotics Toolkit (NTRT), Version 1   ARC-17093-1

A collection of C++ and MATLAB software modules for the modeling, simulation, and control of Tensegrity Robots; a biologically inspired approach to building robots based on the tension networks of tensegrity structures. The NTRT was created to enable the rapid co-exploration of structures and controls in a physics-based simulation environment; the development of tensegrity robotics algorithms such as structural analysis, kinematics, and motion planning; and the validation of the algorithms and controls on hardware prototypes of the tensegrity robots.
Open Source

Ocean Worlds Autonomy Testbed for Exploration Research and Simulation   ARC-18548-1

A simulation environment for research and development of on-board autonomy software for scientific lander missions to the ocean worlds of our solar system: the moons harboring large quantities of liquids, such as Europa, Enceladus, and Titan. The proposed "Europa Lander" mission was chosen as a reference design to inform the development of the simulator.
Open Source

Planetary Observer Planning Software (POPS)   NPO-45418-1

The POPS application suite performs mission design analysis of a spacecraft orbiting a terrestrial planet. POPS is not intended for the study of hyperbolic or interplanetary orbits, although some limited hyperbolic capabilities exist.
U.S. Government Purpose Release

PolyCARP: Algorithms and Software for Computations with Polygons   LAR-18798-1

PolyCARP is a package of algorithms, including both their formal models and software implementations, for computing containment, collision, resolution, and recovery information for polygons. The intended applications of PolyCARP are related, but not limited, to safety-critical systems in air traffic management. Algorithms center on weather avoidance, ensuring that an aircraft stays inside a predetermined safety region, and obstacle avoidance by an aircraft.
Open Source

Power Autonomy Research and Development Environment (PARDE) LEW-20190-1

PARDE is a version of NASA's Autonomous Power Control (APC) software that can be used to evaluate fault management and automatic power system reconfiguration algorithms in a relevant system without having to fully develop all the supporting software. Software items included are a set of C++ class source files representing simplified fault management and reconfiguration logic, a power system simulation representing a notional architecture for NASA's Gateway vehicle, a web-based graphical user interface for running and testing the simulation and APC, a Docker-based automatic setup script for a development environment, and a user's guide.
U.S. Government Purpose Release

Prognostics Algorithm Library ARC-17735-1

The Prognostics Algorithm Library is a suite of algorithms implemented in the MATLAB programming language for model-based prognostics (remaining life computation). It includes algorithms for state estimation and prediction including uncertainty propagation. The algorithms take inputs component models developed in MATLAB and perform estimation and prediction functions. The library allows the rapid development of prognostics solutions for given models of components and systems. Different algorithms can be easily swapped to do comparative studies and evaluations of different algorithms to select the best for the application at hand.
Open Source

Prognostics Model Library ARC-17736-1

The Prognostics Model Library is a modeling framework focused on defining and building models for prognostics (computation of remaining useful life) of engineering systems It provides a set of models for select components developed within this framework. The library currently includes models for valves, pumps, and batteries.
Open Source

PX4 Autopilot Simulink Interface LAR-19482-1

Simulink S-Function PX4 autopilot interface block. This software provides Simulink simulations with an interface to the PX4 autopilot. Enabling Simulink vehicle simulations to be controlled by the PX4 autopilot in simulated environments.
Open Source

Python Prognostics Algorithm Package ARC-18635-1

The Prognostic Algorithm Package is a python framework for prognostics (computation of remaining useful life) of engineering systems, and provides a set of prognostics algorithms for prognostics state estimation and prediction.
Open Source

Python Prognostics Model Package ARC-18634-1

The Prognostic Model Package is a python modeling framework focused on defining and building models for prognostics (computation of remaining useful life) of engineering systems, and provides a set of prognostics models for select components developed within this framework.
Open Source

Robot Application Programming Interface Delegate (RAPID), Version 2 ARC-16368-1A

RAPID is a software reference implementation framework for remote operations. The technology promotes interoperability between robot software modules and includes a standard programming interface and data distribution middleware. RAPID facilitates integration of experimental robot software modules created by a distributed development team; improves the compatibility and reusability of robotic functions; and offers speed prototype robot development in a wide range of configurations and environments.
Open Source

Simple, Scalable, Script-Based Science Processor for Missions (S4PM)　　　GSC-14841-1

S4PM is a set of Perl scripts that implement a data-driven processing system that executes science algorithms automatically as new data arrive. S4PM includes a graphical user interface for monitoring algorithms and the overall system for failures. The Perl scripts can currently process data from the Moderate Resolution Imaging Spectroradiometer and the Atmospheric Infrared Sounder, but the technology can be extended to process data from other missions if desired. Please visit the following URL for more information:
http://opensource.gsfc.nasa.gov/projects/s4pm/
Open Source

Small Body Navigation and Topography (SBN&T)　　　NPO-41647-1

SBN&T provides an integrated program for the spacecraft navigation and determination of small-body dynamics, shape, and high-resolution topography. Multiple-image stereography and photoclinometry are used to construct high-resolution topographic and albedo maps centers treated as control points. These landmark maps are re-illuminated and correlated with images to act as body-fixed navigation tie-points.
U.S. Government Purpose Release

Smartphone Video Guidance Sensor (SVGS)　　　MFS-33014-1

The Smartphone Video Guidance Sensor (SVGS) allows for calculation of the distance and orientation of an object relative to the SVGS. A known retroreflective target pattern is mounted on the target object. The retroreflectors are then illuminated by the camera flash on the smartphone and imaged by the smartphone camera. The resulting image is processed using photogrammetry algorithms running on the smartphone to extract the relative X, Y, and Z distance and relative orientation, expressed as a roll, pitch, yaw angle sequence.
U.S. Release Only

WebGS: A Web-based Platform for Multi-UAV Flight Visualization and Simulation　　　LAR-19641-1

As UAV traffic management development and testing has become more complicated, the need has arisen for tools that can control and visualize multi-vehicle interactions. WebGS is a tool for test design and automated simulation execution (repeatable and adjustable flight planning). It provides a platform for multi-aircraft interaction and visualization, and allows for live flights to interact with simulated vehicles. It is compatible with other flight control software and multiple aircraft simulators. Also, WebGS allows for remote monitoring and multi-user interactions. WebGS provides a platform to handle an increasingly complex and dynamic simulation and operational environments, while simplifying the user experience, and providing an easy to understand visual overview of a complex airspace environment.
Open Source

Business Systems and Project Management

Acquisitions, Business Processes, Property
Management, Risk Management, Scheduling

Perseverance rover project manager Jennifer Trosper leads team members in applause in a control room at NASA's Jet Propulsion Laboratory in Southern California. The team honored 20 students via a live video event for overcoming academic obstacles. Each student received a personalized message from the rover on Mars.

Featured Software

Project Cost-Estimating Capability (PCEC)   **MFS-33187-2**

Used to develop cost estimates/models for space systems, this technology combines an Excel add-in with a simple, robust, and transparent collection of NASA cost-estimating relationships, statistics, work breakdown structures, and cost-estimating algorithms. The approach's use of native Excel functionality to provide basic calculations limits the overhead required to maintain a model and affords more transparency to the user with regard to the calculations and equations involved in generating an estimate.
General Public Release

Schedule Test and Assessment Tool (STAT), Version 5.0   **MFS-33362-1**

STAT is a schedule management software add-in developed to work specifically within the Microsoft Project scheduling application. The software provides the automated capability to quickly identify, quantify, and report numerous types of critical schedule-assessment data for management use. Clear and objective reporting of key schedule-assessment information includes: logic network integrity indicators, performance and trend metrics, schedule driver identification, data comparisons, margin and milestone tracking, and various other analysis data that can be used by project teams to assist in decision-making.
General Public Release

NASA Root Cause Analysis Tool (RCAT)   **LEW-19737-1**

The NASA Root Cause Analysis Tool (RCAT) has been designed to facilitate the analysis of anomalies, close calls, and accidents and also identify the appropriate corrective actions to prevent recurrence. The software provides an analyst with a quick, easy-to-use, accurate, and repeatable method to perform and document root cause analysis, identify corrective actions, perform trending analysis, and generate usable data for probabilistic risk assessment. All possible causes of accidents (hardware, software, the environment, weather, natural phenomena, external events, human error) can be incorporated into the timeline and fault/causal factor trees. The software features an intuitive logic diagramming capability and uses standard terminology, definitions, and symbols.
U.S. and Foreign Release

Action Item System, Version 2.0
GSC-16768-1

This Web application allows users to assign and track action items. Helpful emails are distributed when an action is created, updated, or closed, and reminder emails are sent to assignees when an action item deadline is approaching or has passed.
U.S. Government Purpose Release

Application Information Logging Services (AILS)
KSC-13992

AILS allows applications to log application events using a centralized set of services. Administrative and report functions are available to view logs.
U.S. Government Purpose Release

Authorization Services (Authos)
KSC-13984

Authorization Services (Authos) provides a suite of tools to authorize access to client applications. This includes application services and an end-user configuration module.
U.S. Government Purpose Release

Brahms: A Multiagent Simulation/Execution Environment for the Brahms Multiagent Language
ARC-15654-1

Brahms is a multiagent programming language for modeling people and systems in a conceptual world. Brahms language gives users the ability to model the behavior of human organization, communication, and teamwork, as well as human-machine interaction.
U.S. Government Purpose Release

Comments Export/Management Tool
MFS-33498-1

This tool is a collection of macros that enable a user to export Microsoft Word comments into a pre-formatted Excel spreadsheet, serving as an official record of the disposition for each comment.
U.S. Government Purpose Release

Data Service Provider Cost-Estimation Tool and Comparables Database
GSC-14905-1

The Data Service Provider Cost-Estimation Tool (CET) and Comparables Database (CDB) package provides NASA's Earth Science Enterprise (ESE) the ability to make lifecycle cost estimates for the implementation and operation of the data service providers that are required to support its science and applications programs. The Data Service Provider CET and CDB package employs a cost-estimation-by-analogy approach. For more information on the package, please visit: http://opensource.gsfc.nasa.gov/projects/CET/index.php
Open Source

eInfo Services (EIS)
KSC-13991

EIS is a Web service used to provide employee information to Web applications. The tool is composed of an API service. Using this service, developers can create service calls within a given application, passing the established parameters to retrieve specific employee information as needed.
U.S. Government Purpose Release

Employee Health and Safety System
KSC-14081

This software was built to facilitate the process of employees completing their Health and Safety Requirements.Web application for supervisors to record their Work Center Safety and Health Guide progress. Application would ask supervisors questions on all 22 sections of the document and records their answer for reports. Supervisors must complete this safety assessment annually and this application will facilitate the OSHA requirement. In addition, employees have the ability to certify they have completed their required training, JHA and certifications.
U.S. Government Purpose Release

HORIZON 5: Framework for Distributed Data Management and Product Generation Workflow
NPO-49540-1

HORIZON 5 is an extensible framework for data management systems. It is packaged with SIP/AIP.
Open Source

ID Digit Widget Plug-in
LEW-19442-1

This plug-in utilizes the open API of MagicDraw and allows the user to manage and validate requirement IDs simply and effectively. The user can do single or mass prefix ID changes and/or renumbering and see the results before the changes are executed. The tool also performs requirement number validation, informing the user if a requirement ID is missing or duplicated and provides an opportunity to correct the issue.
U.S. Government Purpose Release

Kennedy Action Tracking System (KATS)
KSC-13968

In the KATS application, a method of abstraction was used in a foundational Web site platform that liberated developers from the concern of having to manually generate entity framework calls to interact with the data layer of the application. The abstraction method/layer provided the ground work from that led to the development of a "project foundation" that has now become the basic starting block for a wide variety of Web-based development. This foundation drastically reduces project spin-up time and standardizes data layer and other service interactions to ensure consistently high-performing transactional solutions.
U.S. Government Purpose Release

Lessons Learned Bot, Version 1.2
LAR-19934-1

The software is an add-in application for use with the spreadsheet software provided by Microsoft Corporation under its Excel® brand name. The add-in offers an easy installation process on the user's PC machine for licensees of that spreadsheet software. The add-in application provides a user interface to accept text input (in various forms from a keyword, a sentence, a paragraph, to an entire document) in an active cell of any worksheet and then output the relevant NASA lessons learned (LL) documents via a customized side panel. The invention transforms the traditional passive LL system, where users search with keywords on the intranet web-based LL system, to an innovative active system, where users search for similar content within their own business flow.
U.S. Government Purpose Release

Mission Operations Cost-Estimation Tool (MOCET)
LAR-18894-1

MOCET is a model developed by the Aerospace Corporation in partnership with NASA's Science Office for Mission Assessment (SOMA). It implements new cost-estimating relationships (CERs) that were derived from historical data for various mission operation stages as applicable to the Planetary Science, Earth Science, and Astrophysics/Heliophysics Explorer missions.
General Public Release

NASA Aircraft Management Information System (NAMIS)
MSC-24723-1

The NASA Aircraft Management Information System (NAMIS) is an enterprise resource planning/mission support software suite designed from the ground up to meet both the mission support requirements and the business management requirements of Johnson Space Center's Aircraft Operations Division (AOD). The system features tools and processes that: (1) eliminate the risk of conducting flight operations in aircraft with overdue inspections, in aircraft with grounding discrepancies, and in aircraft not properly configured for the mission; (2) provide continuous and positive control of all assets including materials, parts, and equipment that exceed a customer-defined value; and (3) reduce material costs and labor hours. NAMIS includes the data, information, and metrics required to support flight operations management and business decisions, as well as the data required by other systems and external components to support consistent and accurate financial reporting and asset accounting.
U.S. Government Purpose Release

NASA Claims Authentication Provider   KSC-14146

An authentication provider built for Microsoft SharePoint. The NASA Claims provider allows code to be executed once a user authenticates to a SharePoint site. Once a new token is created, events are triggered to add claims to the current user's account using claims augmentation. Claims not available in part of the out of the box functionality in SharePoint can be added to a user's token. The solution also allows for customization of people picker actions through the SharePoint infrastructure. A companion application to migrate existing user accounts to a SAML based claims authentication format is provided as part of the NASA Claims provider solution.

U.S. Government Purpose Release

NASA COVID-19 Contact Tracing and Tracking (CTT) Application   MSC-26882-1

The NASA Office of the Chief Health and Medical Officer and the Office of the Chief Information Officer have developed a contact tracing application to help control the spread of Coronavirus (COVID-19). NASA Contact Tracing is used to identify employees who may have been in contact with a COVID-19 case at a NASA installation. Trained NASA Clinic employees interview the index case to trace back who they may have had recent contact with while at work. Subsequently, people who may have been exposed are contacted, interviewed about their symptomatic status, and encouraged to self-quarantine to prevent further spread. Of those contacts tested, if there is a new confirmed case of the virus, the process of contact tracing continues.

U.S. and Foreign Release

NASA Hazard Management System (HMS)   MSC-25694-1

The Web-based, access-controlled NASA Hazard Management System (HMS) provides a centralized repository for hazards regardless of origin and offers the ability to report and manage real-time hazards and controls. The primary mechanism for identifying and documenting hazardous conditions within HMS lies in the creation and management of two types of analysis documents: Hazard Analyses (HAs) and Job Hazard Analyses (JHAs). While these two document types offer different approaches for hazard identification and classification, they both offer controls for mitigating hazards. HMS provides a framework within which HA and JHA documents are created, reviewed, and approved. Once approved, the hazardous conditions identified within a document are considered active. More important, the controls associated with the hazards are then also considered active. HMS includes the mechanisms required to evaluate hazards using standard Risk Assessment Code (RAC) scoring.

General Public Release

NASA Instrument Cost Model (NICM) Version 9c   HQN-11886-1

A probabilistic cost and schedule estimating tool. NICM has proven instrument cost and schedule modeling capabilities that provide probabilistic estimates at both the system and subsystem level for many different instrument types. NICM is used by all NASA centers to support agency-wide proposal activities and program-directed missions.

General Public Release

NASA Root Cause Analysis Tool (RCAT)   LEW-19737-1

The NASA Root Cause Analysis Tool (RCAT) has been designed to facilitate the analysis of anomalies, close calls, and accidents and also identify the appropriate corrective actions to prevent recurrence. The software provides an analyst with a quick, easy-to-use, accurate, and repeatable method to perform and document root cause analysis, identify corrective actions, perform trending analysis, and generate usable data for probabilistic risk assessment. All possible causes of accidents (hardware, software, the environment, weather, natural phenomena, external events, human error) can be incorporated into the timeline and fault/causal factor trees. The software features an intuitive logic diagramming capability and uses standard terminology, definitions, and symbols.

U.S. and Foreign Release

Programmatic Cost Tool (PCT)   NPO-50859-1

PCT explores the affordability of user-generated architectures for human spaceflight. The PCT is an Excel-based tool using VBA code that produces a particular view of affordability, commonly called a sand chart, along with the underlying year-by-year costs for that architecture.
U.S. General Public Release

Project Cost-Estimating Capability (PCEC)   MFS-33187-2

Used to develop cost estimates/models for space systems, this technology combines an Excel add-in with a simple, robust, and transparent collection of NASA cost-estimating relationships, statistics, work breakdown structures, and cost-estimating algorithms. The approach's use of native Excel functionality to provide basic calculations limits the overhead required to maintain a model and affords more transparency to the user with regard to the calculations and equations involved in generating an estimate.
General Public Release

RedShift: Mobile App for Following the Tactical
and Strategic Operations Meeting Schedule   NPO-50256-1

RedShift is an application for iOS and Android that presents the meeting agenda for MSL strategic and tactical meeting events that are a part of the operations workflow.
Open Source

Schedule Test and Assessment Tool (STAT), Version 5.0   MFS-33362-1

STAT 5.0 is a schedule management software add-in developed to work specifically within Microsoft Project. STAT provides the automated capability to quickly identify, quantify, and report numerous types of critical schedule-assessment data for management use. This software provides clear and objective reporting of key schedule-assessment information, including logic network integrity indicators, performance and trend metrics, schedule driver identification, data comparisons, margin and milestone tracking, and various other analysis data that can be used by project teams to assist in management decision making.
General Public Release

Shipping Foam Designer Software   MSC-25515-1

The Shipping Foam Designer Software is an easy-to-use design tool that allows the user to select the proper type and dimensions of shock-attenuating packing foam. A simple graphical user interface is provided. The software was developed in response to a large number of documented cases of critical hardware failures that resulted from drops during shipment.
General Public Release

Source Lines Counter (SLiC), Version 4.0   NPO-45962-1

SLiC has been used in a variety of projects and missions at the Jet Propulsion Laboratory (JPL). It is the official code counter endorsed by the Software Quality Improvement Project for its metrics collections effort across JPL. SLiC provides data for cost models used during all major JPL pre-Phase A software estimation activities, as well as cost validation activities throughout project lifecycles.
U.S. Government Purpose Release

Stennis Space Center (SSC) Site Status Mobile Application   SSC-00424

This application provides SSC civil servants, contractors, and tenants the ability to view the NASA center's weather radar and current site status bulletin from a mobile device. The application also alerts users via push notification when a new site status is posted. It is available at the Apple App Store.
General Public Release

Crew and Life Support ✚

Biological Sensors, Food, Medical, Biological Analysis, Crew Support, Basic Human Model and Cognition

During Underway Recovery Test-8, NASA's Landing and Recovery team from Exploration Ground Systems at Kennedy Space Center in Florida performed their first full mission profile test of the recovery procedures for Artemis I aboard the USS John P. Murtha in the Pacific Ocean. Artemis I will be the first integrated flight test of NASA's Deep Space Exploration Systems: the Orion spacecraft, Space Launch System rocket, and newly upgraded Exploration Ground Systems at Kennedy.
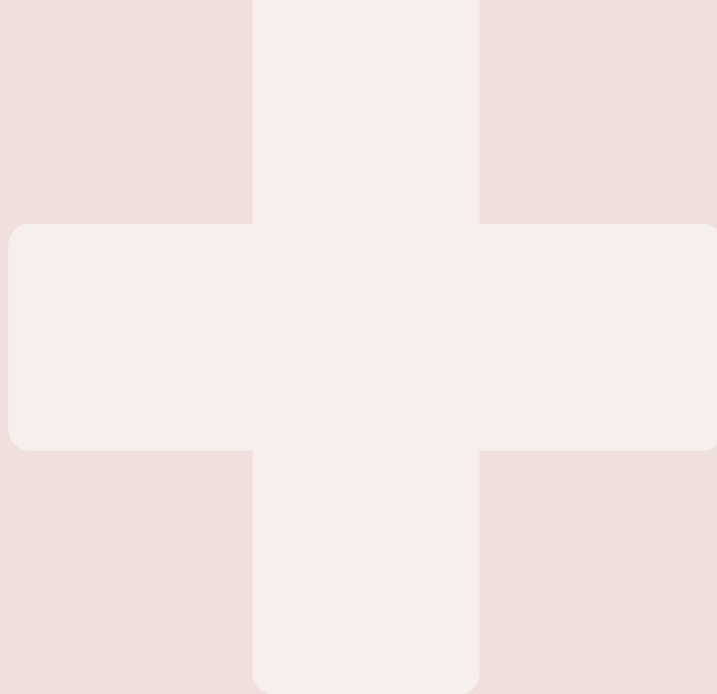
Featured Software

Multi-Attribute Task Battery (MATB-II)   **LAR-17835-1**

MATB-II is a computer-based task battery designed to facilitate research in human multiple task performance with consideration for the effects of automation. The tool includes five component tasks: system monitoring, tracking, communications monitoring, and resource management. A scheduling window provides preview of anticipated workload, and component tasks can be automated or manual. Coded in C++, MATB-II has been tested on the Windows XP Service Pack 3, Windows Vista, and Windows 7 operating systems.

General Public Release

HZETRN 2020   **LAR-19979-1**

This latest update to the HZETRN deterministic space radiation transport code contains new algorithms and options for calculating three-dimensional transport in user-defined combinatorial or ray-trace geometry. More computationally efficient bi-directional algorithms may be used to perform transport through multi-layer slabs. Users may also opt to create an interpolation database for various thicknesses within one to three user-defined material layers using a straight-ahead transport algorithm. Calculations may be executed for galactic cosmic ray, solar particle event, low-Earth orbit, and user-defined environment boundary conditions.

General Public Release

VESsel GENeration Analysis (VESGEN) 2D Software   **ARC-17621-1**

VESGEN maps and quantifies key parameters in black-and-white images of vascular trees and networks that are important for astronaut and terrestrial pathologies such as inflammation and angiogenesis in diabetes and tumors.

U.S. and Foreign Release

Acute Radiation Risk and BRYNTRN Organ Dose (ARRBOD), Version 2.1   MSC-26211-1

ARRBOD is a radiation risk projection model for typical space traveling scenarios that calculates gender-dependent organ doses and various acute radiation responses due to some historical large solar particle events (SPEs).
General Public Release

Fine Motor Skills (FMS) Software Application   MSC-26032-1

The Fine Motor Skills (FMS) software test battery is designed to collect data from multiple tasks that are indicative of fine motor performance. It was developed to evaluate the effect of microgravity on the senso-rimotor system during 6 month and 1 year missions on the International Space Station (ISS). The application runs on an iOS platform, and is intended for use on an iPad. The data recorded on the iPad can be sent to a server or retrieved from iTunes directly from the device.
Open Source

GCR Event-Based Risk Model Code (GERMcode)   MSC-24760-1

GERMcode provides scientists with data interpretation of their experiments. For mono-energetic ion beams, basic physical and biological properties are calculated for a selected ion type, such as kinetic energy, mass, charge number, absorbed dose, or fluence. Evaluated quantities include linear energy transfer, range, absorption and fragmentation cross-sections, and the probability of nuclear interactions. In addition, a set of biophysical properties are evaluated (e.g., Poisson distribution for a specified cellular area, cell survival curves, and DNA damage yields per cell). GERMcode also calculates the radiation transport of the beam line for either a fixed number of user-specified depths or at multiple positions along the Bragg curve of the particle in a selected material.
General Public Release

HZETRN 2020   LAR-19979-1

HZETRN2020 is the latest evolution of the HZETRN space radiation transport code. It is a deterministic radiation transport code capable of calculating the transport of the large variety and broad energy spectra of particles found in the space environment through shielding materials. HZETRN2020 contains updated algorithms for calculating three dimensional transport in user-defined combinatorial or ray-traced geometry, or users can opt to create an interpolation database for various thicknesses of one to three user defined materials using a "straight ahead" (1D) transport algorithm. Pions and muons are explicitly coupled to the neutron and light ion solutions in HZETRN2020. HZETRN2020 supports calculations for Galactic Cosmic Ray, Solar Particle Event, and Low Earth Orbit environments. HZETRN2020 also allows the input of user-defined environment boundary conditions, and SPE environment options include fits to historic events and spectra defined by the user with commonly used fitting functions.
General Public Release

LED Lighting Panel Software Simulation Tool   KSC-13752

The software tool was originally designed and implemented for use with the Advanced Biological Research System (ABRS) lighting panel upgrade. The upgrade was required since the LEDs used in the original design are no longer available in small quantity, and newer LEDs have a much higher efficiency. Even though the software tool is currently written for a flat panel containing LEDs pointing normal to the panel, the equations used are fundamental to the physics of the problem and therefore can be applied to any geometrical configuration by implementing a modified user interface.
General Public Release

Multi-Attribute Task Battery (MATB-II)   LAR-17835-1

MATB-II is a computer-based task battery designed to facilitate research in human multiple task performance with consideration for the effects of automation. The tool includes five component tasks: system monitoring, tracking, communications monitoring, and resource management. A scheduling window provides preview of anticipated workload, and component tasks can be automated or manual.
General Public Release

Crew and Life Support

NASA Space Radiation Cancer Risk (NSCR) Model 2012 — MSC-25352-1

NSCR is an integration of various components of the cancer risk projection model used for assessing radiation-induced cancer risks for humans in space. It utilizes the latest analysis of human radio epidemiology for low-linear energy transfer (LET) radiation and cancer, as well as survival rates in the U.S. population and a population of never-smokers. Models of space environments and radiation transport are used to determine organ exposures behind spacecraft shielding. NSCR uses Monte-Carlo propopagation of errors in various factors to determine the overall uncertainties in radiation cancer projections.
U.S. Government Purpose Release

NASA Task Load Index (TLX) iOS — ARC-15150-1A

The NASA Task Load Index (TLX) provides multi-dimensional ratings of overall workload based on a weighted average of six subscales: mental demands, physical demands, temporal demands, performance, effort, and frustration. Data collection may be performed through an iPhone or an iPad.
General Public Release

Network-Form Game Software Library (libnfg) — ARC-16764-1

The libnfg software library describes how humans interact with their environment and with other humans. The tool provides a Monte Carlo analysis of user-specified "network-form games," which are flexible modeling methodologies that combine Bayes nets and game theory to model complex systems.
Open Source

RITRACKS: A Software for Simulation of Stochastic Radiation Track Structure, Micro- and Nano-Dosimetry, Radiation Chemistry, and DNA Damage by Heavy Ions — MSC-25937-1

RITRACKS has been developed over the last several years at Johnson Space Center to simulate the effects of ionizing radiations at the microscopic scale and to understand the effects of space radiation at the biological level. The fundamental part of this code is the stochastic simulation of radiation track structure of heavy ions, an important component of space radiations. The code can calculate many relevant quantities such as radial dose, as well as voxel dose, and it may also be used to calculate the dose in spherical and cylindrical targets of various sizes. Recently, DNA structure and damage simulations at the molecular scale have been incorporated into RITRACKS.
General Public Release

Second Generation Beacon Performance Analysis Test Tools — GSC-18375-1

NASA is building Spread Spectrum Second Generation Beacons (SGB) intended to comply with all Cospas-Sarsat T.018 requirements. NASA has built a set of test tools to evaluate the performance of the SGB. The tools use Digital Signal Processing (DSP) to analyze the transmit characteristics and demodulate the message. The test tools are written in MATLAB scripts.
Open Source

Space Science Investigations: Plant Growth — MSC-26184-1

This interactive app for mobile platforms teaches about growing plants in space. Downloads are available on Apple or Google App Stores (no agreement with NASA needed).
General Public Release

VESsel GENeration Analysis (VESGEN) 2D Software — ARC-17621-1

VESGEN maps and quantifies key parameters in black-and-white images of vascular trees and networks that are important for astronaut and terrestrial pathologies such as inflammation and angiogenesis in diabetes and tumors.
U.S. and Foreign Release

Data and Image Processing

Algorithms, Data Analysis, Data Processing

University of California, Santa Barbara (UCSB) student Piper Lovegreen calibrates a sensor to measure leaf chlorophyll content at the Jack and Laura Dangermond Preserve in Santa Barbara County. Lovegreen is among the researchers working on the Surface Biology and Geology High-Frequency Time Series (SHIFT) campaign, which is jointly led by NASA's Jet Propulsion Laboratory in Southern California, UCSB, and The Nature Conservancy. SHIFT combines airborne science instrument data from wide areas with the study observations of field scientists about the functional characteristics, health, and resilience of plant communities.
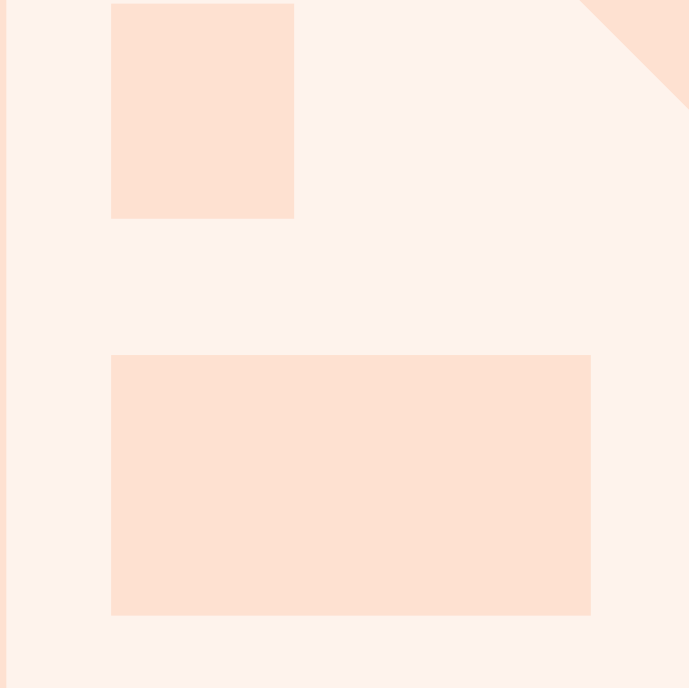
Featured Software

WinPlot Graphical Display System   **MFS-31664-1**

WinPlot is a powerful desktop graphical analysis tool that allows the user to generate displays of unre-stricted amounts of data. It was developed to fulfill the need for fast and easily managed graphical displays of NASA test articles and facilities. WinPlot features include seamless displays of real-time and post-test data with time and event-time synchronization of data from multiple sources.
General Public Release

Video Image Stabilization and Registration (VISAR)   **MFS-31243-1**

This software program will stabilize video images distorted as a result of video camera motion. There are multiple applications for this technology including stabilization of images from mobile platforms, crime scenes, robotic systems, spacecraft, and home video.
General Public Release

Dynamic Onboard Ubiquitous Graphics (DOUG) Software Application   **MSC-23586-1**

The Dynamic Onboard Ubiquitous Graphics (DOUG) is a 3D rendering software package used for simulation and virtual reality display systems.
General Public Release

Data and Image Processing

3D GRAPE/AL: Three-Dimensional Grids About Anything
by Poisson Equations, Version 3
<div align="right">LAR-17758-1</div>

The 3.0 suite of 3DGRAPE/AL software advances the state of the art in structured volume grid generation by implementing a new matching point block-to-block boundary condition on adjacent faces of two blocks. The software also has two preprocessors that enable rapid development of the input data to run 3DGRAPE/AL.

U.S. Release Only

3D Ground Control Station for Aerial Vehicles
<div align="right">NPO-50759-1</div>

This software provides a 3D graphical user interface for intuitive generation, assessment, and modification of optimal trajectories for quadrotors through obstacle rich environments. Implemented in the software are three state-of-the-art algorithms that plan trajectories through a premapped obstacle field. The software is designed to be integrated with a hardware system to record a flown trajectory to repeat, send trajectories to a quadrotor to fly, and get live feedback during a flight. Use cases of the software include assessment of existing or new trajectory optimization algorithms, assessing feasibility of operations in a given environment, and the operational planning and flying of a quadrotor. The operational application is for flying in a premapped environment, and requires other software tools for the complete system (map generation, and hardware system).

Open Source

3D Mapping Software for High-Resolution Display
of Hail and Rain Data from NWS Radar
<div align="right">KSC-12952</div>

This software can be used to generate a 3D hail/rain map around a large structure (e.g., a launchpad or a power plant).

U.S. Release Only

ACCEPT: Adverse Condition and Critical Event Prediction Toolbox
<div align="right">ARC-16839-1</div>

This MATLAB-based source code includes an overall software infrastructure framework and two main software components. The software infrastructure framework consists of code written to preprocess data, pass information between the two main software components, learn models that will be shared by nearly all of the elements in one of the two software components (which will require calling third-party open-source software modules), and select which element/method should be used in each one of the two main software components. The two main software components can use interchangeable software elements that enable the regression and detection functionality.

Open Source

AFIDS: Automated Fusion of Image Data System
<div align="right">NPO-52175-1</div>

This library is a subset of the JPL Video Image Communication and Retrieval (VICAR) image processing system. AFIDS incorporates "georeferenced map images" into VICAR using the AFIDS "VicarGT" format (a compatible version of the "GeoTIFF" format). AFIDS includes Ortho-Rectify and Co-Register orbital satellite imagery and image processing tools to perform scientific analysis and research of co-registered imagery AFIDS support MISR, MAIA, CloudSat, EMIT, ECOSTRESS, OCO2, more in addition to mapping support for Mars and planetary orbital datasets. This collection of 200+ vicar-based programs and scripts relies on other libraries including GDAL, GeoTIFF, Python, JPL GEOCAL, NASA NAIF/SPICE, and others.

General Public Release

<div align="right">**Data and Image Processing**</div>

AMMOS Instrument Toolkit
NPO-50696-1

The AMMOS Instrument Toolkit (AIT) is a Python-based software suite developed to handle Ground Data System (GDS), Electronic Ground Support Equipment (EGSE), commanding, telemetry uplink/downlink, and sequencing for JPL International Space Station and CubeSat Missions. This toolkit is a lightweight operations and data processing resource for instruments and small satellites. It provides traditional uplink and downlink capabilities across all phases of the project lifecycle from early development and prototyping, through to integration and test, and ultimately operations.
Open Source

AMMOS Instrument Toolkit (AIT) Sequence Editor
NPO-52061-1

The AIT Sequence Editor is a generalization and expansion of the AMMOS Instrument Toolkit providing sequence editing capabilities for the AMMOS Instrument Toolkit. The editor uses AIT command dictionary to provide command validation and completion capability to assist users while working with AIT sequences. The editor also provides a loading and saving of seq.json capability for the generated sequences.
Open Source

Analysis Software for Cosmic Microwave Background Research
GSC-17667-1

This is a suite of analysis tools for cosmic microwave background research. It currently consists of an implementation of the pure C_\ell cosmic microwave background power spectrum estimator, as well as an implementation of the mode-mixing matrix calculation.
Open Source

ARAJ Low-Density Parity Check (LDPC) Codes
NPO-43949-1

This software provides a construction method for protograph-based Low-Density Parity Check (LDPC) codes that simultaneously achieve low iterative decoding thresholds and linear minimum distance. The technology can be used for various code rates. Proposed codes may have either fixed input block or fixed output block sizing. Both cases provide rate compatibility. In fact, one encoder and one decoder can support different code rates.
U.S. Government Purpose Release

ASSESS: Automatic Semantic Search Engine for Suitable Standards
NPO-52309-1

This is an AI/ML application for the Department of Homeland Security that can assess what government standards and regulations apply to a given input (e.g. a document, text string, etc.).
Open Source

Asteroid Survey Simulation Tool
NPO-50825-1

The software allows simulation of both ground-based and space-based surveys. This tool is fast and efficient, capable of accepting user-defined asteroid model populations and telescope parameters such as a list of pointing angles, camera field-of-view shape, etc. and generating an output list of detectable asteroids. The software takes advantage of the widely used and tested SPICE library and architecture developed by NASAs Navigation and Ancillary Information Facility (NAIF) to save and asteroid trajectories and camera pointing.
Open Source

Astromaterials 3D Website & Explorer Application
MSC-27059-1

This is the first virtual library of NASA's collections of Apollo Lunar and Antarctic meteorite samples. This web-based custom visualization tool presents each extraterrestrial rock in a visually stunning, information rich manner. This is the first virtual library of NASA's collections of Apollo Lunar and Antarctic meteorite samples. This web-based custom visualization tool presents each extraterrestrial rock in a visually stunning, information rich manner.
General Public Release

AutoBayes: Automatic Design of Customized Analysis Algorithms and Programs ARC-16276-1

AutoBayes uses extended Bayesian networks, a powerful symbolic system, and algorithm schemas to automatically generate efficient and customized programs for data analysis. It generates a standardized design document containing a graphical representation of the Bayesian network and of the details regarding the code's generation.

Open Source

Automated Snow Index Tool (ASIT) LAR-19128-1

This software loads in image collections from Google Earth Engine from different sensors (Landsat 5, 7, and 8, and Sentinel 2a, 2b). The code identifies pixels using two snow indices – Normalized Difference Snow Index (NDSI) and the Saito S3 Snow Index. The area of snow can then be calculated for a region or for an individual watershed.

Open Source

Autonomous Data Reduction for NASA Earth Science Data NPO-45583-1

NASA atmospheric and Earth science missions generate vast amounts of data every day. Clustering algorithms are used in various applications including pattern recognition, classification, data compression, regression, and related optimization problems. The design implements a computational solution for an autonomous data-reduction/clustering process to produce a representative distribution and joint relationships of the data without assuming a specific type of distribution and relationship nor resorting to domain-specific knowledge about the data.

U.S. Government Purpose Release

AutoPost MFS-32925-1

AutoPost can process any configuration of test data as needed. The tool can combine a series of data parameters into a single parameter.

U.S. Release Only

BALFIT: A Multivariate Regression Analysis Tool ARC-15804-1A

BALFIT is designed for the automated regression analysis of wind tunnel strain-gage balance calibration data. Related strain-gage balance data analysis tasks are also supported. In addition, BALFIT performs an automated regression analysis of more general multivariate data sets at a basic level.

U.S. Release Only

Bingo Mini-App LAR-19460-1

Software that performs symbolic regression through the use of genetic programming. It uses a genetic-algorithm-based procedure to find free-form equations that describe an input dataset.

Open Source

BodyDataReader NPO-51530-1

BodyDataReader is an ephemeris and physical constants reader that makes it easy to retrieve data on any body in the solar system. It gathers data (position, mass, other physical constants) on solar-sytem bodies (planets, moons, asteroids) from publicly available JPL websites and returns it via user-friendly queries. Data is retrieved from JPL Horizons (https://ssd.jpl.nasa.gov/?horizons), the JPL Small-Body Database (https://ssd.jpl.nasa.gov/sbdb.cgi), and the NAIF SPICE system (https://naif.jpl.nasa.gov/naif/index.html). Retrieved data is saved locally for fast access later.

Open Source

Data and Image Processing

Campaign Analysis Mapping and Planning Tool (CAMP) NPO-51390-1

The Campaign Analysis Mapping and Planning tool (CAMP) provides an advanced web-based geospatial data creation tool for a distributed user base. This tool is designed for science operations to create strategic 'targets' for mission guidance as well as a collaborative tool to make, edit, and share geospatial data.
Open Source

Cassini RADAR SAR Processor, Preprocessor, and Topography from SAR (SARTopo) Processor NPO-51960-1

The Cassini RADAR instrument onboard the Cassini Orbiter is currently collecting SAR Imagery of the surface of Saturn's largest moon, Titan. The ground processing of Cassini SAR data focuses upon the unusual features of the data and how these features impact the processing. A data dependent mechanism eliminates artifacts due to attitude and ephemeris knowledge error. Trade-off SAR performance vs. area of coverage informs spacecraft pointing profiles.
Open Source

CERBERUS: Bayesian Retrieval Scheme for Efficiently Applying High Dimensionality Model Spaces to The Study of Exoplanet Atmospheres NPO-50770-1

CERBERUS is a scientific software code developed for estimating properties of exoplanet atmospheres – planets that orbit nearby stars – based on spectroscopic observations from astronomical observatories. The code implements a Bayesian approach coupled with a novel branch-pruning method which allows the efficient evaluation of a complex model space that incorporates both thermo chemical equilibrium (TCE) and non-TCE models for atmospheric chemistry. The forward models used in the retrieval process include a detailed radiative transfer equations and support for both gaseous and aerosol opacity sources. Vertical dependence for both opacity sources and the atmospheric temperature profile are supported. The model selection capability of CERBERUS is a significant advancement over the current state of the art and allows CERBERUS to efficiently evaluate the statistical evidence a much broader range of models than other codes; when combined with the new high spectral resolution observations that are now becoming available, CERBERUS allows new insights in the conditions and composition of exoplanet atmospheres and allows rapid processing of large data sets.
Open Source

CertWare Safety Case Workbench Software LAR-18067-1

This technology contributes several core modules to support safety case models and offers a service-based application programming interface that enables new model-processing capabilities to be plugged into the workbench.
Open Source

Chapter 10 Tools: Solving the Challenges of Varying Implementations of the IRIG Standard DRC-014-009

Sometimes even though post-flight processing data files originating from various onboard digital recorders follow the Range Commanders Council Inter-Range Instrumentation Group (IRIG) 106 Chapter 10 Digital Recording Standard, they use differing interpretations of it. This software toolkit reads data files regardless of the vendor implementation of the source recorder, display data, identify and correct errors, and produce a data file that can be successfully processed post-flight.
General Public Release

Chesapeake Bay Chlorophyll Hotspot Identifier (CBCHI) LAR-18794-1

CBCHI uses raw Landsat 8 surface reflectance products to produce two ArcMaps to identify chlorophyll hotspots. It also creates a true color image.
Open Source

Classification and Verification Editor (CaVE)   LAR-18861-1

This code improves the efficiency of analyzing multiple classification methods in order to produce accurate classified images for land use and land cover change. Instead of running multiple classifications, validations, and algorithms separately, this is all performed through one script with one condensed output located in the console.
Open Source

Cloud-based Data Match-Up Service (CDMS) In Situ Data Services   NPO-52071-1

The CDMS In Situ Data Services can be used by in situ data providers to provide a standardized interface to in situ data that can be used for satellite-to-in situ data match up.
Open Source

Cloud-based Data Processing System for ECCO   NPO-51406-1

ECCO-Cloud leverages serverless cloud-based solution to automate product generation and to establish a cloud-based analytics center for fast access and interactive analysis using the Apache Science Data Analytics Platform.
Open Source

Coastal Mid-Atlantic METRIC Model   LAR-18665-1

This software calculates evapotranspiration rates of agricultural fields by executing the METRIC model in an ArcGIS Python script. It requires input data from Landsat 8 OLI/TIRS and local weather stations. The software was developed to reduce irrigation costs for farmers and provide a means to monitor droughts.
Open Source

Comprehensive Analysis of Time Series Forecasting Using Neural Networks   NPO-51540-1

This is an advanced machine learning method to predict future gas production in tight rock unconventional reservoirs. A particular capability is early prediction, over a range of horizons, only from data first weeks to months.
Open Source

Connection of Cameo Simulation Toolkit with RabbitMQ Messaging Service   NPO-50468-1

Cameo Simulation Toolkit provides the first in an industry-extendable model execution framework based on OMG fUML and W3C SCXML standards. It enables the validation of system behavior by executing, animating, and debugging models of the system in the context of realistic mock-ups of the intended user interface.
Open Source

Constellation PRACA Extension of the Bugzilla Application   ARC-16033-1

The Constellation PRACA I-1 system is a modified version of a defect tracking tool called Bugzilla. Bugzilla allows software developers to document and track outstanding bugs in their products. In the Constellation PRACA I-1 system, these core capabilities have been extended to provide the necessary functionality and usability defined in the PRACA processing requirements.
Open Source

Convenient and Flexible Satellite Data Spatial-Temporal Collocation System   GSC-18900-1

Data collocation is often a critical initial step in many remote sensing applications to fuse data from multiple instruments. This systems provides users a convenient and flexible approach to collocate data from arbitrary sensors and/or platforms based on their own requirements.
Open Source

Convolutional Neural Networks for Spacecraft Pose Estimation
NPO-51334-1

The software trains and tests convolutional neural networks to determine the spacecraft pose estimation. It also contains functionality to perform image preprocessing, data augmentation, and tensorflow model compression. The software takes a unique approach that incorporates more image data than other approaches while retaining the original spatial dimensions. Other approaches will down sample images significantly which causes the neural network to lose a lot of spatial information retarding robustness. The software is designed to estimate the pose of a spacecraft based on an image of that spacecraft. This includes the relative position and attitude of the target satellite with respect to a chasing satellite. Application of this technology aids functions such as active debris removal and formation flying among other applications.

Open Source

CORAL-TT:
Calculating Oscillations in Regional Aquatic Locations – Temperature and Turbidity
LAR-19547-1

This JavaScript code intended for Google Earth Engine (GEE) allows easy access to all data available on this free platform, calculates Normalized Difference Turbidity Index (NDTI) median over years and seasons, and calculates fluctuations between seasons. The code combines 27 years of satellite data and maps sea surface temperature (SST) using Level 3 Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) processed by Earth Observing System Data and Information System (EOSDIS). The GEE user interface presents a graph that allows users to see fluctuations in SST at any given selected point of interest over time. The user can also specify dates, image collections, and a study area to display and export a map of interest.

Open Source

Core Hierarchical Segmentation (HSEG) Software Package
GSC-15855-1

This version of HSEG is not subject to patent restrictions. Please visit the following URL for additional information: http://opensource.gsfc.nasa.gov/projects/HSEG/

Open Source

Coronagraph Alignment and Calibration Software
NPO-52194-1

Coronagraphs are a promising technology for the direct imaging of exoplanets at high contrast. To provide peak performance, coronagraphs must be well aligned and calibrated. This software package provides alignment and calibration routines for several common types of coronagraphs, along with functional tests to demonstrate the accuracy of the provided algorithms.

General Public Release

COVER: Calibrate Observed Vegetation Estimates Remotely
LAR-19181-1

The source code provided develops calibration models using linear regression models with in-situ field data. The calibration models are then used to predict biomass (log), nitrogen percent, and nitrogen content for Landsat images from 2006-2016. Model results and data tables are output as separate files for each field season (i.e. winter and spring seasons).

Open Source

Cover Crop Remotely Observed Performance (CCROP)
LAR-19113-1

The source code extracts Normalized Difference Vegetation Index (NVDI) values from Landsat 5, Landsat 8, and Sentinel-2 images. NDVI values are averaged within field boundaries for each image and exported as a table with field ID and average NDVI value (with image date as the column header) for each date in a given range.

Open Source

Data and Image Processing

44   NASA Technology Transfer Program **Software Catalog 2023-24**

Cross-Institutional Open-source Collaborative for NASA's Multi-Mission Algorithm and Analysis Platform (MAAP) High-End Computing (HEC) and Amazon Web Services (AWS) Development, Integration and Deployment   NPO-52250-1

Update MAAP allows seamless employment of the compute/storage capacity of both AWS and NASA HECC for algorithm development and data processing and analysis. The NAS enabled deployment of these containerized algorithm workloads are interoperable across AWS and Pleiades. Data management services are also updated to enable automatic data migration between AWS storage and local storage on Pleiades. A separate MAAP development system accommodates the changes required for AWS-NASA HEC infrastructure needs and to develop new capabilities. Science algorithm software, the Jupyter notebooks, and the NASA HECC remain open.
Open Source

CryoFab: Harmonic Analysis of Isotropic Fields on the Sphere with Arbitrary Masks   NPO-52134-1

CryoFaB derives a harmonic basis adapted to the survey geometry of a galaxy survey. It does this in 2D on the sphere and 3D similar to a spherical Fourier-Bessel decomposition. CryoFaB can also be used to calculate the pixel window and effect of the geometry on the power spectrum. The power spectrum covariance matrix can also be calculated. CryoFaB aims to handle wide-angle effects in the power spectrum measurement of galaxy surveys such as SPHEREx, Euclid, and Roman.
Open Source

DAISY: DAta to Image SYstem   NPO-50269-1

Level 2 data can be visualized with accurate geometry through the use of the DAISY software and the GIBS web services. L2 data geolocation is indexed and instrument viewing geometry is used to generate accurate data footprints per data point in the form of an index image. An index image contains index values in its pixels to associate the corresponding data to the pixel. The index image is used as input to the MRF generation software that is part of GIBS and served out as tiles to clients. Clients that receive the index tiles must also access the source data via a technology such as webification in order to pull out the data at the indices that are in the tile image. This allows science data to be transferred into a client as an "image."
Open Source

Data Driven Solutions for General Satellite Maneuvers   NPO-50934-1

This software solves the assignment problem in flying formations so that each satellite can go to the desired location with an optimal fuel expenditure while avoiding collisions with other satellites. This is accomplished by moving satellites from prespecified start and end points within a fixed amount of time.
Open Source

Deep Learning and Anomaly Detection in Mars Rover Data   NPO-51336-1

This software performs data processing and machine learning analysis used in the project Deep Learning and Anomaly Detection in Mars Rover Data Transmission. The files contain the signal processing directory and Python scripts to organize and clean a dataset before passing it into the various machine learning and deep learning models. The machine learning directory contains an Adversarial Auto encoder, a deep learning model used in reconstructing data, and a file for a One-Class SVM, which is used in detecting anomalies in the dataset. It also contains a deep neural network, which is used in classifying the success of different Mars downlink successes.
Open Source

Deep Reinforcement Learning Model for High Level Science Planning Using Formation Flying

NPO-51314-1

The software trains algorithms to optimize science return for Earth orbiting missions that use formation flight. The usage of deep learning techniques is uncommon for ground planning systems and has never been used before for onboard systems. The software has been designed with future onboard usage in mind. The software creates a plan for each satellite in the formation to maximize science data return and minimize fuel consumption.

Open Source

DejaVu

NPO-50864-1

DejaVu is a software program for analyzing execution traces generated by a running system, typically another program, referred to as the monitored system (MS). The MS must be instrumented to emit events as it executes. The emitted trace is consumed by the DejaVu monitor, which verifies it against a property (requirement) formalized in first-order past time temporal logic. The system is innovative in using BDDs (Binary Decision Diagrams) for storing data from the execution trace.

Open Source

DEVELOP: DRIP and SLIP Landslide Detection Package (DRIP-SLIP)

LAR-18789-1

The DRIP-SLIP model automatically analyzes red band spectral information and soil moisture information derived from Landsat 8, ASTER, and SRTM data (at fine to moderate resolutions) to determine possible new landslide areas. This software increases the temporal latency for landslide products that emergency managers, planners, and scientists use in their work.

Open Source

DEVELOP: National Program Python Package

LAR-18583-1

This package creates a Python programming environment for simple processing of large NASA data sets to prepare them for further analysis in an ESRI ArcMap environment. It includes an instructional framework to guide users.

Open Source

Distributed Observer Network (DON), Version 3.1

KSC-13775

DON3 is the innovative combination of NASA simulation technologies, NASA information technologies, and commercial video game technology to provide a unique system that leverages the strengths of all three. A key component is a standardized data interface for simulation-related information that is coupled with custom software integrated into the game environment.

U.S. and Foreign Release

Dorado-Sensitivity

GSC-18703-1

Dorado is a proposed space mission for ultraviolet follow-up of gravitational wave events. This repository contains a simple sensitivity and exposure time calculator for Dorado.

Open Source

Drought Severity Assessment Decision Support Tool

LAR-18731-1

Within a user-specified boundary, this tool allows a user to calculate standardized precipitation index (SPI) values for each cell of a set of monthly precipitation raster's that span at least thirty years. The tool calculates basic SPI statistics within a user specified boundary and allows for visualization of calculated SPI rasters over time.

Open Source

DthData Armstrong Time-History Software Utility · DRC-012-024

A standalone command-line-driven utility program, DthData processes time-history format data files generated by the Armstrong Core Simulation Software.
U.S. and Foreign Release

DthDiff Armstrong Time-History Difference Software Utility · DRC-012-025

A standalone command-line-driven utility program, DthDiff is used to compare two Armstrong time-history format data files generated by the Armstrong Core Simulation Software.
U.S. and Foreign Release

Dynamic Onboard Ubiquitous Graphics (DOUG) Software Application · MSC-23586-1

The Dynamic Onboard Ubiquitous Graphics (DOUG) is a 3D rendering software package used for simulation and virtual reality display systems.
General Public Release

Earth Science Keyword And Variable Mapping Tool · MFS-33551-1

Uses several text processing and natural language processing concepts to map file level metadata to dataset science keywords.
Open Source

ECCO Interactive Solution Evaluator · NPO-52394-1

The Estimating the Circulation and Climate of the Ocean (ECCO) consortium estimates ocean circulation and its role in climate - combining state-of-the-art ocean circulation models with global ocean data sets. Data visualizations of ECCO help scientists better understand these models and provide comparisons with other data sets. The ECCO Interactive Solution Evaluator is a web application that allows users to compare data visualizations of ECCO data fields with those from other data sources side-by-side. The application includes a map interface to select a region of interest and a charting tool to plot data for comparisons.
Open Source

Elimination of Parameter Input Requirement for Elliptic Grid-Generation Methods in Engineering · ARC-14710-1

This software implements an enhanced method of elliptic grid generation.
U.S. Government Purpose Release

Elkhorn Slough Vegetation Imagery Assessment (ESVIA) · LAR-19012-1

This script conducts marsh vegetation health analyses using remotely sensed imagery sources. It analyzes vegetation change in a historical time-series using Landsat imagery, as well as current day vegetation productivity using Sentinel 2A imagery. Included in the script are operations such as image acquisition, image processing, and applications of vegetation indices with band combinations.
Open Source

Embedded Power Controller With Safety E-Stop and LED Indicators · NPO-52467-1

The software runs on an embedded system which is controlling the power to computers and sensors within a robot. The software monitors voltages and currents and enables or disables the voltage regulators and load switches to power the various loads. The software also has control over an e-stop and lights to indicate the estop is enabled or disabled. The software can control the brightness of high brightness LEDs.
General Public Release

Embedded GCC/gcov

NPO-52123-1

This software allows gcov lines of code coverage data to be extracted from software compiled with GCC and running on embedded systems, without requiring a file system, operating system, or even standard C libraries. This software provides the ability to select data output via serial port or memory dump or single output file, and provides other configuration options for adaptation to the user's specific environment. And it provides a complete, encapsulated, flexible, portable, and documented method.

Open Source

EMIT Science Data System

NPO-52219-1

This software suite facilitates the mapping of Earth surface mineralogy from remote imaging spectroscopy data, along with aggregation and interpretation of the use of these data in Earth System Models. Facilitates the analyses of the EMIT objectives: The net contribution of mineral dust to regional and global radiative forcing is to warm the atmosphere (positive forcing) and the impact of mineral dust on regional precipitation and radiative forcing will promote the expansion of dust source regions.

Open Source

Encoding and Decoding Library for the Bundle Protocol

LEW-20091-1

As part of the implementation of a high-rate DTN, it was necessary to implement a standards-compliant software library that is capable of parsing various versions of protocol headers. This library offers some benefit to other NASA centers (and possibly academia, industry) interested in implementing the same.

Open Source

Event-Based Visual-Inertial Odometry

NPO-52048-1

Estimating the position of a robot (localization) is an important precursor to enabling a robot to navigate autonomously. Traditional camera-based localization methods fail when the robot is moving fast (motion blur) or when the robot is in very dark or bright environments (over/undersaturated pixels). An event camera is a new type of imaging sensor that reports changes in pixel brightness per pixel independently and asynchronously with microsecond resolution and overcomes both of these problems. However, the asynchronous nature of the data is a challenge for traditional "synchronous" pipelines that receive a full image at a time. This software offers a couple of approaches to processing this asynchronous event stream to estimate the position of an event camera.

Open Source

EVRTH: Virtual Reality Earth Data Visualization Using Streaming Tiled GIBS Data

NPO-50576-1

This project offers users a real-time globe textured with the latest imagery received from NASA spacecraft. Users are able to manipulate the globe and access scientific data. Features include: real and up-to-date image access; accessing the latest daily imagery from NASAs Global Imagery Browse Services (GIBS); automatically fetching imagery at the correct level of detail based on globe scale and head distance; accessing imagery acquired at different times in the past; spinning the globe on two axes; positioning and scaling the globe; scrubbing and animating imagery over time; visualizing a 3D iso-surface of scientific data (e.g., gravity or water vapor), and visualizing scientific data that varies by altitude.

Open Source

Exploration Ground Data Systems (xGDS), Version 1

ARC-17174-1

The Exploration Ground Data System (xGDS) is information-sharing software to support human and robot field science operations. xGDS includes tools for planning, execution monitoring, asset position tracking, mapping, data visualization, documentation and annotation, data analysis, search, data filtering and clustering, telemetry processing, recording, and playback, bulk data import/export, mitigating impact of communications delays, panorama stitching, automated cross-linking of related data products, automated fault detection and data summarization, mobile device interfaces, video processing and playback, audio transcription, requirements traceability, performance and availability monitoring, and data backup and synchronization.

Open Source

Fast Linearized Coronagraph Optimizer (FALCO)   NPO-50715-1

The Fast Linearized Coronagraph Optimizer (FALCO) is a free toolbox of routines for coronagraphic focal plane wavefront correction. The goal of FALCO is to provide a modular, open-source framework for the simulation and/or testbed operation of several common types of coronagraphs. FALCO includes routines for pair-wise probing estimation of the complex electric field and Electric Field Conjugation (EFC) control. FALCO utilizes and builds upon PROPER, an established optical propagation library. The key innovation in FALCO is the rapid computation of the linearized response matrix for each deformable mirror (DM), which facilitates re-linearization after each control step for faster DM-integrated coronagraph design and wavefront correction experiments. FALCO is also available on Github as source code in MATLAB and Python.
Open Source

FAULT: Flood Analysis Utilizing Landsat and ArcMap Tools   LAR-19127-1

This automated script performs high-level flood analysis to relieve work load for end-users. It incorporates Landsat 8 Operational Land Imager (OLI) tiles and utilizes computer-learning techniques to generate accurate water extent maps. The script, referencing the Moderate Resolution Imaging Spectroradiometer (MODIS) land-water mask, isolates areas of flood-induced waters.
Open Source

Fep Extensible Proxy (FEP)   ARC-18117-1

FEP is a communication framework that provides abstract message conversion from multiple plug-in micro-services. FEP implements both a publish-subscribe and streaming data flow models to support real-time data visualization and validation as well as to facilitate post-processing and data analysis. Web interfaces are also provided through FEP to control, configure, and monitor the status of microservices and clients. The FEP provides flexibility and scalability through the ability to daisy chain multiple instances together or link via warehouse storage.
Open Source

Field Campaign eXplorer (FCX)   MFS-33977-1

Field Campaign eXplorer (FCX) is a cloud native web based 3D data visualization platform that can incorporate science data collected from instruments onboard aircraft, ground sensors, and satellites. The instrument data are displayed within an interactive map viewer along flight tracks. This advanced tool reduces the effort involved in discovering data. It's designed for event-based research, allows for seamless movement between data visualization, discovery, and acquisition, and enhances the user experience by improving the usability of heterogeneous data.
Open Source

File Exchange Interface (FEI), Version 5   NPO-47089-1

The File Exchange Interface (FEI) service offers secure file transaction, store, transport, and management services. The latest distribution (code name Komodo) is a complete redesign from its predecessors, incorporating the latest computing technologies and standards.
Open Source

File Plotting Tools   LAR-18314-1

This Excel plugin written in VB.net allows rapid post-processing of thermal analysis data from text files or from SINDA-formatted SAV files. The software can be adapted to other data formats as well.
Open Source

Data and Image Processing

FiSSH: Find Suitable Spawning Habitat

LAR-19474-1

This software utilizes Earth observation and citizen science data collected by the Grunion Greeters project to analyze ocean conditions and how they may relate to movement of the California grunion. The grunion is famous for beach spawning, and this tool will allow the user to get an idea of how large a spawning event is expected to be. This output is based on past spawning events and ocean conditions at those times. Moreover, interactive maps allow the user to visualize spatially what was happening in the surrounding coastal region during a particular time frame.

Open Source

Flood Event Monitoring From In-Situ and Satellite Data Using Deep Learning

NPO-51916-1

The automated flood monitoring can be performed using deep neural network models that are trained on historical, known flood events.

Open Source

FOAM: Forward Ocean Atmosphere Microwave Radiative Transfer Model

NPO-52286-1

FOAM is an open-source package developed using the Python programming language. The central solver module coordinates inputs from various individual modules to simulate observations of polarimetric brightness temperatures (forward mode) and the retrieve ocean state parameters (inverse mode). Among the retrievable quantities are ocean state parameters (SSS, SST, OVW), and nuisance ancillary parameters (atmospheric opacity, ionospheric TEC, and galactic background radiation intensity).

General Public Release

FRinGE: Fine Resolution InSAR using Generalized Eigenvectors

NPO-51454-1

FRInGE is an InSAR time-series analysis toolbox which implements the state-of-the-art methods to efficiently explore the full capability of modern SAR observations to produce ground displacement time-series at full resolution of SAR images at pixels dominated by Permanent Scatterers (PS) or Distributed Scatterers (DS). For DS pixels, FRInGE uses all possible interferometric pairs. Starting from a coregistered stack of SAR images, FRInGE evaluates the temporal distribution of the backscatter of SAR images at each pixel to identify statistically self-similar neighbors in a pre-defined window. The neighborhood map also helps to identify PS pixels. FRInGE forms a full covariance matrix of interferometric pairs for each DS pixel over its neighborhood. The wrapped phase time-series of the DS pixels is estimated as the phase of the generalized eigen vector corresponding to the largest eigen values of the covariance matrix. The phase series of the PS pixels are also extracted and together with the estimated phase series of DS pixels can be unwrapped through a minimum span tree network using two-dimensional available unwrappers. The estimated unwrapped phase time-series of DS and PS pixels inclusive of all components (e.g., ground displacement, geometrical residuals, propagation delay) can be post-processed through already available tools to estimate displacement time-series. FRInGE enables efficient generation of a full coherence matrix (all possible pairs) which can be used for Damage Proxy Mapping and change detection.

Open Source

Gas Fitting Spectral Analysis software

NPO-44194-1

A suite of FORTRAN 77 programs developed to analyze solar absorption spectra and thereby determine the conventrations of various gases in the Earth's atmosphere.

General Public Release

GeneLab Amplicon and Metagenomics Data Processing Pipelines

ARC-18677-1

This technology details each step in GeneLab's standard pipelines for processing Amplicon and Metagenomics sequence data. These processing protocols have been wrapped into Snakemake workflows that utilize Conda environments. Instructions for installing and implementing these Snakemake workflows are included along with example processed datasets.

Open Source

Geographic Applications for Transitioning Everglades Regions (GATER)   LAR-18943-1

This code provides an algorithm for cloud removal from Landsat scenes and runs a classification scheme that classifies mangrove extent within Everglades National Park.
Open Source

Geometry Manipulation Protocol (GMP) for Computational Fluid Dynamics (CFD) Applications, Version 1.0   ARC-15193-1

GMP serializes data types between XML and ANSI C data structures to support CFD applications. The library currently provides a description of geometric configurations, general moving-body scenarios (prescribed and/or 6-DOF), and control surface settings.
Open Source

GIANT: Goddard Image Analysis and Navigation Tool   GSC-18758-1

The Goddard Image Analysis and Navigation Tool (GIANT) is an API for performing various kinds of optical navigation (OpNav) through python scripts. It provides the necessary tools for the most common OpNav tasks, including geometric camera calibration, camera attitude estimation, target center finding, surface feature navigation, and more. It makes it easy to add new capabilities through the modular components it exposes. GIANT is mature and flight proven, having been used throughout the OSIRIS-REx mission in an independent verification and validation (IV&V) role with great success.
Open Source

GIBS: Machine Learning for Data Validation and Natural Event Detection   NPO-51089-1

NASA Global Imagery Browse Services (GIBS) provides a full-resolution image archive of over 70 million images and access to services for over 700 NASA Earth science data products covering every part of the world. Most imagery is available within 3-5 hours after satellite overpass and some products span almost 30 years. While the GIBS satellite data remains highly accessible, it remains largely underexploited and analyzed due to its scale. The development of algorithms to ensure the consistency of data is critical for near-real time (NRT) applications. For data validation, machine learning techniques validate images for missing data patterns and miscoloration. For natural event detection deep learning leverages the scale of GIBS imagery to learn state-of-the-art algorithms. Lastly, we implement an operational machine learning system to process new images and notify GIBS operators.
Open Source

Global Assimilative Ionosphere Model (GAIM)   NPO-40584-1

GAIM is used to estimate the three-dimensional electron density distribution of the Earth's ionosphere as a function of time. To achieve high accuracy for users, the software accepts a wide variety of ionospheric measurements as input and produces output either in real time or in post-processing. The software can also generate predictions of the electron density structure for several hours or days into the future.
U.S. and Foreign Release

GNEIMO Advanced Techniques for Constrained Internal Coordinate Molecular Dynamics   NPO-48712-1

The GNEIMO methods and algorithms build up on the Spatial Operator Algebra (SOA) multibody dynamics framework. The specific problems addressed in this work are velocity initialization techniques that are consistent with the CICMD equipartition principle, techniques for nulling momentum drift, analysis and solutions for the flying icecube effect, and performance of integration schemes.
U.S. Government Purpose Release

Data and Image Processing

GPS and Galileo Receiver for the ISS (GARISS)   LEW-20096-1

The GARISS waveform implements a GNSS receiver that performs position determination using the L5/E5a band of the GPS/Galileo satellite constellations. It was operated in a space environment on the SCaN testbed platform aboard the ISS. The waveform takes L-band input as one bit samples at 38 MHz and uses FPGA and CPU processing to implement acquisition, tracking, navigation message decoding, and position-velocity-time (PVT) generation. Signals from both constellations are combined when generating PVT, which often leads to better visibility than using a single constellation alone. The computed PVT and other receiver metrics are output as telemetry logs.

U.S. Government Purpose Release

GPS Occultation Analysis System (GOAS)   NPO-30596-1

GOAS processes atmospheric and ionospheric occultation data obtained from low-Earth-orbiting global positioning systems transmission receivers. The technology obtains input from a variety of receiver types and satellites and outputs full atmospheric and ionospheric retrievals.

U.S. and Foreign Release

gpsGUI: EFIS-style GPS and IMU Visualization, Logging and Log-Playback Software   NPO-52170-1

The gpsGUI software provides real-time Electronic Flight Instrument System (EFIS) style visualization of GPS and IMU data coming over a binary TCP/IP stream. gpsGUI can be used as a stand-alone graphical program, or various pieces can be incorporated into existing codebases using standard C++ interfaces. The software is written with an emphasis on thread-safe real-time operation and is designed for critical operations where corrupted or missed data would not be tolerable.

Open Source

Grand Canyon Regions of Drought Impact (GC-ReDI)   LAR-19017-1

Beginning in 1998, a drought in the Southwestern United States caused water levels in Lake Mead to fall to historic lows, uncovering thousands of acres of lakebed sediment along the shoreline. This software quantifies and visualizes the decreasing water levels and land cover changes in the lower Grand Canyon as it provides images, statistics, and graphs to understand these changes.

Open Source

Ground and Space Radar Volume Matching and Comparison Software   GSC-15738-1

This software enables easy comparison of ground- and space-based radar observations for validation purposes. It can be accessed at: http://opensource.gsfc.nasa.gov/projects/GSRadar/

Open Source

Growler   ARC-15690-1

Growler is a component-oriented framework aimed at distributed and collaborative visualization and computational steering. The technology's distributed object and event architecture is suitable for application to high-performance local area network (LAN) environments as well the Internet. Its features include strong integration with C++, selective distributed reference counting, and efficient well-typed event channels for local as well as remote event broadcast.

Open Source

Harvester of Remote Time-Stamped Data Products   NPO-52290-1

Leveraging an advanced cloud technology stack and ongoing multi-agency pilot efforts being spearheaded by NASA, this program provides a next generation data service infrastructure for a more digitally integrated ocean observing system in support of marine science and ecosystem-based management as well as furthering the use of remote sensing data in multidisciplinary science. This works with existing agency repositories to provide more harmonized access to satellite, in-situ, and model data that includes integrated data search, visualization, and analytics.

General Public Release

Data and Image Processing

Heat Analysis Manager (HAM)
a Thermal Desktop API-Based Heat Map Generation Software   GSC-18322-1

Heat Analysis Manager (HAM) is a Thermal Desktop (TD) based free multi-purpose tool developed to aid thermal engineers in analyzing thermal models which includes a heat map generation utility. HAM's heat map generator retains accuracy and fast processing speed by utilizing TD's application programming interface (API) and TD's built-in post-processor routine Qflow from Results. HAM's heat map output is presented in an easily customizable format in Excel, allowing users to create various custom visual heat maps.
U.S. Release Only

HELM: Hologram Examination for Life-like Motility   NPO-50634-1

These algorithms detect moving objects in holograms produced by a Digital Holographic Microscope (DHM), eliminating the majority of computation required for spatial reconstruction. A functional prototype that tracks these particles, analyzes their motion, and trains a machine learning classifier to distinguish lifelike motility from non-living organic or inorganic particles. There is sufficient speed (limited compute) and memory efficiency (limited memory footprint) to enable laptop-based, in-field, real-time processing of the streaming instrument output leading directly to proposals for an on-board DHM instrument.
Open Source

Hierarchical Data Format-Earth Observing System (HDF-EOS) to NetCDF Converter   GSC-15007-1

This C-language computer program accepts a set of scientific data/metadata from an Earth observing system (EOS) satellite and converts it from the format in which it was created and delivered into another format for data processing and exchange on Earth. The converter can be downloaded at: http://www.hdfeos.org/software/convert_hdfeos5.php
Open Source

Highly Scalable Matching Pursuit Signal Decomposition Algorithm (MPD)   ARC-16345-1

MPD is a powerful and effective iterative algorithm for signal decomposition and feature extraction. The technology decomposes any signal into linear combinations of its dictionary elements or "atoms."
Open Source

Hydrological Anomaly Engine (HAE)   LAR-19151-1

Using the cloud-based computing power of Google Earth Engine (GEE), the Hydrologic Anomaly Index (HAE) is capable of uploading and analyzing large amounts of Earth-observation climate data for the purposes of hydrologic analysis and monitoring. The end user can pull from and modify a library of scripts that are stored in Earth Engine, as well as upload and access data stored on a private data catalog.
Open Source

Hypatheon-Searchable Database Capability for Formalized Mathematics   LAR-18232-1

The Hypatheon suite of software tools provides a searchable database capability for the specialized domain of formalized mathematics. The technology is designed to be a companion to a specific tool called PVS, which supports an emerging type of advanced software verification intended for safety-critical systems. Hypatheon enhances PVS users' productivity by first indexing the mathematical theories rendered in the PVS specification language, then making the contents searchable by an interactive software tool.
Open Source

iMMOD: Interactive Model of Mosquito Distribution   LAR-19386-1

This software visualizes NASA Earth observation, citizen science, and public health data relevant to mosquito habitat suitability by season. This software also implements a seasonal model to predict habitat suitability for mosquitoes in Western Europe.
Open Source

In-situ Data Transformation and Ingestion Software Tool   NPO-52110-1

This generalized tool scans the in-situ netCDF data, selects the variables of interest together with associated coordinate data, and transforms/exports them into a columnar format (such as CSV file format) that can then easily be assimilated in other COVERAGE software tools and services. The tool also allows for and undertakes necessary standardization and reconciliation of data variable names consistent with CF-standard names as necessary for output. The generalized in-situ data transformation and ingestion tool is currently used to extract SPURS data (which is in the netCDF format) via the PODAAC api (https://podaac.jpl.nasa.gov/api/cmr/) and is loaded as python data frame and then exported to a CSV file.
Open Source

Inductive Monitoring System (IMS), Version 5:
System Health-Monitoring Software That Learns System Behavior from Data   ARC-15058-1A

IMS software utilizes techniques from the fields of model-based reasoning, machine learning, and data mining to build system monitoring knowledge bases from archived or simulated sensor data. The technology automatically analyzes the nominal system data to form general classes of expected system sensor values; these classes are used to build a monitoring knowledge base. When monitoring a system, IMS simply checks to see how well the incoming sensor data fit into the classes derived from the training data.
U.S. Government Purpose Release

Inference Kernel for Open Static (IKOS) Analyzers:
A High-Performance Static Analysis Engine to Build Automated Code
Analysis Tools for the Formal Verification of Critical Software Properties   ARC-16789-1

IKOS is a kernel for the construction of open-static analyzers based on Patrick Cousot and Radhia Cousot's theory of abstract interpretation, which states that computations can be abstracted and reduced to a generalized set of objects and still exhibit the same critical properties of the parent program. By reducing the set of objects through abstraction, IKOS is scalable to large complex computer programs and presents a sound approach to verification of such programs.
Open Source

InSAR Processor for ALOS-2 Multi-mode SAR Data and Ionospheric Correction   NPO-50616-1

This software implements the InSAR processing of ALOS-2 multi-mode SAR data and InSAR ionospheric correction based on the JPLs ISCE software. Like ISCE, the parameters are mainly handled by python programs, while image processing are mainly done by C or Fortran programs. When available, the basic modules of ISCE are called to do the processing. Therefore, the high processing efficiency of ISCE is inherited. ALOS-2 has many acquisition modes and different wavelengths. The unique feature of one app to support all can facilitate both the users and the maintenance of the software. The software continues to contribute to the numerous applications of the InSAR technology originally developed at JPL. In particular, the L-band ScanSAR-ScanSAR interferometry helps geophysicists to look at the large-scale and long-term deformation rates of many tectonically active areas. Many of these areas have dense vegetation and high reliefs, and C-band InSAR data does not work very well, while historical InSAR data usually have much smaller swath coverage. In addition, large-scale deformation of large earthquakes can also be measured with higher quality with L-band ScanSAR-ScanSAR interferometry. The support of multi-mode InSAR processing helps to get denser InSAR time series, which is helpful to look at the temporal evolution of the geophysical phenomena.
Open Source

InSAR Scientific Computing Environment version 2   NPO-48344-1

ISCE version 2 provides an integrated processing and visualization computing environment that allows users of interferometric synthetic aperture radar data from a variety of space-borne sensors to process from Level-0 to Level-4 products.
Open Source

Instrument Software Framework (ISF) Software Component Architectural Framework   NPO-49404-1

This software implements a very compact reusable software framework based on a software component architecture. It includes a code generator for producing C++ component base classes by implementing the domain-specific logic. It interconnects components, starts threads of execution, and sends invocations between components. It also provides the ability to serialize and deserialize invocations for multi-processor or memory space interactions. The user specifies interfaces, components and topologies in XML and uses the code generator to generate ports and components. The components are instantiated at runtime and interconnected. The framework and generated code are designed to use a portable, embeddable subset of C++.
Open Source

Interactive Data Analyzer and Reviewer for Machine Learning Systems   NPO-51147-1

The framework we provide is extremely lightweight and flexible to be expanded to adapt for almost any data related interactions in machine learning systems. The tools included in the framework not only aim to provide deeper insights into the system to machine learning experts, but also are key components for the goal to operationalize machine learning systems.
Open Source

Introduction of Collaborative State Estimation for Multiple Agents
into a Thermal/Visual-Inertial State Estimation Framework   NPO-52198-1

This software is a modification to the X framework that enables multi robot collaboration. It adds a communication class that enables the program to exchange messages with other agents in the network. It extends the MSCKF update class to work with collaborative MSCKF updates, by using the new Covariance Intersection class. It implements a multi SLAM class to handle collaborative SLAM updates. Moreover, to use the data coming from the other robots the program implements a place recognition class that creates the messages needed by the collaborative update methods. The software also includes a third-party code, that we slightly modified to perform photometric calibration of thermal images.
General Public Release

Ionospheric Slant TEC Analysis Using GPS-Based Estimation (IonoSTAGE)   NPO-43504-1

The Ionospheric Slant TEC Analysis Using GNSS-Based Estimation (IonoSTAGE) software package is a MATLAB platform for performing analysis and visualization of ionospheric slant total electron content (TEC) using measurements of global navigation satellite systems.
U.S. Government Purpose Release

iOS Barcode Scanner framework   NPO-52208-1

The framework is a high-performance barcode scanner implementation that scans any iOS supported barcode formats. It uses the system Vision framework to recognize a broad set of formats, from linear UPC barcodes to 2D patterns like QR codes. By using the native iOS Vision framework, the performance is hardware-accelerated and improves with each new generation of chips in iPhones and iPads.
Open Source

IPv6 Python Extension Module   LEW-19323-1

IPv6 Extension module for Python allows a user to enable IPv6 features not yet available for any Python versions. It allows for IPv6 flow labels to be enabled for a given Python socket object.
Open Source

Data and Image Processing

ISS Camera Geolocate   MFS-33558-1

This Python software library facilitates the geolocation of photographs and video frames from the International Space Station (ISS). It provides functions that take camera and pointing information along with publicly available ISS position information to geolocate every pixel of the photograph in latitude and longitude. The library enables geospatial analysis of astronaut photography from Earth, including pictures of clouds, lightning, coastlines, city lights, etc.
Open Source

ISS Explorer   MSC-26452-1

The ISS Explorer is an interactive application which allows the user to view a 3D model of the International Space Station, rotate it, zoom into it, and select different parts and pieces. Descriptive information about each piece can be viewed. Parts can be turned on or off, labels can be turned on or off, and parts can be made transparent to allow for additional viewing.
General Public Release

Java Pathfinder Core System (JPF-Core)   ARC-17487-1

JPF-Core, is a model checker for Java bytecode. The technology takes a binary Java program and executes it in a user-configurable way to detect defects such as deadlocks and unhandled exceptions, providing significantly higher confidence in correct program behavior than conventional testing.
Open Source

Java Program to Promote an Open-Source E Standard for Mass Properties Engineering   LAR-17635-1

This open-source Java software helps develop electronic standards (E-Standards) for mass properties engineering. An E-Standard is a highly descriptive dataset that includes standardizing functions for data manipulation, interrogation, and formatting. With this tool, any number of users can interface with the proposed E-Standard datasets and still seamlessly utilize their own software methods.
Open Source

Java-Based Software Tool for Dynamic Aerospace Vehicle Exchange Markup Files   LAR-17460-1

An update to software originally named DAVEtools 0.5, this software-based technology is used for manipulating standard Dynamic Aerospace Vehicle Exchange Markup Language (DAVE-ML) models. The improved technology embeds the necessary initialization data into a data structure to keep the MATLAB workspace uncluttered and creates Simulink models from a generated MATLAB script.
Open Source

Javascript Implementation for Rendering 3D Tiles in Three.js   NPO-51486-1

This program implements a renderer for the open-source 3D Tiles format in the web for three.js which is being used to represent Mars terrain for operations tools.
Open Source

Javascript Implementation of CAHVORE Camera and Image Transformation Utilities   NPO-52459-1

This is a series of packages for visualizing and rendering images and frustum shapes based on CAHVORE camera models as well as loading SGI and PGM images in three.js.
General Public Release

JPEG Image Compression Software with improved Safety   NPO-52154-1

This program performs lossy compression and decompression of images with increased safety compared to previous software.
Open Source

Data and Image Processing

JWST Backgrounds
GSC-17919-1

For use in proposal planning, this simple Python program predicts the levels of background emission that will appear in JWST observations. It accesses a precompiled background cache that is already hosted online for JWST users.
Open Source

Kawin: A Kampmann-Wagner Numerical (KWN) Phase Precipitation and Coarsening Modeling Code
NPO-52029-1

Kawin is an open-source Python library for simulating precipitation behavior in alloys using the Kampmann-Wagner Numerical (KWN) model coupled with Calphad-based thermodynamics. The Calphad coupling is done through the open-source PyCalphad software, which allows for the usage of .TDB databases for thermodynamic and mobility parameters. However, this package also allows the user the define their own thermodynamic calculations. Methods for creating surrogate models on top of the thermodynamic calculations are also introduced in this package, which can greatly reduce computational time. The usage of surrogate models expands the applications of the KWN model by allowing for quicker exploration and/or calibration of model parameters and incorporation into larger scale simulations.
Open Source

Kepler Robovetter
ARC-17981-1

The Kepler mission observed approximately 200,000 stars for four years and identified over 34,000 transit-like events. The Kepler Robovetter translates the logic used to discriminate between "likely planet candidates" and "false positives" and automates the evaluation of large Kepler data sets that are available at the public archive. SETI Institutes had primary role in authoring and producing the Kepler Robovetter under Cooperative Agreement number NNX13AD01A.
Open Source

Kepler Science Data Processing Pipeline
ARC-16332-1A

The Data Processing Pipeline is a central element of the Kepler Ground Data System. It analyzes stellar photometric data from the Kepler spacecraft and reports search results for planets within the Kepler photometric dataset. The pipeline performs pixel-level calibration, photometric analysis, systematic error correction, transiting planet detection, modeling and diagnostic testing of potential transit signatures, attitude determination, stellar target management, and monitoring of instrument health and performance.
Open Source

Kepler/K2 Cadence Events (K2CE)
ARC-18415-1

K2CE is a data visualization/manipulation Python application which runs on publicly available data from the NASA Kepler, K2, and TESS missions to produce annotated light curve plots and, optionally, filtered versions of the input data files.
Open Source

KeplerPORTs (Kepler Planet Occurrence Rate Tools)
ARC-17979-1

The Kepler Plotting Program was developed as an aid to understanding the publicly available data files that have been released by the Kepler project. This tool allows end users to reproduce plots utilized in project documentation, facilitates the user's scientific understanding, and promotes the utilization of the Kepler science data products. SETI Institutes had primary role in authoring and producing the KeplerPORTs under Cooperative Agreement number NNX13AD01A.
Open Source

**Knowledge Acquisition and Synthesis
for Information Model Driven Architectures (CornerStone)**   **NPO-49832-1**

This framework uses established requirements and best-practices for long-term digital repositories to create an information model for a set of one or several related domains in a community. The information model is subsequently used to configure the functional components of an information model-driven architecture. The result is an information system that meets the information requirements levied on the system by the community.
Open Source

Kodiak: A Software Library for Verifying Nonlinear Arithmetic Statements   **LAR-18268-1**

Kodiak is a software implementation of an algorithm for verifying expressions involving nonlinear real arithmetic. It includes an optimizer for nonlinear real functions, a solver for nonlinear inequalities, and an application programming interface (API) for integrating other software verification tools.
Open Source

Kodiak's Boolean Checker Software Module   **LAR-19222-1**

Kodiak is a software implementation of a branch-and-bound algorithm for rigorous approximations of expressions involving nonlinear real arithmetic. It includes an optimizer for nonlinear real functions, a solver for nonlinear inequalities, and an application programming interface to integrate directly with other software verification tools. Kodiak's Boolean Checker Software Module is an implementation of a general mixed Boolean/real-expression checker that is integrated into Kodiak's global optimization solver.
Open Source

Kontest: A tool for Scenario-Based Software Testing   **NPO-50601-1**

Kontest is a new tool for automated software testing. It provides convenient syntax allowing a developer to write test scenarios that can describe broad classes of tests. Scenarios can be as simple as an ordinary unit test with added parameters that can take a range of values, but can also include nondeterministic sequences of actions with temporal or other constraints (the notation is still under development). Given a scenario, Kontest automatically refines it into thousands of concrete tests, using dynamic program analysis to find realizations of the scenario that will trigger different execution paths through the program under test.
Open Source

LAGER: Light-weight Accumulator Gathering Efficiently in Real-time   **MSC-26455-1**

LAGER is a reliable software logging system designed to allow multiple logging sources to log to multiple end users.
Open Source

LAMP: Large-scale Autonomous Mapping and Positioning   **NPO-51451-1**

Large-scale Autonomous Mapping and Positioning (LAMP) is a complete package for Simultaneous Localization and Mapping (SLAM) that is adaptable to a large range of robotic systems for exploration of unknown indoor and underground environments. LAMP will process sensor inputs, such as lidar scans, IMU, and odometry estimates, and produce an accurate global location, global map, and global pose-graph. This capability is also extended to multi-robots system, through a centralized fusion of pose-graphs with low data-rate communications of sparse pose-graph information. The lidar-odometry front-end can be lever-aged as part of LAMP or separately to produce an accurate odometry estimate by processing lidar scans along with IMU and other less accurate odometry estimates. LAMP is designed to be a modular architecture and can have modules adapted to include different information in the global pose-graph to leverage what sensing information is available for maximum localization accuracy. LAMP runs in the ROS ecosystem and expects sensor inputs as ROS messages and outputs information as ROS messages.
Open Source

Land Cover Change Detection Tool (LCD) LAR-19235-1

This is a script within Google Earth Engine (GEE) that is able to analyze study areas for significant vegetation change and incorporates ancillary datasets that allow the user to evaluate possible causation of this loss or gain. The Normalized Difference Vegetation Index (NDVI) for the study time period is calculated and then compared to the maximum and minimum NDVI from a baseline range of years in order to calculate Relative Greenness (RG). The change in RG from the previous year is found, and this allows the user to identify abrupt change in vegetation. On a date input by the user, the map viewer displays the RG, the change in RG, the percent change in RG, and the NBR, along with the Cropland layer from that year and NAIP imagery taken closest in time to the requested display date.
Open Source

Land Surface Temperature MODIS Visualization (LaSTMoV) LAR-18877-1

Extreme heat causes and exacerbates a number of health problems leading to hospitalization and death in some cases. The problem of severe heat is notably felt in Maricopa County, Arizona, where the socially disadvantaged and physically vulnerable are especially susceptible to the effects of extreme heat. Several organizations, including the Arizona Department of Health Services and the Phoenix Heat Relief Network, are working to create more effectively placed cooling centers and heat warning systems to aid those with the highest risk of exposure. This project created a Python tool using Aqua Moderate Resolution Imaging Spectrometer (MODIS) land surface temperature parameters to generate heat maps that reference demographics data on extremely hot days.
Open Source

Land Use Classification Tool (LUCT) LAR-19197-1

Uses the Google Earth Engine Code interface to create a classification of land use on the United States Virgin Islands (USVI) under six classes: water, low density residential, high-density residential, forest/shrub, agriculture and barren. The final product is at a 30 meter spatial scale.
Open Source

LithoSphere: A tiled, 3D Planetary Web-Based GIS Library NPO-52010-1

Lithosphere is a web-based 3D visualization tool capable of rendering raster and vector open-source planetary datasets. The software supports viewing any spherical planetary body (Earth, Mars, Europa, etc.) in three dimensions including both raster and vector datasets. It is a standalone web-based viewer that supports open-source formats like Tile Map Service (TMS), 3D tiles, meshes, and GeoJSON formats. It supports mapping 2D vectors to the 3D surface or rendering vectors using their own 3D coordinates. This software does not rely on commercial data providers.
Open Source

Lossless Hyper-/Multi-Spectral Data Compression Software GSC-15992-1

This software performs lossless hyper-spectral and multi-spectral data compression. It can be downloaded at: http://opensource.gsfc.nasa.gov/projects/LHD/
Open Source

lowfssim: Integrated Model of the LOWFS System on the Roman Coronagraph Instrument NPO-52083-1

lowfssim is the official model of the LOWFS/C system on the Roman Coronagraph Instrument. It is a model of the system including sensor and actuators. The model is used to form CBEs on mission requirements and validate testbed experiments. Ad-hoc questions about the system and more generally integrated modeling inquiries are answered using the model.
Open Source

LSTM-based Anomaly Detection System for Spacecraft Telemetry NPO-50838-1

This program detects anomalies in spacecraft telemetry using fully-automated machine learning-based approaches.
Open Source

Machine Learning Test and Evaluation for Learning with Less Labels (LwLL) NPO-51578-1

The Learning with Less Labels (LwLL) machine learning test and evaluation toolkit automatically generates an environment to test, graph, and collect metrics about machine learning software. The purpose is to quantitatively assess a performer (institution) and their machine learning code to evaluate whether they are using orders of magnitude less data for machine learning while not sacrificing accuracy.
Open Source

Mariana: Text Classification System ARC-16070-1

Mariana is an algorithm that efficiently optimizes the hyperparameters for support vector machines for regression and classification. It currently uses simulated annealing for optimization but can be extended to use a variety of stochastic optimization techniques, including Markov Chain Monte Carlo, Sequential Monte Carlo, and genetic algorithms.
Open Source

Mars Target Encyclopedia NPO-50498-1

The Mars Target Encyclopedia (MTE) contains compositional information about Mars surface targets. The information was automatically extracted from scientific publications. Users can search for all targets that contain an element (e.g., calcium) or mineral (e.g., hematite) and see a map view of their spatial locations. They can also look up information about a specific target of interest (e.g., Dillinger) to browse previous findings about its composition. All information in the MTE is linked to the source publication from which it was extracted, so users can easily browse the full context in the original document.
Open Source

MaRSHE: Marsh Remote Sensing Health Evaluation LAR-19211-1

This tool includes three general types of scripts: one for extracting average NDVI values from Landsat 5 and Landsat 8 image collections for specified reference dates (typically a period of 10–15 years), another for performing unsupervised classifications to determine marsh extent for a variety of years, and a third for statistics regarding the maps generated in the classification scripts.
Open Source

MATLAB-Code V Toolkit GSC-15140-1

This toolkit is a set of MATLAB scripts and functions that enable rapid transfer of optical system and performance data from Code V optical software into the MATLAB environment. Typical applications include: extracting prescription data into MATLAB to confirm consistency of various delivered models, perturbing the models and performing various analyses such as ray tracing or generation of point-spread functions in support of integrated modeling activities, and enabling a MATLAB-driven optical model for integrated system-level modeling of wavefront sensing and control. The toolkit can be downloaded at:
http://opensource.gsfc.nasa.gov/projects/Matlab_Code_V/index.php
Open Source

MATLAB-Oslo Toolkit
GSC-15138-1

This toolkit is a set of MATLAB scripts and functions that enable rapid transfer of optical system and performance data from Oslo optical software into the MATLAB environment. Typical applications include: extracting prescription data into MATLAB to confirm consistency of various delivered models; perturbing the models and performing various analyses in support of integrated modeling activities; and enabling a MATLAB-driven optical model for integrated system-level modeling of wavefront sensing and control. The toolkit can be downloaded at http://opensource.gsfc.nasa.gov/projects/Matlab/index.php
Open Source

MATLAB-Zemax Toolkit
GSC-15151-1

The MATLAB-Zemax toolkit is a set of MATLAB scripts and functions that enable rapid transfer of optical system and performance data from Zemax optical software into the MATLAB environment. Typical applications include: extracting prescription data into MATLAB to confirm consistency of various delivered models; perturbing the models and performing various analyses in support of integrated modeling activities; and enabling a MATLAB-driven optical model for integrated system-level modeling of wavefront sensing and control. The toolkit can be downloaded at: http://opensource.gsfc.nasa.gov/projects/Matlab_Zemax/index.php
Open Source

Methane Source Finder Web Application (user-interface and server)
NPO-51093-1

We will combine our collective expertise in atmospheric chemistry, carbon cycle science, spectroscopy, data assimilation, machine learning software engineering, and science systems engineering to develop CEDAS to meet the following objectives: 1. Detect and characterize localized methane and CO_2 anomalies that manifest in an intermittent and stochastic but with net high magnitude fluxes. 2. Apply machine learning techniques to provide more autonomous and lower latency source detection, attribution and process understanding. 3. Automate and optimize methane and CO_2 analysis workflows to reduce data product latency and improve on-demand services including quality control and validation. 4. Develop a regional-scale scale analysis framework that can assimilate surface and satellite atmospheric observations and high-resolution weather reanalysis products for any region globally. 5. Demonstrate a common data system that facilitates anomaly notification/response, data search, discovery, fusion and on-demand analytics.
Open Source

Methods for Detecting Novel Geology in Mastcam Multispectral Observations
NPO-51508-1

This novelty detection is implemented in Python using the Keras and TensorFlow machine learning libraries. A dataset of Mastcam multispectral images and selected known examples of novel observations to evaluate the novelty detection performance is included. This program trains autoencoders using a loss function that explicitly captures spatial properties in the input (e.g., structural similarity index). It also characterizes the influence of the autoencoder loss function on the type of novel features that can be detected.
Open Source

MiniWall: Data Visualization Web Browser Application
ARC-18270-1

This is a browser-based software used to analyze and understand large and small computationally and experimentally generated data sets. The MiniWall software presents a matrix view of plots and other visualization images and provides a responsive and productive way to investigate the data from it. Because it's browser based, it runs on any computer or device that can display a web page. It can also be used remotely and securely by using web server software.
Open Source

Data and Image Processing

MISR Geometric Calibration Software
NPO-20999-1

This software is part of NASA's Earth Science Enterprise (Code Y). MISR is part of the EOS Terra mission. Terra is one of several EOS missions. EOS is the centerpiece of Code Y work. A more thorough description of this software can be found in the MISR Science Data Processing Functional Design Document (D-12941A).
General Public Release

Model-Driven, Science Data Product Registration Service
NPO-47832-1

The Planetary Data System (PDS) overhauled the PDS data architecture (e.g., data model, data structures, data dictionary, etc.) and deployed a software system (online data services, distributed data catalog, etc.) that fully embraces the PDS federation as an integrated system while leveraging modern information technology. The CCSDS Reference Model in turn relies heavily on the Electronic Business using eXtensible Markup Language (ebXML) standards for registry services and the registry information model, managed by the OASIS consortium.
Open Source

Modified Snowmelt Runoff Model for Forecasting Water Availability in Chile
LAR-18602-1

Modified Snowmelt Runoff Model for Forecasting Water Availability in Chile (M-SRM) models daily stream flow of snowmelt runoff as a function of temperature, elevation, snow-covered area, precipitation rate, and experimentally determined coefficients. Using MODIS and TRMM data, the software provides tools for synthesizing daily fractional snow cover and daily precipitation measurements. M-SRM provides daily stream flow estimates for three months beyond the start of the growing season.
Open Source

Move Away Superfluous Clouds (MASC)
LAR-19032-1

This source code removes clouds, cloud shadow, water, and snow pixels from Landsat scenes using the cloud mask layer that is provided with Landsat data.
Open Source

MPS Editor
NPO-47237-1

The MPS editor is written in Java using the Eclipse Rich Client Platform. The software allows users to start in the early development phase and continue on through the operations phases. It is currently built with four perspectives: the activity dictionary perspective, the project adaptation perspective, the sequence building perspective, and the sequence modeling perspective.
U.S. Government Purpose Release

mrcal: A Toolkit to Precisely Solve Calibration and Structure-From-Motion Problems
NPO-51600-1

Mrcal contains a C library for 3D geometry operations and lens projection/unprojection operations, supporting many camera models, including JPL-specific versions that no other programs support. Functions report the values and the gradients related to input variables. The optimization solves for the geometry of the world, cameras, lens parameters and/or for the shape of the object being observed. The Python library to read/write camera models from/to disk, and to manipulate them. Additional tools allow the user to quickly process their data. https://github.com/dkogan/mrcal
Open Source

MRSDS: Methane Research Science Data System
NPO-52074-1

This Multi-scale Methane Analytic Framework (M2AF) addresses one of the more persistent challenges in Earth System Science: understanding the causes for the changing atmospheric growth rate of methane. M2AF extends existing methane analysis systems beyond experimental states, reduces latency, and reduces the cost of methane data This program brings together multiple observational data sets, models, and analysis methods to estimate methane fluxes across overlapping spatial scales in order to disentangle confounding processes.
Open Source

Data and Image Processing

Multidecadal Satellite Record of Water Vapor, Temperature, Clouds and Atmospheric Moist Processes
NPO-52383-1

The MEaSUREs projects are focused on product generation, availability, and utility of Earth System Data Records (ESDRs). An ESDR is defined as a unified and coherent set of observations of a given parameter of the Earth system, which is optimized to meet specific requirements in addressing science questions. These data records are critical to understanding Earth System processes and in assessing variability, long-term trends, and change in the Earth System as well as providing means for input and validation to modeling efforts. Emphasis is placed on linking together multiple satellites into a constellation, developing the means of utilizing a multitude of data sources to form coherent time series, and facilitating the use of extensive data in the development of comprehensive Earth system models.
Open Source

Multi-mission Algorithm and Analytics Platform (MAAP)
NPO-50982-1

The purpose of the joint NASA/ESA Multi-Mission Algorithm and Analysis Platform (MAAP) is to maximize the use of Earth observational data in an open and collaborative environment. Initially, the project will use data from the BIOMASS, GEDI, and NISAR missions, which represent a highly complementary set of measurements to determine Earths above ground woody biomass with the goal of functioning as a general purpose platform for analyzing Earth science data. MAAP will enable for the first time efficient and tailorable comparisons, cross calibration, and fusion of data from these missions for a broad community of scientists and other users.
Open Source

Multi-Mission Geographic Information System: A Spatial Data Infrastructure for Planetary Missions
NPO-50389-1

This multi-mission geographic information system (MMGIS) creates a planetary mission spatial data infrastructure (SDI) with geospatial data standards, tools, and interfaces for accessing science instrument data on a map in near-real time. Automated the localization/georeferenced science data products and a unified mapping interface to visualization and querying spatial and quantitative data from multiple sources is included.
Open Source

Multi-Scale Three-Dimensional Variational Data Assimilation System for Coastal Ocean Prediction
NPO-47768-1

This multi-scale three-dimensional variational data assimilation scheme (MS-3DVAR) software is for high resolution coastal ocean models, assimilating simultaneously and effectively sparse vertical profiles and high-resolution surface measurements, and constrains forward-model biases. In this system, the cost function is decomposed into two separate units for the large and small scale components, respectively.
Open Source

Multivariate Time Series Search Capability to Identify Complex Patterns in Large Datasets
ARC-16452-1

This software allows the user to specify a time series over multiple variables to search massive datasets. The tool returns a list of events (a time series) from the database that spans multiple variables and within a threshold distance from the query. Experiments on numerous real aviation datasets demonstrated the algorithm's capability to uncover potential aircraft safety events (as validated by multiple aviation safety experts and airlines).
Open Source

MYSTRAN
GSC-17173-1

MYSTRAN is a finite element analysis (FEA) processor that takes NASTRAN data decks as input and processes them to generate results files.
Open Source

Data and Image Processing

NASA App
ARC-16325-1A

The NASA App delivers near-real-time NASA content to phones and tablets. The technology features missions, images, videos, tweets, a live stream of NASA TV, and news topics. The app can be downloaded at: http://www.nasa.gov/centers/ames/iphone

General Public Release

NASA Assurance Standards Workflow Assistant (ANASWA)
NPO-51913-1

The purpose of this software is to show, by means of an operational (albeit incomplete) prototype, the feasibility of software that would help missions develop a Safety and Mission Assurance Plan that complies with NASA standards (and others, if relevant, e.g., OSHA). As a side-effect of its creation, it brings to bear considerations of clarity, consistency and completeness upon the NASA documentation from which it draws its information.

Open Source

NASA PDS: NSSDCA Delivery Software
NPO-51496-1

NSSDCA Delivery Tool is responsible for the generation of two information packages for ensuring the integrity of the archive with respect to the NSSDCA and Open Archival Information System (OAIS) reference model. The packages are intended to be generated by Discipline Node staff any time new data is released into the PDS, but can also be executed retroactively for data that has not previously been submitted. Once generated, the Archive Information Package and Submission package are both validated by the PDS Engineering Node, and the Submission package is delivered to the NSSDCA. The two packages are the Archive Information Package and Submission Information Package.

Open Source

NASA Vision Workbench (VW), Version 3
ARC-15761-1A

Vision Workbench (VW) is a modular, extensible computer vision framework that supports a range of tasks, including automated science and engineering analysis, large satellite image processing, and 2D/3D environment reconstruction. The framework provides a rapid C++ development environment, as well as a flexible, multi-platform system to deploy computer vision applications. The module interface allows new capabilities to be rapidly integrated, and the dataflow architecture allows image-processing pipelines to be quickly developed and reconfigured.

Open Source

NASAaccess: Downloading and Reformatting Tool for NASA Earth Observation Data Products
GSC-18095-1

NASAaccess is a software application in the form of a R package and a web application. NASAaccess software can generate gridded ASCILL tables of climate (CIMP5) and weather data (GPM, TRMM, GLDAS) needed to drive various hydrological models (e.g., SWAT, VIC, RHESSys, etc.). The current version processes remote sensing data products (i.e., TRIMM, IMERG, and GLDAS) and creates weather input definition tables as well as stations data files in a format readable by earth science model. The package can be expanded to include other remote sensing products needed in future.

Open Source

NeBula: Networked Belief-Aware Perceptual Autonomy
NPO-52184-1

This software leverages a lot of open-source modules and software from the ROS (Robot Operating System) community and aims at gluing them together to build an overall autonomy stack for specific robot platforms. This overall software allows the robot to navigate between simple obstacles.

Open Source

Neural Network Emulation of VSWIR Atmospheric Radiative Transfer Models   NPO-50675-1

This program uses a pure spectroscopic approach to improve atmospheric inversion accuracy to minimize regional biases in global-scale investigations. This software offers swift execution of line-by-line Radiative Transfer (RT) models. Neural Network (NN) emulation can replicate the results of the MODTRAN 6.0 line-by-line A-band model to high accuracy and a five order of magnitude improvement in execution time. This provides a significant improvement in the accuracy and modeling power of VSWIR atmospheric correction.
Open Source

New Statistical Trajectory Estimation Program (NewSTEP)   LAR-19345-1

NewSTEP is a MATLAB-based iterative extended Kalman filter/smoother designed for solving trajectory reconstruction problems. The filter blends various measurement data to obtain the best estimate of the vehicle trajectory and aerodynamics. The equations of motion include the effects of several systematic error sources, whose values may also be estimated by the filter. The measurement models include Inertial Measurement Units, Global Positioning System, ground-based tracking radar, magnetometers, air data sensors, and meteorological measurements.
U.S. and Foreign Release

NFER: A Notation and System for Inferring Event Stream Abstractions   NPO-50406-1

NFER provides a rule-based notation and system for labeling event streams. The result of a labeling is a set of intervals: named sections of the event stream, each including a start time, and end time, and a map holding data selected from the events and sub-intervals making up the interval. Typically intervals are built on top of intervals, forming a hierarchy of abstractions. The result can be visualized, and can generally help engineers to better comprehend the structure of an event stream. The NFER system is implemented as an internal Scala DSL. Each interval-generating rule spawns an actor, that subscribes to events and/or sub-intervals, and publishes new intervals in the publish/subscribe architecture. The software can process events online, as they come down to ground from the spacecraft, as well as events produced at an earlier point in time, and stored in a database.
Open Source

NISAR Science Notebooks   NPO-51956-1

The NISAR Science Team has been developing algorithms described in the Algorithm Theoretical Basis Documents (ATBD) and implemented as Jupyter Notebooks. The Jupyter Notebooks were tested with representative NISAR data (e.g., UAVSAR-NISAR simulated data or Sentinel-1 data). Notebooks will be shared with the JPL NISAR Project.
Open Source

nu-Anomica (Previously Sparse One-Class Support Vector Machines (SOC-SVMs))   ARC-16346-1

nu-Anomica is an anomaly detector that can run faster than traditional OC-SVMs. The technology can handle large training sets and works with a well-defined target function. The program utilizes the OSU SVMs code (which is a MATLAB version of Lib-SVMs) as the baseline.
Open Source

OCO-2 Level 2 Retrieval Algorithm   NPO-49044-1

The primary purpose of the Level 2 retrieval software is to derive estimates of the column-averaged atmospheric CO_2 dry air mole fraction, XCO_2 (defined as the ratio of the column abundances of CO_2 and the column abundance of dry air), and other Level 2 data products from the spectra returned by the OCO-2 mission.
Open Source

ODL to XML Converter
GSC-15013-1

This command-line Java-based utility converts an ODL Hierarchical Data Format-Earth Observing Satellite (HDFEOS) metadata file to an HDFEOS XML file. The tool utilizes an all-Java ODL library that includes a syntax and grammar parser. The software can be downloaded at: http://opensource.gsfc.nasa.gov/projects/ODL_XML/index.php

Open Source

OIIP Data Viewer
NPO-50897-1

The Oceanographic In-Situ Interoperability Project integrates diverse in-situ datasets with related remote sensing products from NASA. The data viewer is the web application through which users can explore and interrogate the range of data available within this project. The application reveals the multi-dimensional facets of in-situ data at full data resolution. It provides a coherent search interface that accommodates the heterogeneity of in-situ products and sophisticated charting options that provide granular control over data displays.

Open Source

OMG Tool Infrastructure Working Group Workflow Automation and Modeling Tool Extensions
NPO-49757-1

The Jet Propulsion Laboratory led the production of official machine-readable artifacts for several cycles of the official task forces that develop the Unified Modeling Language (UML) and Systems Modeling Language (SysML) specification standards published by the Object Management Group (OMG). This technology focuses on capturing JPL's experience into extensions of various tools for replacing labor-intensive manual workflows typically involved in standards development at the OMG with automated workflow processes.

U.S. Government Purpose Release

Onboard Coaddition of Multiple Image Frames to Increase Signal to Noise Ratio and Facilitate Target Tracking
NPO-50487-1

This software is part of the agile science framework and the Near Earth Asteroid Scout (NEAScout) CubeSat flight software. The purpose of this software is to automatically increase the signal to noise ratio of image data, acquired by a spacecraft, without the need for data downlink. This is accomplished by taking multiple images, in rapid succession, and merging the data between these frames together, while accounting for instrument jitter and other intermediate effects. Increasing the signal to noise ratio also eliminates single image artifacts, like cosmic rays, which results in a higher fidelity product for subsequent processing. This process creates a single data product, representing the data from multiple image frames. This product can then be downlinked with a fraction of the bandwidth of the original, or further processed onboard the spacecraft.

Open Source

OnSight: Multi-Platform Terrain Visualization for Science, Engineering, and Public Outreach
NPO-50830-1

OnSight allow scientists and engineers to immerse themselves within a reconstruction of the terrain around the Curiosity rover. Using an immersive display, OnSight can render a reconstruction of Mars at full scale, and allow users to navigate the model by simply walking and looking around. OnSight was developed for the context of Mars exploration, but the system provides general capability for visualization and virtual presence in a remote environment.

U.S. Government Purpose Release

Data and Image Processing

Open CAESAR Server NPO-51247-1

Computer Aided Engineering for Systems Architecture (CASER) is a software platform that supports the transformation of systems engineering (SE) into a rigorous, integrated, and model-centric practice. It supports the definition of a rigorous, multi-disciplinary, and tool-neutral methodology for SE. It adopts the semantic web approach of specifying knowledge with ontologies to specify a system architecture description. The Open CAESAR Server developed in the Integrated Model-Centric Engineering (IMCE) initiative is part of a foundation and ecosystem for experimenting and tackling an increasingly complex set of challenges in the modern practice. It uses specialized engineering modeling tools. The functionality related to CAESAR integration workflows addresses directed acyclic graphs of processes operating on SE information.
Open Source

Open-Sourcing the Odysea Mission Simulator NPO-52472-1

This software simulates scientific measurements for Odysea, a proposed JPL spaceborne mission that measures ocean winds and currents. These simulated measurements include the errors associated with the instrument, but not specific details of how these errors are produced or any proprietary/controlled/ITAR design details.
General Public Release

OpenSCRUB NPO-50805-1

OpenSCRUB is an orchestration framework that is used to run and aggregate results from multiple static code analysis tools. OpenSCRUB is customizable to the needs of the project, allowing teams to tailor execution to meet their needs. OpenSCRUB also allows users to export static analysis results to Collaborator in order to perform peer reviews. The end goal of OpenSCRUB is to incorporate static analysis results into peer reviews to ensure that all the static analysis findings are addressed and discussed. The internal OpenSCRUB GUI can also be used by developers strictly as a viewer for browsing static analysis results from multiple sources.
Open Source

OPERA SDS (Observational Products for End-Users from Remote Sensing Analysis Science Data System) Software NPO-52101-1

OPERA software is designed to better monitor and forecast the state of the following Earth systems - surface water extent, land surface disturbance and displacement.
Open Source

Orion Optical Navigation Image Processing Software (OpNAV) MSC-26456-1

Key components of this software are processing images and producing navigation measurements. The software is as an application within the Core Flight Software of the Orion camera controller module.
U.S. Release Only

Palm Oil Plantation Predictor (POPP) LAR-18862-1

This software is designed to simplify the process of manipulating and converting both satellite data and ancillary data so that they can be used within the Maxent modeling software. The tool converts vector or raster data into the correct format and processes all files in order to have identical rows, columns, and resolution.
Open Source

PDS Archive Inventory and Monitoring System (AIMS) NPO-51132-1

For PDS Cartography and Imaging Science Node, it is critical to know what data is available, where it is located in the system, data integrity must be maintained, and the data must be available through the Atlas. This software tool provides a more detailed picture of the data, is runnable via the command-line (and also a web browser if possible but not required) and has a documented API for the CLI (command-line interface).
Open Source

Data and Image Processing

PDS DOI Service
NPO-51572-1

The PDS Data Object Identifier (DOI) service is responsible for the management of DOIs for the Planetary Data System. Currently, the PDS is attempting to acquire DOIs for any new data sets entering the system. This software will help automate the management of those DOIs.
Open Source

PDS Transform Tool
NPO-51240-1

The PDS Transform Tool project contains software for transforming PDS3 and PDS4 product labels and product data into common formats more applicable for user applications and scientific research.
Open Source

PDS4 Java Library and Tools
NPO-51130-1

Software for accessing PDS4 data objects including selected transformations to common formats. This software is packaged as a Java library with an example driver program and is called by the Validate Tool to assist in validation and by the Transform Tool to transform PDS4 products into common formats. The PDS4 Tools software was developed using Java and will run on any platform with a supported Java Runtime Environment (JRE).
Open Source

PDSC: Planetary Data System Coincidences
NPO-50785-1

The PDSC library allows for quickly querying coincident observations by constructing a set of special databases and index structures during the ingestion process. The first database constructed is simply a SQL version of the PDS cumulative index. The second set of index structures holds geometric information used for coincidence queries
Open Source

Perilog, Version 3.0
ARC-15310-1

Perilog software capabilities include keyword-in-context search, flexible phrase search, search by example, phrase generation, and phrase extraction. The technology's keyword-in-context search feature retrieves documents that contain one or more user-specified keywords in context, ranks documents on their relevance to the keywords in context, and displays the documents with the query words highlighted and, optionally, with strongly associated words also highlighted.
U.S. Government Purpose Release

Photogrammetry Pyramid
KSC-14027

The Photogrammetry Pyramid software is a 3D photogrammetry Windows application intended to support the use of a stand-alone reference target system. The software requires images from two or more camera views. For static scenes, a single camera can be used by taking pictures from different viewpoints (two or more). The reference target is composed of seven spheres connected by equal-length rods. A sphere is located at each of the four vertices of the pyramid. Three additional spheres are located at the midpoint of the three vertical rods. The distance between any set of vertices-spheres defines the characteristic pyramid length. This length is the only value needed by the user during reference target generation.
General Public Release

Physical Scalars and Plotting Tools in Scala — ARC-18212-1

This is an open-source scalar package and associated software tools developed in the Scala programming language and includes plotting tools based on the free GRACE plotting package. The scalar package represents physical scalars and can help to prevent errors involving physical units in engineering and scientific computation. The design also allows users to easily define a specialized or reduced set of physical units for any particular application or domain. The scalar package can be used in two modes interchangeably: one provides unit compatibility checking but is slower, and the other bypasses the compatibility checks but is much faster and still prevents the most common type of unit error.

Open Source

PIQUANT: X-ray Fluorescence Quantification Software — NPO-50887-1

Calibration work to enhance the elemental quantification capabilities of the prototype Planetary Instrument for X-ray Lithochemistry (PIXL) on Mars 2020 will ultimately benefit scientists analyzing PIXL data derived from the eventual flight instrument. Quantification of X-ray data is made possible using PIQUANT, the in-house fundamental parameters (FP) approach software constructed for this application.

General Public Release

PIXELATE: an Astrobiology Visualization Tool — NPO-50960-1

This software allows scientists to build custom visualizations to analyze M2020 Rover Planetary Instrument for X-ray Lithochemistry (PIXL) instrument data, including geological morphology and elemental composition. It has a tool called an X-ray spectrometer that identifies chemical elements at a tiny scale. PIXL also has a camera that takes super close-up pictures of rock and soil textures, capturing features as small as a grain of salt. This tool combines this data into a visual format.

General Public Release

PixelLearn — NPO-42082-1

PixelLearn is a tool for classifying the pixels in scientific image data sets. Based on one or more images on the same grid, the tool uses cutting-edge clustering algorithms to automatically find structures in the image, or to label individual classes and use supervised classification methods to extend the labels to the rest of the image.

U.S. Government Purpose Release

Pixelwise Correlation-Based Landscape Classification (PiCo) — LAR-19015-1

PiCo automates and regionalizes the Climate Landscape Response (CLaRe) metrics. CLaRe maps invasive buffelgrass in the Southwestern United States. This grass both propagates and benefits from increased wildfire events, and it is a threat to the local ecosystems within the Sonoran Desert. Buffelgrass responds to precipitation quicker than native vegetation. This behavior is what CLaRe captures. Correlation values derived from regression analysis between Normalized Difference Vegetation Index (NDVI) and precipitation values are used to separate pixels invaded by buffelgrass from those that are not. PiCo, written in R, performs a pixelwise regression analysis.

Open Source

Planetary Data System Inspect Tool — NPO-51099-1

The Inspect Tool is a component of the Preparation Tools suite of tools providing functionality for preparing data for ingestion into PDS. It is intended to provide a capability for opening and inspecting the contents (e.g. label, objects, groups) of any PDS compliant archival product, and a method to visualize selected archival products.

Open Source

Data and Image Processing

Plotting Program for Kepler Planet Detection Efficiency Products
ARC-17980-1

The Kepler Plotting Program was developed as an aid to understanding the publicly available data files that have been released by the Kepler project. This tool allows end users to reproduce plots utilized in project documentation, facilitates the user's scientific understanding, and promotes the utilization of the Kepler science data products. The SETI Institutes participated in authoring and producing the KeplerPORTs (Kepler Planet Occurrence Rate Tools) under Cooperative Agreement number NNX13AD01A.
Open Source

PO.DAAC Open Software Development
NPO-52065-1

The Physical Oceanography Distributed Active Archive Center (PO.DAAC) at JPL was designated the Physical Oceanography discipline DAAC in 1992. PO.DAAC is responsible for assembling, distributing, and providing data services for a comprehensive archive of NASA flight mission observations to facilitate research, application, and policy formulation in support of NASA Earth sciences.
Open Source

PODAAC Level 2 Subsetter
NPO-51992-1

This software is capable of spatial, temporal, and variable subsetting of NetCDF Level 2 data products. Provides an adapter for the EOSDIS Harmony API https://harmony.earthdata.nasa.gov/
Open Source

PointClouds VR
GSC-18208-1

This tool visualizes and manipulates point clouds from multiple scientific domains in virtual reality, including time-dependent point clouds. Point clouds can be colored by reflectance, natural color, elevation, or even mapping hyperspectral data to color channels. It can animate points forwards and backwards in time from calculations or by loading separate point cloud datasets as frames. It is able to visualize locations captured from LIDAR data, such as lava tubes scanned by planetary scientists, to allow revisiting field sites.
Open Source

PolyFit: A C++ Code for Polynomial Curve Fit with Calculation of Error Bars
MSC-26693-1

This C++ code calculates the coefficients of a polynomial of a degree k that is the best fit for a series of n points (xi,yi) using the least-squares method. The code offers two options: (1) to fix, or not, the intercept (the first coefficient) to a given value; and, (2) to use weights on points proportional to their errors, or inversely proportional to the square of the errors. PolyFit calculates the error and confidence intervals of the coefficients, the total and residual sum of squares, the coefficient R2, and the covariance and correlation matrices. It also reports the results of an ANOVA test for the fit, and writes the prediction and confidence bands into a file. The source code is provided as a single file using basic C++, so that it can be re-used easily.
Open Source

Portable Environment for Quick Image Processing (QuIP)
ARC-16295-1A

The QuIP interpreter, a software environment for QUick image processing, uses an interactive scripting language designed to facilitate use for everyday users. It features context-sensitive automatic response completion and integrated documentation, and also includes a number of script packages that implement high-, medium-, and low-level functions (e.g., analysis of eye images for human gaze tracking, feature tracking, and image filtering).
Open Source

Pour: A Framework for Periodic, On-Demand, and User-Specified Information Reconciliation
ARC-15468-1

Pour is a general-purpose information service framework for periodic, on-demand, and user-specified information reconciliation. The technology is designed to accommodate a wide variety of information types with support for high-volume, low-frequency periodic updates, user-specified updates, and automatic updates collected on demand when needed.
Open Source

Precipitation Interface for the Middle East (PrIME)
LAR-18945-1

This tool allows users to visualize data from several sources and extract data at points of interest. There are seven types of data loaded into the interface (SRTM, MOD16, GRACE, TRMM, GPM, school location points, and a study area polygon). When the user clicks on a point within the study area extent (where there is data present), the interface returns three graphs, each of which shows the historical amount of a climatological variable (precipitation, groundwater, and evapotranspiration). The interface automatically loads all data and centers the map around the study area, though layers can be turned on and off as the user desires.
Open Source

Principle Component Analysis (PCA) for Thermography NDE Data
LAR-20094-1

This software reads thermography data and performs principal component analysis (a well known technique used on many data types) on the data over a specified number of image frames.
U.S. Release Only

Probabilistic Assessment of Surface Composition by Remote Imaging Spectroscopy
NPO-51367-1

This algorithm is being used primarily as a research strategy with end-to-end accounting and propagation of uncertainty across calibration, reflectance, and mineral detection with closure of error budgets and residuals consistent with uncertainty predictions. This is the first time statistical validation of second-order uncertainty predictions has been demonstrated in the domain of remote mineralogy mapping. The approach applies to surface composition measurement in other planetary and Earth science domains.
Open Source

Probabilistic Iterative Inversion of Combined Surface/Atmosphere Models for Atmospheric Correction of Imaging Spectrometer Data
NPO-50704-1

This software package permits inversion of imaging spectrometer data using a Bayesian probabilistic formalism and least squares optimization with a "forward model" of photon transport to match an estimate of atmosphere and surface properties to the measured spectrum. It is instantiated as a python package and can take advantage of externally-available radiative transfer packages such as MODTRAN. It runs on data formats such as ASCII text files and binary files similar to those used by NASA instruments such as AVIRIS-NG.
Open Source

ProtoSpace Web CAD Renderer
NPO-52525-1

This program renders complex CAD models in a web browser at interactive framerates. It was originally designed and implemented for the ProtoSpace project.
General Public Release

Py-Sonde-Comparison
NPO-52559-1

The program has three core elements. Read product: This method reads satellite data products, which will be modified as new groups are included in the analysis. Key elements extracted are lat/lon, ozone profiles and aprioris and averaging kernels. Colocate: This method takes the data from read product, and uses the WOUDC ozonesonde extraction tool pywoudc to extract ozonesonde data within the same timeframe as the satellite data. The lat/lon and timestamps of satellite data are compared with those of the ozonesondes, if matches are found within a certain tolerance, these locations are saved, and output as a separate datafile. Plot results: This method takes the files saved in colocate and performs statistical analysis and plots the results for further analysis and discussion.
General Public Release

PyCMR
MFS-33409-1

This Python client library (pyCMR) abstracts the CMR search application program interface which calls to a simple set of Python functions that can be incorporated into client applications. The search responses are stored in the Python dictionary for easy manipulation on the client side.
Open Source

PyTDI
NPO-52047-1

PyTDI is a Python package which provides a toolset to perform symbolical and numerical time-delay interferometry (TDI) calculations. Its functionalities include a) definition of arbitrary linear combination of time-shifted signals (i.e., TDI combinations), b) symbolical handling of TDI combinations, and c) numerical evaluation of TDI combinations. It also provides commonly used TDI combinations ready to use (first- and second-generation Michelson, quasi-orthogonal), and can compute clock-noise corrected combinations.
General Public Release

Python-ION interface (pyion) NPO-51196-1

Pyion provides a Python interface to JPL's Interplantary Overlay Network (ION) via a Proxy class that allows create Endpoints through which users can send or receive bytes, bytearrays, and memory views. They operate in a manner similar to how TCP/UDP sockets operate.
Open Source

Quick-Plot General-Purpose Plotting Tool
DRC-012-022

Quick-Plot is a general-purpose tool used to plot Armstrong time-history data files and data files in the MATLAB format. The graphical user interface allows commands to be scripted and read from an input script file; input signals can be modified using algebraic expressions.
U.S. and Foreign Release

Radio Astronomy Software Tools
NPO-51204-1

Radio Astronomy Software Tools} is a collection of software packages that have proven useful in doing radio astronomy with NASA's Deep Space Network. It includes a monitor and control system that is overlaid on the operational monitor and control to provide features necessary or useful for conducting radio astronomy research. The collection may provide a quick way to start a small single dish radio astronomy ab initio. It can also manage a telescope system in which all subsystems have their own, network-accessible controllers.
Open Source

RAIn: Rainfall Analysis Integration   LAR-19205-1

This software analyzes Tropical Rainfall Measuring Mission (TRMM), Global Precipitation Measurement (GPM), and Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) precipitation data. It also analyzes Terra Moderate Resolution Imaging Spectrometer (MODIS) Normalized Difference Vegetation Index (NDVI), Normalized Difference Drought Index (NDDI) and Land Surface Temperature (LST) data. Areas are mapped on the screen and corresponding trend charts are produced. The software also provides a visual comparison with social and economic variables including human population density, demographic, and conflict data to better understand the dynamics within these stressed areas.
Open Source

Random Forest Classifier for Real-Time Operations   NPO-51337-1

There are several points along the journey from space where data can get lost. This program determines whether data was lost and, if so, where it was lost. Machine learning techniques analyze and predict the classifications.
Open Source

Random Variable Library   ARC-18082-1

This software library provides a framework for uncertainty representation using probability distributions. The Random Variable Library presents a solution to overcome the challenges presented by various forms of uncertainty. In particular, standard parametric distributions such Gaussian, Lognormal, etc. are supported, in addition to non-parametric representations such as unweighted/weighted samples, percentiles, etc. It is extendable, allowing for the addition of additional distributions. Beyond representation, the library includes basic capabilities for multivariate sampling and fitting using several methods.
Open Source

Rapid Model Import Tool (RMIT) Version 2.0   KSC-14470

The Rapid Model Import Tool (RMIT) version 2 is an enhancement to the original RMIT software. It is software designed to import 3D models from Computer Aided Design (CAD) software tools such as 3DS Max, Catia, or Creo, and perform several modifications to the model's underlying format. Some of the modifications include flattening the hierarchical tree structure of the model's objects, translating the model to world coordinates origin, polygon simplification, and object merging, all designed to reduce the size of the model's file structure, while retaining fidelity to the original model. This new version expands file formats to most CAD file types. A support form has also been added for user feedback as well as MRET (Mixed Reality Exploration Toolkit) support. There are also expanded model manipulation tools such as linking of materials to reduce material definition bloat and finer control over model decimation.
General Public Release

Raytracing Atmospheric Delay Estimation for RADAR (RAiDER)   NPO-51433-1

RAiDER is a Python package that contains tools to calculate tropospheric radar slant delays for both airborne and space borne sensors. It estimates delays by calculating the index of refractivity at the native weather model grid nodes and then integrating along the ray path of the signal, from the ground pixel to the sensor location (up to a reference height).
Open Source

Real Time Spectroscopic Survey and Analysis   NPO-50185-1

The real-time system operates onboard the AVIRIS-NG instrument computer. It first executes the standard AVIRIS-NG ground data pipeline to create calibrated radiance measurements. It then matches these spectra to the known absorption signature of the target. For example, when mapping fugitive leaks from natural gas and oil infrastructure, the procedure allows operators to detect CH4 emissions in real time. These detections are geolocated so that operators know the precise latitude/longitude coordinates. A watchdog process waits for a new image to appear on disk. The real-time analysis results are stored making them immediately available on the operator display.
Open Source

Data and Image Processing

Real-Time Analytics Platform (RTAP) GSC-18319-1

RTAP is a framework for developing high-performance distributed computing systems that analyze science data in real-time. The goal of the framework is to provide the building blocks necessary for developing stream processing applications.
Open Source

Regional Incendiary Fuel Risk Assessment Framework (RIFRAF) LAR-19156-1

Climate data from the Google Earth Engine library was leveraged in a script to calculate the fire potential in the Missouri River Basin. Variables instrumental to fire potential were drought conditions, temperature, relative humidity, precipitation, wind speed, and fuel moisture.
Open Source

Requirements Tracing on Target (RETRO) GSC-14976-1

RETRO offers methods and techniques for information retrieval (IR), including vector retrieval and probabilistic retrieval. The technology can be downloaded at: http://opensource.gsfc.nasa.gov/projects/RETRO/index.php
Open Source

RiverObs NPO-50138-1

RiverObs is a set of Python modules designed to ingest raster or point data, project them to a river centerline, modify the centerline, if desired, and calculate quantities, such as width, slope or stage that apply to a river reach.
Open Source

Rocket Plume Spectroscopy Simulation for Hydrocarbon-Fueled Rocket Engines SSC-00281

Enhancements and modifications to a code developed for plume spectral data analysis in 1994 have made the original computer program applicable to the space shuttle main engine and the Diagnostic Test-bed Facility Thruster (DTFT). The new code can now handle the non-uniform wavelength intervals at which spectral computations are made.
U.S. Government Purpose Release

SAR Exploration Notebooks NPO-52050-1

The notebooks enable quick visualization and interpretation of false-color SAR RGB images, and InSAR correlation images. Notebooks are run in Google Colab and the first cells will set up the python environment. Users are asked to upload image samples into their Google Drive for easy access from Google Colab.
Open Source

Scalable Gaussian Process Regression (Block GP) ARC-16864-1

Block GP is a Gaussian process regression framework for multimodal data that can be an order of magnitude more scalable than existing state-of-the-art nonlinear regression algorithms. The framework builds local Gaussian processes on semantically meaningful partitions of the data and provides higher prediction accuracy than a single global model with very high confidence. The method relies on approximating the covariance matrix of the entire input space by smaller covariance matrices that can be modeled independently, and can therefore be parallelized for faster execution.
Open Source

SciHound NPO-51299-1

SciHound is an Android app that allows users to survey areas and help with calibration and validation of land cover maps from remote sensing. It streamlines the interfacing between remote sensing scientists and researchers from the broader environmental sciences community.
Open Source

Data and Image Processing

SDCI: Scaled Drought Condition Index — LAR-19472-1

This innovation processes Normalized Difference Vegetation Index, land surface temperature, and precipitation data. It then scales each component based on regional maxima and minima. Each scaled value is then inserted into the Scaled Drought Condition Index equation in order to produce a monthly drought index value for each pixel in the study area.
Open Source

SequenceMiner: Anomaly Detection in Large Sets of High-Dimensional Symbol Sequences — ARC-16053-1

SequenceMiner was developed to address the problem of detecting and describing anomalies in large sets of high-dimensional symbol sequences. The technology performs unsupervised clustering (grouping) of sequences using the normalized longest common subsequence (LCS) as a similarity measure, followed by a detailed analysis of outliers to detect anomalies. SequenceMiner utilizes a new hybrid algorithm for computing the LCS that has been shown to outperform existing algorithms by a factor of five.
Open Source

SGNDI: Separable Grid N-Dimensional Interpolator — LEW-19702-1

This is a software library for multidimensional numerical data interpolation, in an arbitrary number of dimensions. Analytical gradients are supported.
Open Source

Simple Analysis of Vegetative Trends in Earth Engine (SAVeTrEE) — LAR-19195-1

SAVeTrEE is a script within Google Earth Engine for classifying areas of vegetation mortality. It prompts the user for a year, duration, and spectral index for which a mortality map should be produced, then fits a trend line to an imagery time sequence of vegetative spectral index values calculated from Landsat multispectral data. The slope of the trend line, as well as the spectral index values, are used in determining the final classification of each pixel within the study area. Classification categories are: 1) Growing 2) Mortality (declining) 3) Stable Vegetation and 4) Stable Barren.
Open Source

Simplegrid: Simple Local Grid Creation and Refinement for Ocean Circulation Models — NPO-51303-1

Simplegrid is a Python package for creating, refining, and joining horizontal quadrilateral grids that are used in connection with the MIT General Circulation Model (MITgcm). Simplegrid is based on equal great circle arc subdivision (hence the name) with geodesic computations provided by pyproj/PROJ.4, and implements both Python callable and command-line functionality for embedded and scripted solutions. It also contains several useful utilities for grid manipulation, file i/o, and coincident edge detection.
Open Source

Simulation Package for Underwater Hydrothermal Vents — NPO-51593-1

This software simulates the shape, appearance and composition of hydrothermal vents, and the structure of an instrument package designed to study vents.
Open Source

Simulation-Based Uncertainty Quantification for Atmospheric Sounding — NPO-51511-1

Specific algorithm implementation choices can impact the algorithm's accuracy and precision. This probabilistic and computational pipeline can be studied in depth with Monte Carlo simulation experiments of the satellite observing system using ensembles of realistic true states. This software facilitates design and post-processing of these simulation experiments.
Open Source

Data and Image Processing

Skyglow Estimation Toolbox (SET)
<div align="right">LAR-19184-1</div>

This script models light pollution from differing azimuth and beta angles, creates hemispheric models of light pollution at given points on the landscape, and generates products relevant to decision makers in the park service, or any regional actor interested in examining the effects of light pollution on natural resources.
Open Source

Software Lifecycle Improvement and Modernization (SLIM)
<div align="right">NPO-52266-1</div>

The Software Lifecycle Improvement and Modernization (SLIM) project seeks to provide sample scripts, configuration, documentation, and recommendations for best practices in software lifecycle modernization, software governance improvements and standards, as well as software information sharing consistency and standards. Through both software and documentation, the SLIM effort seeks to improve overall software lifecycle standards for multi-mission Multi-mission Ground Software Systems (MGSS) Instrument Data Systems (IDS) participant teams and software projects.
Open Source

Spatial Resolution Verification Tool (SRVT)
<div align="right">SSC-00339</div>

An automated Spatial Resolution Verification Tool (SRVT) was developed to rapidly determine the spatial resolution characteristics of remotely sensed aerial and satellite imagery. Most current methods for assessing spatial resolution characteristics of imagery rely on pre-deployed engineered targets and are performed only at selected times within pre-selected scenes. The SRVT addresses these insufficiencies by finding uniform, high-contrast edges from urban scenes and then uses these edges to determine standard estimators of spatial resolution, such as the modulation transfer function (MTF) and the relative edge response (RER).
U.S. Government Purpose Release

Spectral Analysis Tool (SAT), Version 6.2
<div align="right">NPO-43129-1</div>

The SAT computer program calculates signal spectra, bandwidths, and interference effects for several families of modulation schemes found commonly in radio, satellites, and space communications. It is primarily used for spectrum management purposes to examine the effects of radio frequency interference on a satellite communication system.
U.S. Government Purpose Release

SpiceyJS: Time Conversion Library Based on NAIF's CSPICE
<div align="right">NPO-50793-1</div>

Spicey is a time-conversion library based on NAIF's CSPICE. This project only includes wrappers for the functions relevant to time conversion and some light time calculations. The default kernels are enough to refer to most NAIF ID's, a planetary constants kernel, and a leap seconds kernel.
Open Source

SPOC-Lite: On-Board, Lightweight Terrain Classifier for Planetary Rovers
<div align="right">NPO-50647-1</div>

The SPOC-Lite software is intended for on-board rover software to enhance safety of autonomous driving. By remotely detecting sandy surface, the rover can safely avoid slips/wheel embedding caused by sandy terrains.
Open Source

Structural Analysis Routines (STARS)
<div align="right">DRC-011-003</div>

Structural Analysis Routines (STARS) is an efficient, cost-effective, and unique computer program that analyzes a variety of practical engineering problems. The software is a fully integrated, multidisciplinary, finite-element-based, graphic-oriented analysis tool that combines individual modules to solve complex engineering problems. STARS can be used for a range of applications, including structural analysis, heat transfer, linear aerodynamics, and computational fluid dynamics (CFD), as well as coupled linear and CFD-based (aeroelastic, aeroacoustic, and aerothermoelastic) analysis. Because of the tool's highly integrated nature, it has broad application across many engineering disciplines.
U.S. and Foreign Release

Data and Image Processing

Stellar: A Web-Based Design System for Information Dense Applications in Spacecraft Operations NPO-52220-1

Modern web applications use a variety of popular libraries for user-interface design. The most common today include Material by Google, and Bootstrap by Twitter. These libraries expose common elements of a standardized design that can be used across applications (e.g. button, input field, etc.). When building applications for spacecraft operations the main problem that arises with these libraries is they are optimized for mobile, and their elements take up more screen space than necessary. The Stellar software aims to solve this problem by providing design and implementation of elements that are more efficient with screen space so more information can be displayed in smaller screen areas. This increases overall usability, as more data is available without having to scroll or increase the screen size.
Open Source

Streaming 3D Tile Support for Unity3D Game Engine NPO-50595-1

3D Tiles is an emerging standard for describing and storing large 3D models as a series of tiles at various levels of detail. These tiles are broken up according to a space partitioning graph. This enables rendering clients to download only the tiles needed to saturate the resolution of a client devices display. This gives the illusion of downloading and rendering the entire 3D model but only requires a small portion of it be downloaded and displayed by the client device at any given time.
Open Source

Sun Format Database (SunAcc) File Read/Write Library MFS-32397-1

The Sun Format Database (SunAcc) was developed to fulfill a need for local native storage of space shuttle main engine (SSME) test data. While the file format itself is native to the Sun UNIX platform, the read/write library was developed to be a cross-platform tool and is compatible with a variety of UNIX and Windows platforms.
U.S. Release Only

Surface Water Indication Model (SWIM) LAR-19013-1

SWIM is a user-friendly tool that allows users to identify surface water from the most current imagery available or monitor temporal changes of surface water in their management areas. The code provides calculations for water indices and thresholding, as well as algorithms for slope and aspect creation.
Open Source

Surfer: An Extensible Pull-Based Framework for Resource Selection and Ranking ARC-15295-1

Surfer examines the pool of potential grid resources and extracts the highest-ranking resources that meet user-specified constraints and preferences. The technology has been implemented as a grid service that is compliant with an Open Grid Services Infrastructure (OGSI), and it can also be embedded directly into Java applications through its application programming interface or into non-java applications through its XML-based command-line interface.
Open Source

Swim: A Software Information Metacatalog for the Grid ARC-15469-1

Swim is a software information service for the grid built on top of the NASA-developed Pour framework. Software information is periodically gathered from native package managers on FreeBSD, Solaris, and IRIX, as well as the RPM, Perl, and Python package managers on multiple platforms.
Open Source

SWPC CAT Web Tool
GSC-18546-1

The SWPC CME Analysis Tool Web (SWPC-CAT-Web) tool is an online version of the original SWPC CME Analysis (SWPC-CAT) Tool. The original SWPC CAT tool is developed by the NOAA Space Weather Prediction Center (SWPC). It is the primary tool being used by NOAA SWPC in measuring key parameters of a Coronal Mass Ejection (CME) as it emerges from the solar corona.
Open Source

TASC CMOD and Force Test Data Pre-Processor
MFS-34375-1

This software imports load frame test records for crack mouth opening displacement mechanical tests and offers the user the ability to perform data processing operations and convert the data into a format readable by the Tool for Analysis of Surface Cracks (TASC: NASA Technology MFS-33082-1). The core operations performed by this data pre-processing tool are related to data clean-up to correct for extensometer slips and alignment of the data with the origin to ensure proper test evaluation within TASC.
U.S. Release Only

TIE 0.4: The Imagery Exchange for the NASA Global Imagery Browse Services (GIBS) Project
NPO-49883-1

This software is an extension of the HORIZON 5 framework. It delivers horizontal scaling solutions for image capturing to automate the generation of the Meta Raster Format (MRF) imagery products.
Open Source

Tiled Web Map Service (WMS) Server
NPO-44685-1

This technology processes WMS requests that comply with a given request grid from an existing tile data-set. It also generates the KML configuration files required to access WMS tiles.
U.S. Government Purpose Release

TilePredictor: Image and Pixelwise Classification with Tile-based Convolutional Neural Networks (CNNs)
NPO-50821-1

TilePredictor is a Python library designed to rapidly construct and evaluate CNN-based image classifiers for image and pixelwise classification problems. The program generates pixelwise predictions using image-based CNN classifiers which generate a single prediction per image for large images such as those typically encountered in remote sensing and astronomy. TilePredictor generates pixelwise predictions by efficiently spatially aggregating predictions generated by convolving an image-based CNN over tiles extracted from a target image.
Open Source

To the Moon and Beyond
MSC-26821-1

An educational game teaching how International Space Station research is helping us on Earth and getting us to the Moon and beyond. Users determine what research to fund on the ISS and what projects to fund back on Earth. Results from the funded projects determine the budget for the next year. Everything affects the outcome of the eight part program. But beware, events can happen that can influence that outcome. Will it be possible to complete all of the eight mission objectives in four short years?
General Public Release

Tolerance Domain Specific Language
LAR-17546-1

This sensitivity task program employs the Monte Carlo method. Thousands of simulations are run with randomly varied input parameters, and then statistical correlations are computed to determine the sensitivity of output parameters to each input parameter.
Open Source

Tool for Interactive Plotting, Sonification, and 3D Orbit Display (TIPSOD)   GSC-14732-1

TIPSOD is a software application designed for interactive, animated, 4D (space and time) visualization of satellite orbits. The technology is implemented in Java 3D and is an extension to the existing Satellite Situation Center Web (SSCWeb) 2D static orbit graphics. Please visit the following URL for additional information: http://opensource.gsfc.nasa.gov/projects/tipsod/index.php
Open Source

Topographical Landmarks for Ground-Level Terrain Relative Navigation on Mars   NPO-52169-1

This program is an automated approach to localization in which the rover makes bearing-only measurements to geographic features in its surroundings (hills, boulders, peaked ridge-lines, etc.). When the location of these landmarks is cross-referenced with a map of Mars, the resulting solution is globally registered and will help correct any drift during visual-odometry-aided drives.
Open Source

Trace Gas Profile Generation Software (GINPUT)   NPO-52465-1

This program generates vertical profiles of greenhouse gases and other trace gases. It primarily generates these profiles using only long term trends from NOAA observatories and correlations with meteorological variables. This allows the profiles to be independent of models, which in turn means satellite retrievals that use this software's profiles as prior information are a better independent comparison for the models.
General Public Release

Tree3D Dynamics Visualization Tool   MFS-34076-1

Tree3D is a generic graphics package for MSFC's TREETOPS simulation engine that can be adapted to any 6-degree-of-freedom simulations. Tree3D internally supports a number of celestial bodies/basic geometries in addition to anything that the user can provide. Bring your simulations to life with Tree3D.
U.S. Government Purpose Release

TrickFMI: A Functional Mockup Interface (FMI)
Standard Implementation for Trick Base Models and Simulations   MSC-26230-1

This software supports FMI-based model exchange with Trick-based simulations.
Open Source

Tuning Optimizing Genetic Algorithm (TOGA)   NPO-51929-1

Tuning Optimizing Genetic Algorithm (TOGA) is a lightweight software package for distributed GA optimization of black-box models and algorithms. It can be used when rapid optimization of algorithms with a large number of parameters is necessary, and massively parallel compute is available.
Open Source

Unity: Multi-tenant, Managed Product Development,
Generation, and Analysis Platform   NPO-52159-1

The software brings together 2 key mission activities: Algorithm Development, Data Processing and Storage, and Data use and analysis. The software creates a platform for algorithm developers to login and develop production quality algorithms through the use of standard tools, interfaces, and packaging that is automated on behalf of the user. The packages seamlessly fit into production quality processing systems (think: run at scale on thousands of nodes) with little effort from the algorithm developers. The same algorithm developed is used in the production of 'standard data products' by a mission, fit for science usage and archival. Lastly, the same platform used to create the algorithms and data products is used to analyze and validate the products as well. The cohesive ecosystem for development, generation, and validation is designed to speed up the development effort and enable evolution of back end components over time.
Open Source

Data and Image Processing

Vectorization of Global Flood Monitoring System Using Topojson GSC-17169-1

This program allows for the generation of vectors by reading global flood monitoring data, processing the data, and generating aTopoJSON-encoded file for visualization on the Web.
Open Source

(v)ectorized (S)imulated (m)easurements of the (a)tmosphere using (r)adiative (t)ransfer based on the (M)atrix (O)perator (M)ethod (vSmartMOM) NPO-52333-1

This is a full end-to-end modular software suite for radiative transfer and related atmospheric analysis. It develops a fast and accurate mechanism to simulate measurements (satellite, airborne, ground-based) of the Earth's atmosphere. This represents the state of the art in the ability to: 1. estimate green house gas (mainly CO2) concentrations, 2. their sinks by remotely sensing the health of forest canopies in terms of their vertical moisture distribution.
Open Source

VegMapper NPO-51295-1

VegMapper is an open-source package build in the R language, that employ Bayesian algorithms to generate the presence probability for a user-defined class. It automates and streamlines all GIS operations to integrate remote sensing imagery with in-situ data. The package is flexible and can accept a variable number of predictor variables and in-situ points.
Open Source

VICAR: Video Image Communication and Retrieval NPO-49845-1

VICAR is a general-purpose image processing software system that has been developed since 1966 to digitally process multi-dimensional imaging data. It is used for a variety of other applications including biomedical image processing, cartography, Earth resources, astronomy, and geological exploration.
Open Source

Video Acuity Measurement System ARC-16661-1

The metric of video acuity is used to quantify performance of video systems, using the smallest letters that can be recognized when viewed. The video system comprises a camera and associated optics and sensor, processing elements including digital compression, transmission over an electronic network, and viewing of the display by a human viewer on an electronic display. The quality of the system will impact the ability of the human viewer to perform public safety tasks, such as reading of automobile license plates, recognition of faces, and recognition of handheld weapons. This automated system for measuring video acuity is based on a model of human letter recognition.
U.S. Government Purpose Release

Video Image Stabilization and Registration (VISAR) MFS-31243-1

This software program will stabilize video images distorted as a result of video camera motion. There are multiple applications for this technology including stabilization of images from mobile platforms, crime scenes, robotic systems, spacecraft, and home video.
General Public Release

Viewpoints: Software for Visualization of Multivariate Data ARC-16019-1

This software application allows the interactive visualization of multivariate data using a variety of standard techniques. Viewpoints can be used with extremely large data sets.
Open Source

Viewshed Tool (CAMP/MMGIS Plugin)　　　　　　　　　　　　　　NPO-51796-1

This software performs real-time viewshed analysis from a tiled digital elevation model in a web-based mapping system.
Open Source

VISTA: Visualization for Telemetry Analysis　　　　　　　　　　　　NPO-51981-1

VISTA is a modern web-based application for telemetry visualization and inspection. VISTA supports real-time and historical telemetry access for both on-site and remote users via a simple web GUI. It allows exploration and comparison of telemetry data from multiple sources, and allows teams to create, persist, and share informational displays for use among geographically distributed teams.
General Public Release

Visual Environment for Remote Virtual Exploration (VERVE), Version 2　　　ARC-16457-1A

VERVE is a 3D visualization system that provides situational awareness, science analysis tools, and data understanding capabilities for robotics researchers and exploration science operations. The technology is highly modular and extensible and includes a 3D scene-graph database, an interactive 3D viewer, and associated graphical user interfaces to OSGI plugin-based applications.
Open Source

Visual System for Browsing, Analysis, and Retrieval of Data (ViSBARD)　　GSC-15744-1

ViSBARD provides a way of visualizing multiple vector and scalar quantities as measured by many space-craft at once. The data are displayed three-dimensionally; it may be displayed either as connected lines or as points; and it allows the rapid determination of vector configurations and correlations between many measurements at multiple points. Please visit the following URL for additional information: http://open-source.gsfc.nasa.gov/projects/visbard/index.php
Open Source

VOCAL: Visualization of CALIPSO　　　　　　　　　　　　　　　　LAR-18710-1

VOCAL offers an easy-to-use GUI interface that allows users to open CALIPSO satellite data and visualize that data on a plot. Users can then select areas of the plot by drawing "shapes" around those areas and label shapes with attributes and notes. Shapes can be exported to a backend database which can serve as a centralized point for researchers to share data and help track and identify aerosols in the atmosphere.
Open Source

Water Resources Integration Toolbox (WRIT)　　　　　　　　　　　　LAR-19191-1

This collection of tools manages data, including programs to geolocate and rescale ACOLITE output to make it useful in ArcMap, batch convert a netCDF file (output from ACOLITE) into a raster layer, convert data projections, and truncate all rasters in folder by the desired character string and create txt files of folder paths for all Landsat or ACOLTIE Images in a folder.
Open Source

Waveport Scattering Library　　　　　　　　　　　　　　　　　　NPO-51963-1

The Waveport Scattering Library is a collection of equations, derivations, and Matlab codes on selected topics in electromagnetic scattering.
Open Source

Web WorldWind 3D Virtual Globe, Version 0.10   ARC-15166-1D

Virtual globe technology is an application programming interface-centeric software development kit. It is elemental technology that allows others to see their spatial data in the native context of Earth or any other planet for which there is data. Any application, proprietary or other, can use NASA World Wind to see their data in a 3D context.
Open Source

Web-Based Search Service to Support Imaging Spectrometer Instrument Operations   NPO-49004-1

Just as Web search involves more than matching phrases, spectral search is more challenging than simply matching the shape of the spectrum. The background substrate and illumination changes can cause the same signature to appear very different across scenes. This search service uses an adaptive matched-filter approach that compensates for the context and background characteristics of each scene.
U.S. Government Purpose Release

Webification of Earth Science Guidance Documentation   NPO-51335-1

This technology provides a full stack web application to convert legacy PODAAC user guide documentation from DOCX to HTML and creates standardized structure and intelligently manipulate the content of the documents. The web app is to be used as an internal tool for PODAAC Data Engineers. The web application builds upon an open-source Python 3 library called Mammoth, which converts DOCX to simple and clean HTML. After conversion to HTML, the application parses the HTML using Beautiful Soup 4, adds Bootstrap CSS styling, wraps all img and table tags in responsive CSS classes, converts any unsupported images to PNGs, converts all FTP links to HTTPS PODAAC Drive links and dynamically creates a hyperlinked table of contents. The HTML output is responsive, mobile friendly and fully self contained in one file. The application is containerized using Docker and orchestrated via Docker Compose. The application uses React for the frontend, Flask for the backend and Nginx as a reverse proxy server.
Open Source

WinPlot Graphical Display System   MFS-31664-1

WinPlot is a powerful desktop graphical analysis tool that allows the user to generate displays of unrestricted amounts of data. It was developed to fulfill the need for fast and easily managed graphical displays of NASA test articles and facilities. WinPlot features include seamless displays of real-time and post-test data with time and event-time synchronization of data from multiple sources.
General Public Release

Worldview Satellite Imagery Browsing and Downloading Tool   GSC-17111-1

Worldview is a software tool designed for interactively browsing and downloading imagery from NASA's Earth-observing satellites. Building upon a set of open-source mapping and user interface libraries, it provides an environment to visually discover interesting phenomena as observed by NASA satellites and then download the data for further analysis. The software was originally designed to address the needs of the near-real-time applications community to provide relevant information for time-critical scenarios such as wildfire and flood management. As such, satellite imagery is available to be viewed in Worldview within four hours of observation.
Open Source

XML to HDF-EOS Convertor   GSC-15017-1

This software program takes an XML representation of the contents of a Hierarchical Data Format-Earth Observing System (HDF-EOS) file and recreates the file from that description. Please visit the following URL for additional information: http://opensource.gsfc.nasa.gov/projects/xml2he/index.php
Open Source

XML to ODL Convertor
GSC-15006-1

This program translates an XML representation of Hierarchical Data Format-Earth Observing System (HDF-EOS) ODL metadata back to the ODL format. Please visit the following URL for additional information:
http://opensource.gsfc.nasa.gov/projects/xml2odl/index.php
Open Source

Ziggy: A Pipeline Management System for Data Analysis Pipelines
ARC-16332-1B

Ziggy is a software tool that manages complex data analysis pipelines for science missions. It provides marshaling and persisting services for each algorithm step, sequencing for algorithm steps, monitoring, logging, resource management, and exception handling for all stages of data processing. Ziggy provides the ability to select either local processing or processing on the NASA Advanced Supercomputer (NAS); pipelines can contain a mix of algorithms that run locally and others that run on NAS. Data accountability is provided at all stages of processing: for any given data product produced at any stage, a permanent record is saved regarding which software version was used, what parameters and inputs were provided to the algorithm, and much more. Ziggy can run on computers running macOS or Linux. It supports algorithms written in Python, C++, MATLAB, or Java, and additional language support can be added with just a few lines of code.
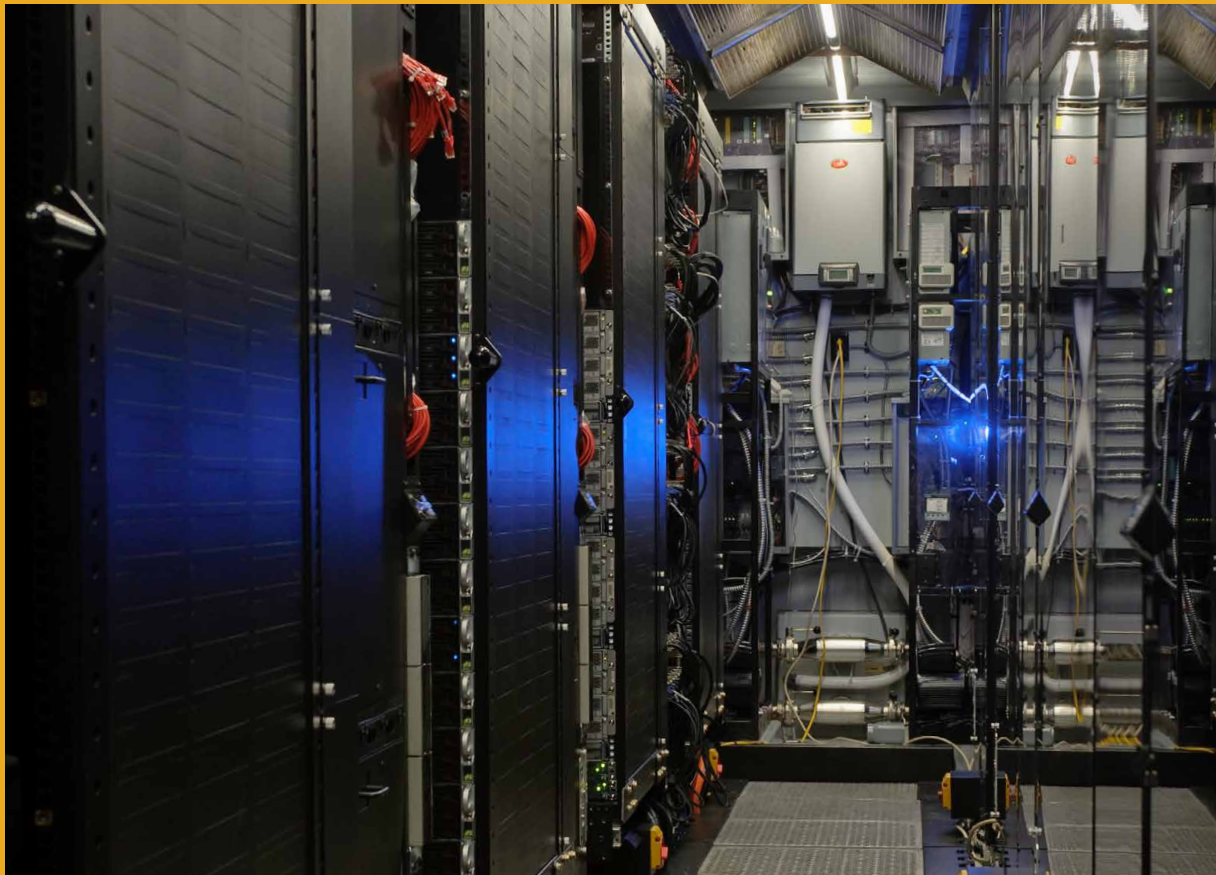**Open Source**

Data Servers Processing and Handling

Algorithms, Data Management, Routers, Servers, Storage

The Nebula containerized server at NASA's Ames Research Center in Silicon Valley, California, became the world's first open-source cloud computing platform in 2010.

Featured Software

Engineering DOUG Graphics for Exploration (EDGE)   **MSC-24663-1**

EDGE is a real-time 3D graphics rendering package based on the Dynamic Onboard Ubiquitous Graphics (DOUG) engine. It combines key elements from software tools developed for the Space Shuttle Program and International Space Station (ISS) and adapts them for integration with other engineering simulations and facilities. The tool allows drop-in integration with the NASA Trick Simulation Environment and provides a fusion of 3D graphics and simulation outputs.

General Public Release

MarsGIS Human Landing Site and Exploration Zone Viewer and Collaboration Tool   **LAR-19183-1**

The innovation includes a GIS layer and a web-based GIS service. The GIS layer includes the geospatial location and spatial extent of the exploration zones (EZs), regions of interest, and data characterizing the science and resources purported to be available. The data was extracted from publicly available abstracts and presentations for the Human Landing Sites Study EZ Workshop in October 2015 as proposals for the first human landing site on Mars. The web-based service allows users to view and analyze this layer; verify, alter, and annotate data; and add/edit/delete new EZs and will support user collaboration on these data. The layer was developed under the auspices of a Systems Analysis and Concepts Directorate investment fund opportunity.

General Public Release

Remote Memory Access Protocol Target Node   **GSC-16467-1**

This NASA technology provides SpaceWire design users with support for executing remote memory access protocol read and write commands. The target IP core is a VHDL description suitable for implementation in a field-programmable gate array or an application-specific integrated circuit.

U.S. Release Only

Analog Input Data Acquisition Software

KSC-13203

With the easy-to-use Analog Input Data Acquisition Software, a user can set up a system for monitoring up to five analog input channels. The software requires LabVIEW runtime engine 8.0 (a free download from ni.com) to run the executable.
General Public Release

Application Research Toolbox (ART)

SSC-00181

Developed in MATLAB, the Application Research Toolbox (ART) is a collection of computer programs that implement algorithms and parametric mathematical models for simulating remote sensing systems. The programs are especially useful for performing design-tradeoff studies and statistical analyses to support the rational development of design requirements for multispectral imaging systems.
General Public Release

Ballast: Balancing Load Across Systems

ARC-16443-1

Ballast is a tool for balancing user load across Secure Shell Handler (SSH) servers. The system includes a load-balancing client, a lightweight data server, scripts for collecting system load, and scripts for analyzing user behavior. Because Ballast is invoked as part of the SSH login process, it has access to user names. This capability, which is not available in traditional approaches, enables Ballast to perform user-specific load balancing. In addition, Ballast is easy to install, induces near-zero overhead, and has fault-tolerant features in its architectures that will eliminate single points of failure.
Open Source

BASSHFS: Bash-Accessible SSH File System

ARC-18333-1

A tool that allows remote directories to be manipulated as if they were mounted locally when using the bash shell. It is similar to the existing SSHFS utility except it is does not require FUSE kernel support.
Open Source

Bundle Restaging Daemon (BRD), a Delay Tolerant Network Marshall Enterprise (DTNME) Feature for Increased Protection against Bundle Overload

MFS-34247-1

Delay Tolerant Network Marshall Enterprise (DTNME) is a NASA supported software for payload operations to support reliable space communications. It is fully CCSDS compliant. This software is continuously updated with new technologies to further support and enhance its operational usage. The Bundle Restaging Daemon (BRD) is a new DTNME technology feature that allows operations to have better control over different data streams within a DTN system. Additionally, BRD provides safeguards to lessen the potential impact of any particular data stream against another.
Open Source

CAPTools-Based Automatic Parallelizer Using OpenMP (CAPO)

ARC-14487-1

CAPO analyzes a Fortran program and inserts OpenMP directives into the code to improve its performance on a parallel machine. The tool relies on accurate inter-procedural data-dependence information currently provided by CAPTools, which was developed at the University of Greenwich.
General Public Release

CODE: A Software Framework for Control and Observation in Distributed Environments

ARC-14672-1

A framework for the control and observation of resources, services, and applications. The technology supports the secure and scalable transmission of observed information to other programs, and it enables the secure execution of actions on remote computer systems.
Open Source

Coordinated Data Analysis Workshop Web (CDAWeb)　　　　　GSC-14292-1

The CDAWeb software and the CDAWeb service built on this software have been developed and continue to be enhanced and maintained by the Space Physics Data Facility. The technology has supported NASA/Office of Space Science programs dealing with the connections between the Sun and the Earth. CDAWeb software is essentially a set of Interactive Data Language (IDL) scripts that act as the engine of the system. Please visit: http://cdaweb.gsfc.nasa.gov/cdaweb/istp_public/

Open Source

DBI: Async, An Asynchronous Wrapper for the Perl 6 DBIish Database Interaction Subsystem　　　　　GSC-17824-1

Here is a simple asynchronous API wrapping of the existing Perl 6 DBIish Database interaction module. It manages a pool of database handles allocated as needed to perform database queries in a thread-safe manner. The tool can utilize promises to queue queries that will be performed asynchronously when a database handle becomes available, and it handles retries gracefully on database connection failures allowing the primary application to continue even when the database goes down and is restarted.

Open Source

Deep Space Network (DSN) Config Converter　　　　　NPO-45423-1

This tool is used in operations by the MRO and Phoenix missions. It provides both time savings and risk reduction in the periodic updating of the dsn_config modeling adaptation.

U.S. Government Purpose Release

DEMUD: Discovery through Eigenbasis Modeling of Uninteresting Data　　　　　NPO-48877-1

We have developed a machine learning solution called DEMUD (Discovery through Eigenbasis Modeling of Uninteresting Data). DEMUD works by building a model U of the uninteresting class and then identifying items that are maximally anomalous (and therefore likely to be interesting) with respect to that model.

Open Source

DTKA: A Prototype Implementation of Delay-Tolerant Security Key Distribution　　　　　NPO-49413-1

Unlike all Internet mechanisms for security distribution (e.g., certificate authorities), DTKA operates over the extremely long signal propagation times and interrupted links that characterize communication with interplanetary spacecraft. It has no single point of failure and cannot be "spoofed" by an attacker's subversion of any single key authority machine (or even two key authority machines, in most configurations).

Open Source

DTNTAP　　　　　NPO-48906-1

DTNTAP is a user space Ethernet driver with the potential to expedite DTN deployment by providing a transition mechanism for legacy IP applications to run alongside delay/disruption-tolerant applications in large-scale communication networks. By presenting an Ethernet-like interface, DTNTAP gives application developers access to many of the benefits of DTN without requiring to the user to become immediately proficient at a new programming API.

Open Source

Dyper: Dynamic Perimeter Enforcement　　　　　ARC-16444-1

Dyper protects a site from unauthorized network flows. The tool offers dynamic perimeter enforcement by providing a general-purpose mechanism for maintaining least-privilege network security policies while still supporting the full utilization of multiport protocols. Dyper requires no changes to software or practices outside of the perimeter and only minimal changes inside.

Open Source

Earth Observing System (EOS) Data Gateway (EDG)   GSC-14938-1

The Earth Observing System Data Gateway (EDG) provides the Earth science community with a single interface that will search for data granules from distributed data archives. The innovation enables users to explore, discover, and order available data from geographically distributed providers. For more information, please visit: http://opensource.gsfc.nasa.gov/projects/edg/index.php#software
Open Source

EDGE: The Extensible Data Gateway Environment   NPO-49884-1

EDGE uses Apache Solr for the fast-indexed search backend. To further ensure reliable serving of data, EDGE's Apache Solr uses the master and slave model.
Open Source

EDRN Knowledge Environment   NPO-48644-1

The Jet Propulsion Laboratory has provided the underlying infrastructure to share data, thereby increasing the study power associated with capturing and comparing information. The infrastructure provides software services including data processing and management (eCAS), biomarker data management (BMDB), specimen data management (ERNE), and a portal to link the system together and provide access.
Open Source

EEPROM File System   GSC-16852-1

EEFS provides a file system abstraction for EEPROM or PROM memories that is simple, efficient, and reliable.
Open Source

Engineering DOUG Graphics for Exploration (EDGE)   MSC-24663-1

EDGE is a real-time 3D graphics rendering package based on the Dynamic Onboard Ubiquitous Graphics (DOUG) graphics engine. It combines key elements from graphics software tools developed for Space Shuttle and International Space Station (ISS) programs and adapts them for integration with other engineering simulations and facilities. The tool allows drop-in integration with the NASA Trick Simulation Environment and provides a fusion of 3D graphics and simulation outputs.
General Public Release

Engineering Units Generator (EUGEN)   SSC-00151-1

EUGEN converts digitized sensor output voltage data to engineering units. The tool creates individual processed data files (one file per transducer per test run), converting raw voltage to meaningful measurements such as pressure or temperature.
General Public Release

Ensemble REST: Framework for RESTful Web Services in OSGI   NPO-45848-1

Ensemble REST makes it easy for developers to write and deploy RESTful Web applications, and the HTTP protocol enables anyone to access and utilize the exposed services. Libraries are available in almost every programming language in order to connect a program in the language to an HTTP service.
U.S. Government Purpose Release

File Exchange Interface (FEI 5)   NPO-40075-1

The File Exchange Interface (FEI) service offers secure file transaction, storage, transportation, and management services. The tool is implemented with the latest Java technologies for maximum portability and supports a 64-bit file system for very large file transfers over secure socket connections. While database-driven for file transactions and user access management, FEI offers an interactive client software suite for managing administration and general use.
U.S. Government Purpose Release

Fortran Unit Testing Framework (fUnit), Version 1   LAR-17081-1

The fUnit software provides a framework for unit-testing Fortran 90, 95, and 2003 code.
Open Source

FreeMe: Filtering and Reorganization of Excessive E-Mail Emanation   ARC-18334-1

A tool for filtering and reorganization of emails sent to a common address according to criteria specified by each user. FreeMe can be used either by a single user as a mail delivery agent or across users as a mailing list manager.
Open Source

HDF-EOS2 and HDF-EOS5 Compatibility Library   GSC-15008-1

This software library provides uniform access to HDF-EOS2 and HDF-EOS5 files through one set of application program interface (API) calls. Without the library, programs would have to be written twice to cover both HDF-EOS2 and HDF-EOS5 files. http://opensource.gsfc.nasa.gov/projects/HDF-EOS2/index.php
Open Source

HDF-EOS5 Validator   GSC-15015-1

This software allows generators of HDF-EOS data products to encode product requirement specifications in XML. The tool will then mechanically check product files against those requirements. For more information, please visit: http://opensource.gsfc.nasa.gov/projects/Validator/index.php
Open Source

Hierarchical Data Format Earth Observing System (HDF-EOS) Data Extractor (HEEX)   GSC-15009-1

The Hierarchical Data Format Earth Observing System (HDF-EOS) Data Extractor (HEEX) is a tool that enables users to extract HDF-EOS data to binary or ASCII data formats in HTML or XML index. The software can be used for both HDF-EOS2 and HDF-EOS5, and it automatically recognizes the two formats.
Open Source

Hierarchical Data Format Earth Observing System (HDF-EOS) Metadata Updater (HEMU)   GSC-15010-1

HDF-EOS Metadata Updater (HEMU) enables users to modify metadata inside an HDF-EOS file (either HDF-EOS2 and HDF-EOS5). The tool can be used to extract metadata from a dataset to a text file that can then be modified with any text editor; replace metadata with text from an external file; or update metadata with text from an external file. For more information, please visit: http://opensource.gsfc.nasa.gov/projects/hemu/index.php
Open Source

Hierarchical Data Format Earth Observing System (HDF-EOS) Web Server   GSC-15011-1

This shell script chains together existing data usability group tools to: extract ODL metadata from an HDF-EOS file; convert the metadata to XML; reformat the XML into HTML; publish the HTML and the original HDF-EOS file to a Web server and an OPeNDAP server; and reformat the XML and submit it to the Earth Observing System Clearing House (ECHO). For more information, please visit: http://opensource.gsfc.nasa.gov/projects/heserve/index.php
Open Source

Hierarchical Data Format Earth Observing System (HDF-EOS) XML Document-Type Definitions and Schemas   GSC-15016-1

An XML standard has been developed for the HDF-EOS5 file format using document-type definitions and schemas. Users can transform HDF5 files into XML format and vice versa. For more information, please visit: http://opensource.gsfc.nasa.gov/projects/XML_DTD_Schemas/index.php
Open Source

IND 2.1: Creation and Manipulation of Decision Trees from Data — ARC-14529-1

Decision trees are commonly used in artificial intelligence and statistical pattern recognition. A tree is "grown" from data using a recursive-partitioning algorithm. IND re-implements parts of existing standard prediction algorithms, offers experimental control suites, and also introduces new, more sophisticated methods for growing decision trees.
Open Source

Information Sharing Protocol VCR (ISPVCR) — MSC-25608-1

The Information Sharing Protocol (ISP) VCR (ISPVCR) is a software program written in Tcl/Tk that provides a capability to record and playback ISP data via Source Independent Telemetry Format (SITF) files. The ISPVCR provides a graphical user Interface that allows for start/stop of the recording capability; specification of output file names; and start/stop of the playback of the SITF data file.
U.S. Release Only

Inverse Reinforcement Learning (IRL) Augmentation for PyMDPToolbox — ARC-17451-1

The software is a augmentation for PyMDPToolbox containing implementations of some new IRL algorithms.
Open Source

JavaGenes Genetic Graphs — ARC-14293-1

JavaGenes is a genetic algorithm code written in Java. It evolves graphs using genetic software techniques and has applications in designing drugs, circuits, or any other system that is easily represented by graphs.
Open Source

JavaGenes-Scheduler: Evolutionary Software for Earth-Observing Satellite Scheduling — ARC-15103-1

JavaGenes-Scheduler is a general-purpose evolutionary system designed to compare techniques for scheduling observations. It was originally developed for scheduling observations made by Earth-observing satellites. JavaGenes-Scheduler uses a simple, earliest-first scheduler to insert observations into the time-line in permutation order.
Open Source

Juneberry Web Service Software — NPO-48378-1

This software implements the open Webification API and provides ReSTful Web services for planetary image data in commonly used formats. It exposes content of planetary image data through meaningful URLs and enables the creation of applications on diverse platforms.
U.S. Government Purpose Release

Juneplum: ReSTful Web Access of OPeNDAP Hyrax Back-End Server — NPO-49868-1

Juneplum is implemented as a Java servlet Web app and can be directly deployed into the same servlet engine that Hyrax front-end occupies. With Juneplum, any data product served by OPeNDAP is made simultaneously accessible in a fully ReSTful way
U.S. Government Purpose Release

Libbrace — GSC-18186-1

In Linux/UNIX shells, it is possible to write a combination of strings in shorthand. For example test{0..3} would expand to test0, test1, test2, test3. Doing this in a C/C++ program currently involves launching a shell to perform the expansion. This library, Libbrace (Library Brace Expansions), performs the simple task of providing bash style brace expansions with the C Standard Library. This library itself is a simple rewrite of existing systems for use in the C/C++ programming language.
Open Source

libSPRITE
MFS-33231-1

libSPRITE was specifically designed for real-time systems that operate on a single computational node (but may be multi-core) to systematically address common coding errors, provide for multi-threaded programming to produce the exact same results regardless of the number of cores on the host compute node, and offer support for in-operation reconfigurability (parameter and control flow modifications). Components include engineering unit encoders, math functions, a task scheduler built on top of pthreads, a publish/subscribe data distribution system, and a Lua scripting language interface.
Open Source

MarsGIS Human Landing Site and Exploration Zone Viewer and Collaboration Tool
LAR-19183-1

The innovation includes a GIS layer and a web-based GIS service. The GIS layer includes the geospatial location and spatial extent of the exploration zones (EZs), regions of interest, and data characterizing the science and resources purported to be available. The data was extracted from publicly available abstracts and presentations for the Human Landing Sites Study EZ Workshop in October 2015 as proposals for the first human landing site on Mars. The web-based service allows users to view and analyze this layer; verify, alter, and annotate data; and add/edit/delete new EZs and will support user collaboration on these data. The layer was developed under the auspices of a Systems Analysis and Concepts Directorate investment fund opportunity.
General Public Release

Mesh: Lightweight Grid Middleware Using Existing SSH Infrastructure
ARC-15857-1

A lightweight grid middleware that is based on the addition of a single sign-on capability to the built-in public key authentication mechanism of SSH using system call interposition. The initial Mesh implementation is compatible with approximately 90% of the world's SSH servers and any SSH client that supports public key authentication. Resources may be added to a Mesh-based grid in a matter of minutes using just three small files and two environment variable settings. Mesh adheres to fundamental security principles and was designed to be compatible with strong security mechanisms including two-factor authentication, SSH bastions, and restrictive firewalls. Several existing services have been integrated with Mesh to provide resource discovery and query, high performance file transfer, and job management.
Open Source

Metadata Check
GSC-15012-1

Metadata Check is a command-line tool to check Earth Observing System (EOS) metadata with a metadata descriptor. For more information, please visit: http://opensource.gsfc.nasa.gov/projects/meta-check/index.php
Open Source

Multi-Threaded Copy Program (MCP)
ARC-16494-1

MCP is a high-performance file copy utility that achieves performance gains through parallelization. Multiple files and parts of single files are processed in parallel using multiple threads on multiple processors. The program employs the OpenMP and MPI programming models.
Open Source

NASA Technology Transfer System (NTTS)
ARC-16564-1

The NASA Technology Transfer System (NTTS) is NASA's enterprise system that captures NASA technologies. NTTS supports various technology transfer related activities and business processes.
U.S. Government Purpose Release

NASA UNIX Tool Kit
KSC-12269

The NASA UNIX Tool Kit contains three components that all work together to form a single technology for UNIX administration: (1) Secure, Web-based UNIX System Administration Tools (KSC-12269) ease the administration of a large, distributed UNIX system, providing a secure mechanism for creating, modifying, locking, and deleting users. (2) The second component of the software kit is the Client/Server to Create, Modify, and Query VERITAS File System Quotas on an NFS-Mounted File System with a Secure Web-based Interface (KSC-12268). In this technology, the client (which exists on an internal secure platform with a secure interface) can be accessed from any authorized platform capable of running a Web browser. The server software exists on a UNIX platform configured with the VERITAS file system. (3) The Web-based IP Address Tool (KSC-12271) provides an easy-to-use system for maintaining IP address information for a network of computers.
General Public Release

Netmark eXtensible DataBase, Data Access, and Retrieval Composition (XDB3-DARC)
ARC-16119-1B

This innovation will query using a suite of operators in the Netmark/XDB query language to retrieve elements based on the absolute value of tags in the XML source. In an earlier version of the software, element retrieval was based solely on "full-text" term searches of the tags and their values.
Open Source

NETMARK, Version 3.0
ARC-15722-1A

NETMARK 3.0 utilizes the same API as the previous versions but includes a rebuilt backend system utilizing NoSQL database technology. NETMARK 3.0 also introduces JSON output (in addition to the previously available XML output).
U.S. Government Purpose Release

Network Management and Monitoring System for Delay/Disruption-Tolerant Networks
GSC-17596-1

This software allows a user to manage and monitor a challenged network of remote nodes.
Open Source

NEXUS: Deep Data Platform
NPO-50157-1

NEXUS provides a bridge between science data and horizontal-scaling data analysis. It provides a workflow to divide science artifacts into small data tiles to store in a cloud-scaled database where they can be quickly retrieved through a high-performance spatial search registry. Through spatial index, NEXUS provides fast access to all relevant data tiles where each tile fits into RAM for fast in-memory computation.
Open Source

NodeMon: A Visualization Tool For Monitoring System Resource Utilization
ARC-15771-1

Allows distributed resource monitoring via a growler software infrastructure. The tool is tailored to the Altix architecture but is applicable to any Linux system. Individual modules will monitor CPU, memory, and numa-link activity. NodeMon will compose large amounts of statistical information and display it through a single graphical window.
Open Source

Oceanographic Data Management and Archive System
NPO-47934-1

The Physical Oceanography Distributed Active Archive Center (PO.DAAC) is the center for oceanographic data for the NASA Earth Science Data and Information System (ESDIS). The primary function of PO.DAAC is to ingest, validate, archive, and distribute oceanographic artifacts.
Open Source

Open GeoSocial Consumer Application GSC-17162-1

This software interface provides a social and collaborative environment to allow end-users to discover, visualize, and access Earth science information on demand from simple browsers and share the resulting products with their friends and/or community of interest through social networks.
Open Source

Optimal Alarm System Design and Implementation ARC-16561-1

An alarm system that can robustly predict a level-crossing event that is specified over a fixed prediction horizon. Given a specific modeling paradigm that can be learned using appropriate data-driven or machine learning techniques, an optimal alarm system can be designed to elicit the fewest false alarms for a fixed detection probability. During implementation, value prediction of future process values can subsequently be used to enable the prediction of associated level-crossing events that may occur in the future, using a parameter that was selected to achieve robustly optimal performance during the alarm system design stage.
Open Source

Perl 6 DBPg PostgreSQL Module GSC-18031-1

PostgreSQL is an open-source relational database management system. This module provides a rich interface to the PostgreSQL libpq library for Perl 6. It includes capabilities for prepared query caching, database connection caching, exception handling, flexible type conversion (including Boolean, date, date/time, byte arrays, etc.), bulk data copy in and out, listen/notify, transactions, and cursors for large query processing.
Open Source

Perl 6 Epoll GSC-18030-1

This simple wrapper exposes the Linux Epoll(7) I/O event notification facility within Perl 6.
Open Source

Perl 6 Eredis Bindings Module GSC-17829-1

These Perl 6 bindings and modules are for interacting with the Redis database system.
Open Source

Perl 6 GraphQL GSC-17798-1

A Perl 6 implementation of the Facebook GraphQL standard query language is described in detail at:
http://graphql.org/
Open Source

Perl 6 Libarchive:
Interface to Libarchive Multi-Format Archive And Compression Library GSC-18241-1

Provides a Perl 6 interface to the widely used libarchive multi-format archive and compression library. The functionality is supplied by the underlying library. This module provides a very easy to use high-level interface to that existing functionality.
Open Source

Perl 6 LibCurl GSC-17847-1

This module is a Perl 6 interface to the C LibCurl library. It includes Perl 6 native call bindings for accessing functionality and an object-oriented layer on top.
Open Source

PSYCO: A Predicate-based Symbolic Compositional Reasoning Environment ARC-17644-1

PSYCO is a software environment that generates precise Java component interfaces which describe legal sequences of method invocations of a component. Guards on method parameters are included in the automata transitions in order to capture more precisely the interface behavior of the component. The first software environment to combine symbolic approaches with automata learning, PSYCO uses a technique named concolic execution to compute guards and active automata learning to compute legal sequences of invocations. PSYCO's concolic execution engine, JDART, handles many data types and scales to industrial and aerospace applications.
Open Source

Remote Memory Access Protocol Target Node GSC-16467-1

This NASA technology provides SpaceWire design users with support for executing remote memory access protocol read and write commands. The target IP core is a VHDL description suitable for implementation in a field-programmable gate array or an application-specific integrated circuit.
U.S. Release Only

Retools: Restriping Tools for Lustre ARC-16873-1

A set of modifications to the commonly used open-source utilities bzip2, gzip, rsync, and tar that automatically selects the stripe size for created and/or extracted files according to the sizes of the files involved.
Open Source

ROC (Receiver Operating Characteristic) Curve Code Augmentation ARC-17529-1

This release extends existing open-source software's capabilities and functionality by bookkeeping more detailed information on internal data structures, as well as enhanced error and special condition checking. Additional performance criteria have also been included, such as computing the AUC (Area under the ROC curve), pAUC (partial AUC), and other relevant statistics such as accuracy, confusion matrices, precision, recall, etc.
Open Source

Shift: Self-Healing Independent File Transfer ARC-16940-1

A lightweight framework for high performance local and remote file transfers that provides resiliency across a wide variety of failure scenarios through various techniques.
Open Source

Simple Subset Wizard GSC-16375-1

The Simple Subset Wizard (SSW) makes searching for granules easier. The tool unites the search function with various subsetters to deliver a single, simple, seamless process. SSW uses OpenSearch to query the Earth Observing System Clearing House (ECHO) for granules and then employs individual subset agents to submit requests. The SSW currently has 11 agents to interface with different subsetters, which support the subsetting of 217 EOSDIS data sets. The SSW provides the capability to subset by either temporal range or spatial region, although not all subsetters have both of these capabilities.
Open Source

Simple, Scalable, Script-Based Science Processing Archive (S4PA) GSC-15877-1

Simple, Scalable, Script-Based, Science Processing (S4P) Archive (S4PA) is a disk-based archiving system for remote sensing data. The tool can be used for new data transfer, data preprocessing, metadata generation, and data archival. Services provided include data access control, data subscription, metadata publication, and data recovery. All data are archived on readily available disk drives, with FTP and HTTP being the primary modes of data access. S4PA includes a graphical user interface for monitoring and re-configuring system operation.
Open Source

Software Suite to Support In-Flight Characterization of Remote Sensing Systems   SSC-00393

A software suite, developed to support NASA's in-flight characterization of commercial remote sensing systems, efficiently automates reproducible processing of ground truth data. It is unique in that it takes input from a number of disparate data sources and condenses and rapidly processes it to a form useable by the characterization process.
General Public Release

Space Station Research Explorer (SSRE) App, Version 5.0   MSC-26214-1

Explore the diverse ecosystem of experiments being researched on the International Space Station – both completed and ongoing. Investigate the results and benefits of many of the experiments and find out why performing research in a microgravity environment is so important. The Space Station Research Explorer provides current information on ISS experiments, facilities and research results through video, photos, interactive media, and in-depth descriptions. Downloads are available on Apple or Google App Stores (no agreement with NASA needed).
General Public Release

SSHIM: SSH Interruption Mitigator   ARC-18335-1

A tool that allows remote commands operating over SSH channels to continue operation across multiple failures of the underlying channel.
Open Source

STAMiNA   NPO-45213-1

Utilizing STAMiNA, a simulation tool for the Advanced Sensors Collaborative Technology Alliance Microsensor Network Architecture, users can define: (1) mission environment including terrain features; (2) a sensed object set including multiple threat objects; (3) sensor placements, their modalities, and their abilities to sense different object types; (4) threat object trajectories; (5) sensing and sensed data dissemination for information fusion; and (6) various network configurations and formations between sensors to examine the coupling of sensing and communication. With these features, STAMiNA provides an overall system-level performance of different sensor network architectures under different parametric conditions.
U.S. Government Purpose Release

State Chart Autocoder   NPO-47810-1

This NASA technology automatically generates code from UML/SysML state-machine models specified in the MagicDraw modeling tool. Input is saved as XML data files, and output is provided by the state-machine implementation code in C, C++, Python, or Promela. A test suite validates output products, and a test harness allows a developer to execute and animate a model with a graphical state-machine monitor. This monitor can run as either a standalone tool or as an Eclipse plug-in to MagicDraw.
U.S. Government Purpose Release

Synchronization, Archival, Validation, and IP Exchange (Save)   ARC-16445-1

Save is a high-availability framework that manages IP addresses shared between multiple servers. It also monitors the health of those servers to determine which one should be actively servicing requests at any given time. Synchronization mechanisms allow configuration files to be kept consistent between systems and also allow commands to be executed across all servers of a particular type. Archival mechanisms provide automatic version control of configuration files to aid in recovery in case of errant configuration.
Open Source

User-Friendly Metadata   GSC-15014-1

The User-friendly Metadata (UFM) tool functions as a filter. The tool accepts an ODL file as input and generates a simple HTML representation of the ODL as output. Command-line options provide a user with the ability to modify the program's functionality. Please visit: http://opensource.gsfc.nasa.gov/projects/UFM/index.php
Open Source

Design and Integration Tools

Vehicle/Payload Modeling and Analysis, Component and Integrated System Simulation

The full-scale mock-up of NASA's Mars Cube One spacecraft held by Farah Alibay, a systems engineer for the project, is dwarfed by the one-half-scale model of NASA's Mars Reconnaissance Orbiter behind her.

Featured Software

Copernicus Trajectory Design and Optimization System, Version 5.2　　　　　MSC-26673-1

Copernicus v5.2 is a new release of the Copernicus spacecraft trajectory design and optimization program. This is an update to version 5.1, which was released in March 2021. Copernicus 5.2 is a significant update to the tool and includes: a new modern Python-based GUI that is now cross-platform and fully functional on Windows, Linux, and macOS3D graphics upgrades including antialiasing and celestial body shadowing; new Python features such as a scripting interface, API, and plugins; inclusion of the IPOPT optimization method; many other new features and options; and bug fixes and stability improvements. Copernicus is capable of solving a wide range of trajectory optimization problems. These include trajectories centered about any planet or moon in the solar system, trajectories influenced by two or more celestial bodies such as libration point trajectories (halo orbits) and distant retrograde orbits, Earth-Moon and interplanetary transfers, asteroid and comet missions, and more. The software is available for Windows, Linux, and macOS.
U.S. Government Purpose Release

Failure Modes and Effects Analysis Tool (FMEA)　　　　　MSC-25379-1

This prototype failure analysis software tool models a system's components, their connective relationships, and their functions in order to assist in failure modes and effect analysis (FMEA) early in the design life cycle. The technology semi-automatically generates a model with functions and failure modes to support FMEA.
General Public Release

TetrUSS Computational Fluid Dynamics Software (TetrUSS)　　　　　LAR-16882-1

The most awarded software in the history of NASA, TetrUSS is a suite of computer programs used for fluid dynamics and aerodynamics analysis and design. The software is widely used in other government organizations, the aerospace industry, academia, and non-aerospace industries such as automotive, biomedical, and civil engineering.
U.S. Release Only

42: A Comprehensive General-Purpose Simulation of Attitude and Trajectory Dynamics and Control of Multiple Spacecraft Composed of Multiple Rigid or Flexible Bodies   GSC-16720-1

This is a simulator of spacecraft attitude, orbit dynamics, and environmental models. Spacecraft models composed of multiple bodies are supported. The environment models include ephemerides for all planets and major moons in the solar system. The simulator is open-source and portable across computing platforms, making it customizable and extensible. It is written to support the entire GNC design cycle, from rapid prototyping and design analysis to high-fidelity flight code verification.

Open Source

Advanced Graphics for Engineering Analysis (AGEA) version 5.7.3   MSC-27334-1

AGEA is a three-dimensional visualization and analysis application that provides modeling and animation tools for real-time and pre-rendered simulations. It is a front-end application that relies on a collection of functions known as the IGOAL Graphics Library (IGL).

U.S. Release Only

Advanced Life Support Sizing Analysis Tool (ALSSAT), Version 12.0   MSC-25510-1

ALSSAT is a computer model for sizing and analyzing designs of environmental control and life support systems (ECLSS) for spacecraft and surface habitats involved in the exploration of Mars and the Moon. It performs conceptual designs of advanced life support (ALS) subsystems that recycle air and water and process wastes in order to reduce the need for resource resupply. ALSSAT is a means of investigating combinations of such subsystems' technologies and thereby assists in determining the most cost-effective technology combination available. Using the Microsoft Excel spreadsheet software with Visual Basic programming language, ALSSAT has been developed to perform multiple case trade studies based on the calculated ECLSS mass, volume, power, and Equivalent System Mass, as well as parametric studies by varying the input parameters. ALSSAT's modular format is specifically designed for the ease of future maintenance and upgrades.

U.S. Release Only

Architecture Adaptive Computing Environment (ACE)   GSC-14911-1

The Architecture Adaptive Computing Environment (ACE) is a parallel computing language, compiler, and runtime library. The purpose of ACE is to allow a programmer to more easily write parallel programs for a wide variety of parallel computer architectures.

Open Source

Arnold Mirror Modeler Software   MFS-33271-1

This software creates complex finite element models of large-format, lightweight mirrors for complete input decks. Before, building these models could take engineers weeks or even months to complete a single iteration. Now the modeler tool can do the same task in minutes. The software creates many levels of model complexity, from single mirrors (circular or hexagonal shapes) to arrays of mirror segments. Models can have local reinforcement surrounding attachment points, and mesh can be refined (doubled) as many times as necessary.

U.S. Government Purpose Release

Assert-Based Unit Test Tools   GSC-16689-1

These tools provide a framework and a collection of utilities designed to facilitate unit testing. They implement an assertion-based philosophy that requires the developer to explicitly write verification statements that assert whether a condition is true or false. In order to use the tools, the developer populates the framework with the ut-assert library to create an executable.

Open Source

Automated Triangle Geometry Processing for Surface Modeling and Cartesian Grid Generation (Cart3D)
ARC-14275-1

Cart3D is a high-fidelity inviscid analysis package for conceptual and preliminary aerodynamic design. It allows users to perform automated computational fluid dynamics (CFD) analysis on complex geometry. The package includes utilities for geometry import, surface modeling and intersection, mesh generation, and flow simulation. Cart3D is highly automated so that geometry acquisition and mesh generation can usually be performed within a matter of minutes on most modern UNIX workstations or PCs.
U.S. Government Purpose Release

Basic Comparison of Python, Julia, Matlab, IDL, R, Java, Scala, Fortran and C
GSC-18111-1

This is a database of codes and test results evaluating the performance of several computer languages (Python, Julia, Matlab, IDL, R, Java, Scala, Fortran and C). The goal is to highlight the strengths and weaknesses of each language. The results (updated at least once a year) and source code are presented through a NASA website accessible to practitioners who need such information to determine which language is appropriate to accomplish a specific task.
Open Source

Bearing Analysis Tool (BAT)
MFS-31864-1

The Bearing Analysis Tool (BAT) allows detailed design of rolling element bearings rocket engine turbopumps and other applications. It includes a graphical user interface that greatly reduces the effort required to define analytical models for simulation and design.
U.S. Release Only

Beyond Low-Earth Orbit (LEO) Architecture Sizing Tool (BLAST)
MSC-25505-1

A user-friendly, configurable spacecraft sizing tool, BLAST provides a shareable, re-creatable and rigorous end-to-end multi-element architecture framework that has been used to generate mass data for in-space, beyond low-Earth orbit (LEO) transportation vehicles and architectures. Offering a novel approach to modeling, BLAST couples extensive MER research with the ability to assess mission changes instantaneously by analyzing sensitivity sweeps of several parameters at once.
U.S. Government Purpose Release

CCSDS SOIS Electronic Data Sheet Implementation for Core Flight System
LEW-19710-1

This software is a set of tools that implement the Electronic Data Sheets specification from the CCSDS SOIS working group, compliant with book CCSDS book 876.0. The code integrates with the NASA Core Flight System to provide a robust EDS-based command, telemetry, and configuration solution.
Open Source

CFACS: Constrained Fitting for Airfoil Curvature Smoothing
LAR-17227-1

CFACS uses a spline-based airfoil smoothing method with the sum of squares of the third derivative jumps as a curvature smoothness measure. CFACS can take out dramatic curvature oscillations with extremely small geometry changes and smooth an airfoil segment without creating curvature oscillations near the endpoints. Visually, CFACS generates an unbiased smooth fit of the curvature profile. CFACS can smooth airfoils to either promote desirable performance characteristics or remove undesirable pressure field oscillations in computational fluid dynamics solutions.
U.S. Release Only

Chimera Grid Tools, Version 2.2   ARC-16025-1B

The Chimera Grid Tools software package is used for performing pre- and post-processing of computational fluid dynamics analysis on complex configurations using overset grids. It contains a collection of software tools for performing geometry processing, surface and volume grid generation, grid manipulation and diagnostics, flow solver input preparation, multi-body dynamics input preparation and animation, flow solution visualization, debris trajectory analysis input preparation, strand grid and AMR Cartesian grid visualization, flow solution post-processing analysis including forces and moments computation, and convergence history visualization.
U.S. Release Only

CMPGEN: A Modeling Tool Used to Compute Off-Design Performance of Fans, Boosters, and Compressors   LEW-19686-1

CMPGEN is a modeling tool used to compute off-design performance of axial fans, boosters, and compressors. Users can obtain rapid and consistent off-design performance characteristics from simple design point inputs. Component performance maps are suitable for use in the Numerical Propulsion System Simulation (NPSS) gas turbine engine cycle analysis code output.
U.S. Release Only

Cobra Code Browser and Analyzer: An Extendable, Interactive Tool for the Analysis of C Code   NPO-50050-1

This tool provides software developers, peer reviewers, testers, and quality assurance personnel with an interactive method that facilitates searching for patterns, confirms compliance or non-compliance with coding guidelines and coding standards, and identifies suspicious code fragments. Cobra uses a lexical analyzer for C to scan in source code.
U.S. Government Purpose Release

CoCoSim: Simulink Verification Framework   ARC-18277-1

This framework integrates analysis technologies for verifying and validating Simulink and Stateflow models. CoCoSim can be used to automatically perform test case generation and to evaluate the validity of user-supplied safety requirements. Structured to operate much like a compiler, the software sequences a series of translation steps leading, eventually, to either the production of source code or to the call of a verification tool.
Open Source

Collection of Nonlinear Aircraft Simulations in MATLAB   LAR-17463-1

This package includes nonlinear six degree-of-freedom simulations for a variety of aircraft created using MATLAB. Data for aircraft geometry, aerodynamic characteristics, mass/inertia properties, and engine characteristics have been obtained from open-literature publications documenting wind tunnel experiments and flight tests. Each nonlinear simulation has been implemented within a common framework and includes an interface with another commercially available program to read pilot inputs and produce a 3D display of the simulated airplane motion. Aircraft simulations include the General Dynamics F-16 Fighting Falcon, Convair F-106B Delta Dart, Grumman F-14 Tomcat, McDonnell Douglas F-4 Phantom, NASA Langley Free-Flying Aircraft for Sub-scale Experimental Research (FASER), NASA HL 20 Lifting Body, NASA/DARPA X-31 Enhanced Fighter Maneuverability Demonstrator, and the Vought A-7 Corsair II.
U.S. Release Only

Computational Fluid Dynamics (CFD) Utility Software Library   ARC-14467-1A

A collection of utility programs and reusable subroutine libraries supports computational fluid dynamics, particularly on multiblock structured grids. The technology is applicable to all flight regimes (subsonic, transonic, supersonic, and hypersonic).
Open Source

Design and Integration Tools

Computational Fluids Laboratory 3-Dimensional (CFL3D)   LAR-16003-1

CFL3D is a structured-grid, cell-centered, upwind-biased, Reynolds-averaged Navier-Stokes (RANS) code. It can be run in parallel on multiple grid zones with point-matched, patched, overset, or embedded connectivities. Both multigrid and mesh sequencing are available in time-accurate or steady-state modes.
Open Source

Configuration-Based Aerodynamics (CBAero)   ARC-15819-1

CBAero is a software tool for the prediction of the conceptual aero-thermodynamic environments of aerospace configurations. The vehicle geometry is defined using unstructured, triangulated surface meshes. For subsonic Mach numbers a fast, unstructured, multi-pole panel code is coupled with a streamline tracing formulation to define the viscous surface solution. For supersonic and hypersonic Mach numbers, various independent panel methods are coupled with the streamline tracing formulation, attachment line detection methods, and stagnation-attachment line heating models to define the viscous aero-thermal environment.
U.S. Release Only

Constrained Direct Iterative Surface Curvature (CDISC) Aerodynamic Design Software   LAR-18693-1

CDISC is a system of software codes that, when coupled with computational fluid dynamics flow solvers, provides a method for aerodynamic design. The core design algorithm uses prescribed flow/geometry sensitivity derivatives to make geometry changes based on the difference between target and analysis pressures on the surface of the configuration being designed. The target pressures can be directly specified or may be generated using the flow constraint options in CDISC that modify the current analysis pressures to meet common engineering quantities such as lift and pitching moment. Geometry constraints, such as wing thickness or curvature, are also included to meet requirements from other disciplines such as structures and manufacturing.
U.S. Release Only

Copernicus Trajectory Design and Optimization System, Version 5.2   MSC-26673-1

Copernicus v5.2 is a new release of the Copernicus spacecraft trajectory design and optimization program. This is an update to version 5.1, which was released in March 2021. Copernicus 5.2 is a significant update to the tool and includes: a new modern Python-based GUI that is now cross-platform and fully functional on Windows, Linux, and macOS3D graphics upgrades including antialiasing and celestial body shadowing; new Python features such as a scripting interface, API, and plugins; inclusion of the IPOPT optimization method; many other new features and options; and bug fixes and stability improvements. Copernicus is capable of solving a wide range of trajectory optimization problems. These include trajectories centered about any planet or moon in the solar system, trajectories influenced by two or more celestial bodies such as libration point trajectories (halo orbits) and distant retrograde orbits, Earth-Moon and interplanetary transfers, asteroid and comet missions, and more. The software is available for Windows, Linux, and macOS.
U.S. Government Purpose Release

Core Flight System Simulink Interface Layer (SIL)   GSC-18115-1

This is a software abstraction layer allowing task or mission-specific code generated from Simulink (or other sources) to interface with the Core Flight System (CFS) via a generic set of wrapper code. SIL simplifies the integration of code as a CFS application and eliminates the need for hand edits to generated code, allowing quicker integration of code and reducing the probability of human error.
Open Source

Data Parallel Line Relaxation Code (DPLR), Version 4   ARC-16021-1A

The DPLR software package is a suite of CFD tools for the computation of supersonic and hypersonic flows in chemical and thermal nonequilibrium. Included in the package are 2D/axisymmetric and 3D structured-grid finite volume Navier-Stokes codes, a pre-processor, and a post-processor. The code supports implicit boundary conditions, generalized multi-block topologies, grid alignment to flow features, and generalized chemical kinetics and thermodynamic property databases.
U.S. Government Purpose Release

dcapp: Displays and Controls Application   MSC-26476-1

dcapp provides a simple interface for building and running displays and controls on a desktop or laptop computer. It processes user inputs, typically mouse clicks and keyboard entries, and renders displays to the computer screen based upon the data fed to it. Designed for UNIX platforms, specifically MacOS and Linux, it has built-in communication libraries to communicate with external Trick-based simulations and EDGE graphics.
U.S. Government Purpose Release

Evolutionary Mission Trajectory Generator (EMTG) v9   GSC-18459-1

This software is a scalable-fidelity optimization package for space trajectory design. EMTGv9 is suitable for trade studies, sensitivity analysis, and serves as an initial guess generator for a flight fidelity tool. EMTGv9 can design missions using high-thrust chemical propulsion or low-thrust electric propulsion.
Open Source

Exploration Visualization Environment, Version 2.15   LAR-19859-1

The Exploration Visualization Environment (EVE) is a simulation, visualization, and analysis system developed to support the design and planning of space-based missions. Through the integration of time dependent data with detailed graphical models within a full scale three dimensional solar system or independent reference frame, the analyst can gain valuable insight into the correlation of data with simulation events. Version 2.15 of EVE has been built upon previously released versions, enhancing analysis capabilities, greater usability, and enhanced input and output features. EVE has been developed to run cross platform under Linux, Windows and Mac.
U.S. Government Purpose Release

Extended Testability Analysis (ETA) Tool, Version 8.0   LEW-19241-1

This technology is a NASA Glenn-developed software application that supports fault management (FM) by performing testability analyses on the fault propagation model of a given system.
U.S. Release Only

Failure Modes and Effects Analysis Tool (FMEA)   MSC-25379-1

This prototype failure analysis software tool models a system's components, their connective relationships, and their functions in order to assist in failure modes and effect analysis (FMEA) early in the design life cycle. The technology semi-automatically generates a model with functions and failure modes to support FMEA.
General Public Release

Flight Dynamics Simulation of a Generic Transport Model   LAR-17625-1

This software is a flight dynamics simulation of a transport aircraft. It implements general rigid body equations of motion for the vehicle dynamics and draws aerodynamic forces from a standard coefficient expansion implemented as table lookups. Dynamics of actuator servos and bandwidth of sensors are also included. The simulation is coded in Simulink, a model-based environment using a commercial simulation package from MathWorks, Inc. The software is not standalone; it must be run from inside this commercial environment, making use of numerical libraries for basic operations, as well as the overall time-stepping and numerical integration routines.
Open Source

fmdtools   ARC-18750-1

Fmdtools is a Python toolkit for simulating the dynamic effects of hazardous scenarios in complex engi-
neered systems and analyzing the associated resilience of the system. To support early design work,
fmdtools uses a function-based representation which can evolve as the concept increases in fidelity,
enabling network-based, static, and dynamic behavioral representations of the system. This function-based
representation additionally enables conduction early functional hazard assessment (FHA) processes in
simulation, thus enabling an iterative design process that can explore and systematically compare the
resilience of a wide range of designs.ere are three main components of the fmdtools package: (1) Model
definition constructs which enable systematic early specification of the high level structure and behaviors
of a system with concise syntax. (2) Simulation methods which enable the quantification of system perfor-
mance and propagation of hazards over a wide range of operational scenarios over a wide range of model
types. (3) Analysis methods for quantifying resilience and summarizing and visualizing behaviors and prop-
erties of interest. Put together, these components comprise a design, simulation, and analysis environment
which can be used consider the resilience of a system of interest in the design process.
Open Source

FIAT: Fully Implicit Ablation and Thermal Analysis Program, Version 3   ARC-15779-1A

FIAT v3 simulates one-dimensional thermal energy transport in a multilayer stack of isotropic materials and
structures that can ablate from the front surface and decompose in depth. The implicit solution algorithm
and general solution technique make the program very stable and robust for application to both robotic and
crewed vehicles entering a planetary atmosphere from space. For input, the code reads material property
information from a database file.
U.S. and Foreign Release

General Mission Analysis Tool (GMAT), Version R2022a   GSC-19097-1

GMAT is a software system for trajectory optimization, mission analysis, trajectory estimation, and predic-
tion. Analysts use GMAT to design spacecraft trajectories, optimize maneuvers, perform orbit determination,
visualize and communicate mission parameters, and understand a mission trade space. GMAT contains
models of real-world objects such as spacecraft and thrusters, as well as analysis "objects" such as
plots and reports. These objects are used in the mission sequence wherein the user employs commands
supported by the system to model missions and perform estimation. Please visit the following URL for addi-
tional information: **http://opensource.gsfc.nasa.gov/projects/GMAT/index.php**
Open Source

General-Use Nodal Network Solver (GUNNS), Version 19.X   MSC-26727-1

This solver combines standard nodal circuit analysis algorithms with the hydraulic-thermal-electric analogy
to allow modeling of flow circuits (fluid, thermal, electrical) with a concise set of generic code. Circuits are
drawn up with a Draw.io drawing, from which run-time C++ code is auto-generated that can be built into
simulations. The software includes custom Draw.io shapes for generic physical components like pumps,
valves, resistors, and capacitors. These can be connected to each other in the drawing and configured with
their characteristic values.
Open Source

Genesis Flight Mechanics Simulation and Trajectory Design Tool v0.3.0   MSC-27061-1

Genesis is a generic, multi-vehicle, variable-degree-of-freedom flight mechanics simulation for trajectory
design. It is capable of modeling ascent, aerocapture, entry, descent, and landing trajectories around
a single planetary body. It is designed to be flexible and easily reconfigured for new vehicles. Genesis
provides generic models for atmospheric properties, winds, aerodynamics, and propulsion. It can easily be
extended with new environment, vehicle, or flight software models. Genesis can be used for a wide variety
of analyses, ranging from optimizing a single trajectory to running a large Monte Carlo analysis in a High-
Performance Computing (HPC) environment. It consolidates and replaces a suite of legacy flight mechanics
simulations. It is implemented in the Julia programming language.
U.S. Government Purpose Release

Global Modeling Initiative (GMI) Software
GSC-15363-1

The Global Modeling Initiative (GMI) is a state-of-the-art, modular 3D chemistry and transport model (CTM) that can be used for assessment of the impact of various natural and anthropogenic perturbations on atmospheric composition and chemistry, including but not exclusively the effect of aircraft.
U.S. Government Purpose Release

Goddard Satellite Data Simulation Unit
GSC-15874-1

The Goddard Satellite Data Simulation Unit (SDSU) is a comprehensive unified system of multi-sensor satellite instrumental simulators. Skill of weather forecasting models can be evaluated in terms of satellite-observed multi-sensor radiance levels. Alternatively, the remote sensing community can more readily utilize atmospheric model simulations to develop and test their retrieval algorithms for application of Earth science.
Open Source

GTM_Polysim: Nonlinear GTM Aircraft Polynomial Simulation in MATLAB, Version 2.0
LAR-17595-1

The GTM_POLYSIM is a nonlinear simulation of the Generic Transport Model (GTM) aircraft at a 5.5-percent scale. The simulation software is a collection of scripts and programs written and executed in the MATLAB computing environment.
U.S. Release Only

HLA2MPC, Version 3.0: A Software Bridge Between the IEEE 1516 High-Level Architecture to the NASA MPC Model Process Control (MPC) 3.0 Telemetry Language
KSC-14109

HLA2MPC provides the link between HLA (High Level Architecture, IEEE 1516) Simulation Federation data and any MPC3- compliant simulation or visualization tool. One such tool is DON, the Distributed Observer Network, now in version 3.1.
Open Source

HybridQ: A Hybrid Simulator for Quantum Circuits
ARC-18652-1

HybridQ is a powerful tool to simulate large scale quantum circuits. It uses different numerical techniques (including tensor contraction, direct evolution of the quantum state and Pauli operator expansion) and it has been specifically designed to run on HPC cluster. It also offers an user-friendly interface to allow users with any background to use HybridQ, without any prior knowledge of high-performance computing.
Open Source

IMCE Ontological Modeling Framework
NPO-49756-1

The Jet Propulsion Laboratory's Integrated Model-Centric Engineering (IMCE) initiative developed ontologies for Model-Based Systems Engineering (MBSE) to support JPL's MBSE practices and methodologies. The IMCE ontologies have been carefully engineered to provide support for scalable query and reasoning according to the semantics of the Ontology Web Language (OWL) standard in such a way that these ontologies can be mapped as extensions of the Unified Modeling Language (UML) and Systems Modeling Language (SysML) standards.
Open Source

Incompressible Navier-Stokes CFD Solver (INS3D)
ARC-14020-1

The INS3D code solves the incompressible Navier-Stokes equations in three-dimensional generalized coordinates for both steady-state and time-varying flow. The equations are formulated using artificial compressibility. The convective terms are differenced using an upwind biased flux-difference splitting. The equations are solved using an implicit line-relaxation scheme. The code is written for single- or multiple-zone calculations. It can utilize either pointwise continuous zonal interfaces or overset zonal interfaces if a PEGASUS interpolation database is supplied.
U.S. Release Only

Design and Integration Tools

Integrated Composite Analyzer in JAVA (ICAN/JAVA)   LEW-17247-1

ICAN/JAVA, the Integrated Composite Analyzer written in Java, was primarily designed to analyze the hygrothermomechanical response and properties of fiber- or particulate-reinforced, resin-matrix-layered composite materials, given the local membrane loads and bending moments. ICAN/JAVA was coded in the Java computer language combining features from earlier versions for both fibers and particulates, as well as adding impact modeling. The multi-factor interaction model allows factors to interact to allow for property changes due to operating conditions after fabrication. ICAN/JAVA has both a batch version and an interactive version that can also plot selected outputs.
U.S. Release Only

Integrated Lunar Information Architecture for Decision Support (ILIADS), Version 3.0   GSC-16210-1

ILIADS 3.0 provides the data management capabilities to access CxP-vetted lunar data sets from the LMMP-provided Data Portal and the LMMP-provided OnMoon lunar data product server. (LMMP stands for Lunar Mapping and Modeling Project.) It also provides specific quantitative analysis functions to meet the stated LMMP Level 3 functional and performance requirements specifications that were approved by the CxP.
Open Source

ISS Systems Integration Lab (ISIL) Operations Framework (RIM 10)   MSC-25380-1

The Software Development and Integration Laboratory (SDIL) in Sonny Carter supports ISS flight software development, integration, and verification. The complexity of the ISS requires efficient and reliable test reconfiguration, flexible resource scheduling, and effective workflow and also time-effective configuration management. An electronic workflow system was conceived and dubbed Rig Information Management (RIM). The SDIL was then transitioned from standalone manual systems to the RIM system with database-centric, Web-based solutions enabling significant efficiencies and paperless operations. It also created productivity improvements in flight software development. This innovation was recognized with a JSC 2007 Exceptional Software Award.
U.S. Release Only

JSC Engineering Orbital Dynamics (JEOD) Version 5.x   MSC-27344-1

The JSC Engineering Orbital Dynamics (JEOD) Software Package contains a set of numerical mathematical models that provide vehicle or vehicles trajectory generation by the solution of a set of numerical dynamical models. These models are comprised of an environment model representing the gravitational and non-gravitational forces and torques acting on the vehicle or vehicles, dynamics models for processing and numerically integrating the equations of motion, Interaction models representing interaction with the environment and a set of mathematical and orbital dynamics utilities.
Open Source

Knife Boolean Substraction Library for Polyhedra, Version 1.0   LAR-17481-1

The Knife library calculates the Boolean subtraction of arbitrary watertight triangular polyhedral in order to make near-field sonic boom predictions. https://github.com/NASA/knife
Open Source

Koviz: A Simulation Data Analysis, Visualization And Mining Tool   MSC-26621-1

This is a visualization tool designed for analyzing data from the Trick Simulation Environment, a framework also developed at Johnson which expedites the creation of simulations for all phases of space vehicle development. Koviz is specialized for handling large Monte Carlo data sets and doing real-time analyses of Trick simulations.
Open Source

Design and Integration Tools

KSOPT: An Indirect Method for Numerical Optimization
Using the Kreisselmeier-Steinhauser Function, Version 3.1
LAR-18488-1

This is a technique for converting a constrained optimization problem into an unconstrained problem. The software transforms one or more objective functions into reduced objective functions analogous to goal constraints used in the goal programming method. The reduced objective functions are appended to the set of constraints, and an envelope of the entire function set is computed using the Kreisselmeier-Steinhauser function.
U.S. Release Only

LEWICE3D, Version 3.63
LEW-19433-1

LEWICE3D is a software system capable of predicting the accumulation of ice on three-dimensional aircraft surfaces given the flight and meteorological conditions representative of an icing cloud. The software utilizes input information of the airflow surrounding the body of interest and then calculates trajectories of approaching water droplets, the mass and energy transfer processes at the surface of the body, and the resulting ice mass and the shape it will take on the body.
U.S. Release Only

Light Gas Gun Performance Code (ONEDIM)
ARC-18153-1

This program calculates the performance of a two-stage light gas gun from first-stage powder burn through projectile exit from gun muzzle.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Body-Centric Insertion Tool
LAR-18741-1

This tool is intended to support mission architecture designers to design simple orbits for vehicles entering into the sphere of influence of a planet from heliocentric space. It allows architects to put in information about the dV or C3 energy state and provide information about the desired parking orbit. From either C3 or dV, it calculates the remaining dV required to take the vehicle and place it in the desired orbit based on the planet and its sphere of influence.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Body-Centric Orbit Change Tool
LAR-18746-1

This tool provides dV requirements for orbit changes in inclination, periapsis, and apoapsis.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Destination Campaign Tools
LAR-18752-1

This tool provides a rough mass estimate of ground campaign equipment.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Fission Power Sizing Tool
LAR-18745-1

This system uses lifetime, chosen archetype, and EOL power demand to determine the mass and power characteristics of a fission power system.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Heliocentric Trajectory Tool
LAR-18744-1

This tool is produced is take advantage of pre-existing resources of known lambert trajectory solutions to various bodies, NEAs and more. This database is created and maintained by Ames Research Center and provides a two-significant-figure estimate of the injection deltaV to get to the desired orbit and the insertion dV to stop at the location. Additionally, it does calculate flyby maneuver effects.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: ISRU Demo Plant Sizing Tool　　　**LAR-18734-1**

The Agile ISRU Demo Plant Sizing Tool will provide a rough parametric estimate of ISRU plant mass and power requirements based on fitting data to a heritage curve. NEO, Phobos, lunar surface, and Martian surface are included at a notional level within this system that allows architecture designers to roughly scale ISRU plants before talking to specialists.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Long-Duration Habitat Sizing Tool　　　**LAR-18737-1**

This tool does parametric sizing of long term human habitats based on duration and crew size up to ten members.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Multiburn/Large-Vehicle Sizing Tool　　　**LAR-18733-1**

This tool will design a large vehicle and do inert mass fraction sizing to scale a vehicle for multiple impulsive maneuvers and different payloads.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: One-Way/Small-Vehicle Sizing Tool　　　**LAR-18739-1**

This tool sizes small or one-way/one-time-use vehicles for propulsive maneuvers both in and out of atmosphere. The system will provide rough Figure of Merit (FOM) estimates of mass, power, volume, and ephemeris/trajectory change capacity and provide a rough breakdown of the inert masses, propulsive masses, and payload masses. Additionally, the system provides context for the mass breakdown and is intended for small vehicles doing one or two maneuvers.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Orbiter Sizing Tool　　　**LAR-18736-1**

This tool sizes rough orbiter buses that include avionics, science payloads (user choice), and a scientific mass fraction, and it produces a baseball card for presentation.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Planetary Ascent/Descent dV Tool　　　**LAR-18743-1**

This tool is designed to provide rough estimates for a landing on the surface of a planet with no atmosphere. Data from this tool are used to drive sizing calculations.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Rover Sizing Tool　　　**LAR-18735-1**

This tool is intended to be used for scientific rover missions based on a heritage catalogue of scientific components, as well as relationships between scientific tool mass and total rover body mass.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Short-Duration Habitat Sizing Tool　　　**LAR-18738-1**

This tool sizes short duration human habitats for short missions less than 20 days based on identified human operations requirements.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Solar Cell/Fuel Cell/Battery Sizing tool　　　**LAR-18740-1**

This tool sizes solar power systems utilizing batteries, fuel cells, and solar cells and calculates the mass, power, and potential volume requirements of the system. It will provide a rough estimate of the sizes of the cells and the tank volumes and masses for the fuel cells and for determining decay rates and BOL/EOL power-generation demands.
U.S. Release Only

Low-Fidelity Space Systems Analysis Tools: Thermal Protection System Sizing Tool   LAR-18742-1

This system sizes Thermal Protection Systems based on simple flight path angle assessments and mass properties of the vehicle. It provides estimates of heat loads and relevant materials.
U.S. Release Only

Low-Order Potential Flow Panel Code (PMARC), Version 14   ARC-14407-1

PMARC is a three-dimensional panel code to solve potential flow around wings and bodies. Relative motion between multiple bodies can be simulated.
U.S. and Foreign Release

Manipulator Analysis – Graphic, Interactive, Kinematic (MAGIK) Robotic Simulation, Version 8.1   MSC-27335-1

MAGIK is a robotic simulation used primarily to conduct interactive kinematic analysis of International Space Station robotic operations. MAGIK can be used to model, specify, simulate, analyze, and modify n-jointed manipulators using built-in control algorithms while displaying interactive, high-fidelity 3-dimensional graphic scenes of the robotic system and its environment. The graphics are provided by the companion package Advanced Graphics for Engineering Analysis (AGEA) – also developed at JSC.
U.S. Release Only

MBJEOD: An Integrated Multibody and Orbital Dynamics Simulation Module   MSC-25732-1

MBJEOD is a multi-body dynamics (MBDyn) software interface layer that allows transfer of forces between multi-body articulating objects and the JEOD orbital dynamics package.
U.S. Government Purpose Release

MIPP-D: In-Situ Resource Utilization (ISRU) Propellant Production Discrete Event Simulation (DES)   KSC-14131

MIPP-D is a Simio-based Discrete Event Simulation modeling Mars surface propellant production. The focus is on the actual chemical plant and processes, including incoming and outgoing materials associated with the production of rocket fuel on Mars. The fuel will be for the Mars Ascent Vehicle used to carry humans into space from the surface of Mars. The simulation utilizes NASA ground rules and assumptions, as well as data from prototype chemical plants, NASA experts, and literature. It is designed to grow in capability and complexity as needed or as additional information becomes available. The simulation does not attempt to model the complexities of surface elements acquiring feed stock or disposing of spent resources, although it does acknowledge those functions exist and uses informed assumptions where necessary.
U.S. Government Purpose Release

Mixed Reality Engineering Toolkit (MRET)   GSC-18169-1

This toolkit can be used to create augmented and virtual reality tools for integrating spacecraft designs and real-time mission telemetry for multiple domains over a mission lifecycle, including pre-phase A concept design; hardware integration and test planning and execution; and tele-robotic operations.
U.S. Government Purpose Release

Mixed Reality Exploration Toolkit (MRET) v2.0   GSC-18602-1

The Mixed Reality Exploration Toolkit (MRET) framework/platform advances NASA engineering and scientific efforts by leveraging industry advances in virtual reality (VR) and augmented reality (AR) technology to use NASA data and tools in new and innovative ways. MRET provides cross-domain, mission lifecycle support by integrating NASA "models" (both scientific models and engineering CAD-based models) with a common tool set available in AR/VR (e.g., measurement tools and lunar and planetary lighting models) and access to NASA data sources. MRET leverages the GSFC developed GMSEC tools to integrate real-time and recorded engineering (telemetry) data from multiple engineering sources to stimulate visualizations as well as provide collaboration within the NASA networks.
Open Source

Design and Integration Tools

Modular Instrumentation/Controller System (MICS)　　　　　　　　MSC-25413-1

This innovation describes a small computer system form factor that is modular in design in order to encourage reconfigurable designs. Current key modules in the concept include power, CPU, and communications. Other modules can be added as the target project requires. No agreement needed.
General Public Release

NASA Acronyms Browser Extension: Firefox and Chrome　　　　　　　　KSC-14126

This is a simple browser extension for Firefox and Chrome that defines NASA abbreviations according to the NASA acronyms database found at https://acronyms.larc.nasa.gov/. Just select any NASA-related acronym and its definition appears below it.
Open Source

NASA Lewis Steady-State Heat Pipe (LERCHP) Code　　　　　　　　LEW-15625-1

LERCHP predicts the performance of heat pipes in the steady state. It can be used as a design tool on a personal computer or, with a suitable calling routine, as a subroutine for a mainframe radiator code. For accurate heat pipe modeling, a variety of wick structures are available to the user, including a user wick input option. Several working fluids can be chosen as well (including potassium, sodium, and lithium) for which the monomer-dimer equilibrium is considered.
U.S. Release Only

NASA STRuctrual ANalysis (NASTRAN)　　　　　　　　LAR-16804-GS

NASTRAN is a finite element analysis program that was originally developed for NASA in the late 1960s under U.S. government funding for the aerospace industry. The software suite provides engineers a comprehensive simulation solution for insight into structural behavior. NASTRAN source code is integrated into a number of different software packages, which are distributed by a range of companies.
Open Source

NASA.rb (formerly fUnit)　　　　　　　　GSC-15137-1

NASA.rb (formerly fUnit) is a collection of Fortran modules that provide a framework for automating the construction, execution, and reporting of unit tests for Fortran software applications. Support is provided for several aspects of unit testing that are peculiar to scientific technical computing including distributing jparallel applications and parameterized behavior.
Open Source

NetworKing: Space Communications and Navigation (SCaN) App　　　　　　　　ARC-16778-1

The NetworKing Game is an educational, interactive 3D game in which the player develops a space communication network. As he builds his network infrastructure, client spacecraft are attracted to the network, generating income and allowing the player to build further. As the player expands his robust communication network, fortunate and unfortunate events occur. The game can be downloaded at: http://www.nasa.gov/multimedia/3d_resources/scan.html
General Public Release

Nonequilibrium Radiative Transport and Spectra Program (NEQAIR), Version 15.x　　　　ARC-15262-1B

NEQAIR has been NASA's main radiative heating code for the last 35 years. It is a line-by-line radiation code that computes spontaneous emission, absorption and stimulated emission due to transitions between various energy states of chemical species along a line-of-sight through a non-uniform gas mixture. This allows NEQAIR to calculate the radiative heat flux and detailed spectra at a specified location. The NEQAIR v15.0 release has focused on improving stability, solution robustness, usability and providing different options for running the code.
U.S. and Foreign Release

NPSS Electrical Power System Analysis Toolbox — LEW-19857-1

This electrical-power system analysis tool can integrate with traditional combustion-based propulsion models to analyze the potential benefits of aircraft electrification in the Numerical Propulsion System Simulation (NPSS) environment. The toolbox sizes the electrical power system based on required load demand at the design point and determines the power available to the loads in off-design.
Open Source

NPSS: Numerical Propulsion System Simulation — LEW-17051-1

NASA Glenn Research Center is developing a common collaborative full engine simulation tool for the U.S. Government, aerospace industry, and academia called the Numerical Propulsion System Simulation (NPSS). NPSS provides an environment for the analysis and design of propulsion systems for thermodynamic systems. The NPSS focuses on the potential integration of multiple disciplines such as aerodynamics, structures, and heat transfer, along with the concept of numerical zooming between 0-Dimensional to 1-, 2-, and 3-dimensional component engine codes.
U.S. Government Purpose Release

NPSS Elements, Models, and Interfaces — LEW-17051-1A

These engineering elements and sample models were a part of the overall NPSS package before the 2.8 release. The package contains the default set of engineering elements, sample models, and interfaces with other software packages.
U.S. Government Purpose Release

OMINAS: Open-Source Modular Image Navigation and Analysis System — NPO-50136-1

The primary motivation for the development of this software was to separate the analysis part of a problem from the data-specific part. This allows the exact same software to be used for multiple missions as needed; the only requirement for new mission input is the creation of a translator specific to that data source. The software provides an API and for developing tools for astronomical data analysis.
Open Source

Open Scheduling and Planning Interface for Exploration (OpenSPIFe) — ARC-15795-1B

The Open Scheduling and Planning Interface for Exploration (OpenSPIFe) is an integrated planning and scheduling toolkit based on hundreds of hours of expert observation, use, and refinement of state-of-the-art planning and scheduling technology for several applications within NASA. It was designed from the ground up with the needs of the operational user in mind, and it presents unique solutions to a number of problems common in other commercial and homegrown systems.
Open Source

Optimal Experimental Design with Fast Neural Network Surrogate Models — LEW-20316-1

Designing optimal experiments minimizes the uncertainty of results and maximizes the efficient use of resources. This technology uses machine learning surrogate models and the approximate coordinate exchange (ACE) algorithm are used to determine optimal experimental designs (OEDs) over large or arbitrarily restrictive design spaces. OED is particularly salient in materials science, where experiments are expensive and material properties must often be inferred indirectly. To perform tractable optimization, a neural network is trained as a surrogate model to mimic a physics-based simulation, which can calculate the expected experimental outcome based on a candidate experimental design and sampled constituent properties. The ACE algorithm is used to optimize over large design spaces with many tests and controlled parameters where an exhaustive search would be intractable even with the surrogate model.
Open Source

Design and Integration Tools

Orbit Lifetime Monte Carlo (OLMC)   LAR-17498-1

Given the dynamic environment in which spacecraft exist, a better methodology for performing orbital life-time analyses over the current practice of point analyses was desired. The approach chosen was to utilize Monte Carlo-based predictions; this provides the ability to gauge the probability of meeting mission lifetime goals, as well as identifying driving factors. The Monte Carlo analysis, called Orbital Lifetime Monte Carlo (OLMC), is based on the NASA Langley Research Center long-term orbit propagator Orbital Lifetime. OLMC incorporates the ability to model variations in predictions of solar flux levels and timing of associated peaks, the variation in launch vehicle orbit insertion accuracy (altitude, velocity, and flight path angles), spacecraft ballistic coefficients, and launch delays.

U.S. Release Only

Periodic Table of Life (PeTaL)   LEW-19879-1

This framework uses artificial intelligence to aid in the systematic inquiry of biology for its application to human systems. The backbone of PeTaL integrates an unstructured database with an ontological model consisting of function, morphology, environment, state of matter and ecosystem. Tools include text clas-sification, thesaurus, data visualization, and analysis. Applications of PeTaL include guiding human space exploration, understanding human and geological history, and discovering new or extinct life.

Open Source

PLOT3D Export Tool for Tecplot   LAR-17678-1

The PLOT3D Export Tecplot add-on is a runtime library linked into Tecplot at the time of startup of the Tecplot software. It enables Tecplot users with the ability to output PLOT3D style files from Tecplot as a grid, grid and solution, or grid and function file for use by another computer code. Existing functionality of Tecplot only offers input of PLOT3D data and output of image data or Tecplot proprietary formatted data. The PLOT3D Exporter add-on thus enables the use of Tecplot as a generation and manipulation of grid and solution data for output to flow solvers. In this capacity, Tecplot can be used to interpolate old solutions onto new grids imported into Tecplot or created within the Tecplot software. The output of PLOT3D data also enables use of Tecplot to convert solutions from other flow solvers into a standard PLOT3D data set.

General Public Release

Porous Material Analysis Toolbox Based on OpenFoam (PATO)   ARC-16680-1A

The Porous Material Analysis Toolbox (PATO) is a modular analysis platform for multiphase porous reactive materials. It can be run as a simple Fourier heat transfer code or include more advanced features as internal decomposition (pyrolysis, vaporization), gas-gas and gas-solid chemical interactions (combustion, crack-ing, coking), gas species transport (convection, diffusion), and solid morphology evolutions (internal density changes, surface ablation). PATO is implemented as a C++ top-level module of the open-source (GNU GPL) computational fluid dynamics software program OpenFOAM. This offering is not approved or endorsed by OpenCFD Limited, the producer of the OpenFOAM software and owner of the OPENFOAM and OpenCFD trademarks. PATO also uses the open-source (GNU LGPL) thermodynamics, transport, and chemistry library Mutation++ produced by the von Karman Institute for Fluid Dynamics.

Open Source

Program Round-Off Certifier via Static Analysis (PRECiSA) with Kodiak Integration   LAR-19227-1

PRECiSA, which in the current invention disclosure stands for Program Round-off Certifier via Static Analysis, is a fully automatic static analyzer for floating-point valued functions. It computes an over-approxi-mation of the round-off error of a given floating-point expression, along with a formal certificate that ensures the correctness of the estimated error. The current invention extends PRECiSA in three ways: it enables the use of external tools such as the global optimization tool Kodiak to compute numerical bounds in an efficient way; it adds input language support for loops and recursion, and it implements a more efficient analysis of nested conditionals.

Open Source

Puppet Module Master
GSC-18229-1

This is a Puppet change management module that covers a very wide range of configurations across Debian, SLES, and CentOS/RedHat that can be used as a core to automatically build and configure systems to a simple YAML specification.

Open Source

PyCycle: A Cycle-Modeling Tool for Design with Gradient Based-Optimization
LEW-19288-1

PyCycle is a novel software library written in the Python programming language. It allows a user to perform standard engine cycle analysis while also providing analytic derivative (sensitivity) calculations to the end user.

Open Source

QEMU Model for BAE Rad750 (Board Model)
GSC-17147-1

This work provides a board model and implementation of the BAE Rad750en PPCI PowerPC to PCI bridge chipset for QEMU.

U.S. Government Purpose Release

Reconfigurable Bandwidth-Efficient Transmit Waveform for High-Rate Telemetry
LEW-19307-1

This software has been developed for space communications and is intended for implementation on soft-ware-defined radio (SDR) technology. The waveform is designed to optimize the data-throughput through NASA's Space Network, in particular, the Ku-band or Ka-band single-access service, which has 225 MHz of available bandwidth. The waveform is written in very high-speed integrated circuit Hardware Description Language (VHDL), appropriate for space-qualified Field Programmable Gate Arrays (FPGAs).

U.S. Release Only

Savors: A Scalable Aural-Visual Environment for Security Event Monitoring, Analysis, and Response
ARC-16186-1

Savors is a tool for security event monitoring, analysis, and response. The technology scales to real-world environments and uses high-end computing resources on-demand to compile behavior profiles that point to anomalous behavior. Auralization allows both monitoring and analysis to be performed in parallel and draws attention to critical events in one tool when utilizing another. Remote data access and response capabilities across distributed resources are enabled using grid computing that provides a secure, single sign-on environment.

Open Source

SCaN Optical Link Assessment Tool, Version 3
LEW-19463-1

This calculation procedure has been designed and implemented in software that enables the specification and design of a space-based optical communications system. The resulting optical link budget essentially accounts for the communication power flow through the entire optical communications channel from the transmitter to the receiver and yields design specifications for the optical system necessary to assure reli-able data transmission with desired operational metrics such as data rate, link margin, etc.

U.S. Release Only

SCaN Optical Link Budget Tool
LEW-19225-1

A calculational procedure in this software enables the specification and design of a space-based optical communications system. The resulting optical link budget essentially accounts for the communication power flow through the entire optical communications channel (from the transmitter to the receiver) and yields design specifications for the optical system necessary to assure reliable data transmission with desired operational metrics. The link budget takes into account all of the sources of deleterious noise that enters into the communications, and it has the capability of being interfaced with the orbital element calculations of the Satellite Tool Kit (STK) to allow the dynamic description and evolution of optical link operation from any space-borne satellite within the solar system to and from the Earth.

U.S. Release Only

Design and Integration Tools

Sequential Monte Carlo Sampling with Python (SMCPy)   LAR-19517-1

This software is an implementation of Sequential Monte Carlo (SMC) that uses the Message Passing Interface (MPI) to provide users general access to parallel UQ methods in Python 2.7. To operate the code, the user supplies a computational model built in Python 2.7, defines prior distributions for each of the model parameters to be estimated, and provides data to be used for calibration. SMC sampling can then be conducted with ease through instantiation of the SMC class and a call to the sample() method. The output of this process is an approximation of the parameter posterior probability distribution conditioned on the data provided.
Open Source

SimuPy Flight Vehicle Toolkit   ARC-18618-1

This software library leverages open-source scientific computing tools to implement an efficient simulation framework for flight vehicles in Python. Equations of motion are composed in blocks using the SimuPy library, an open-source Python alternative to Simulink, and integrated using SciPy's wrappers for standard Fortran implementations of ordinary differential equation solvers. Dynamics equations of the inertial state variables for the position, orientation, and their corresponding rates for integration are developed using the SymPy symbolic library and implemented using code generation. Kinematics equations are implemented through symbolic definition and code generation as well as leveraging other open-source software that implements useful functions, such as the solutions to the inverse geodesy problem.
Open Source

Software Architecture Framework for Extensibility
Using Dynamic Assembly of Reflective Types (SAFE-DART)   LEW-19593-1

SAFE-DART is a framework designed to increase the extensibility and flexibility of a software system written in C++ and utilizing the Qt C++ framework from The Qt Company. SAFE-DART adds flexibility to the software system by making it simple to change computer software components (CSC) by selecting from multiple implementations provided by the software system in a way that can be controlled by the user at run-time. SAFE-DART also allows the use of modules to provide additional CSC implementations without the need to alter the original software system, allowing additional functionality to be added to the system even at run-time.
Open Source

Software for Controlling a Magnetically Levitated Rotor   LEW-17293-2

The ultimate goal in designing FATMaCC (Five-Axis, Three-Magnetic-Bearing Control Code) was to achieve full rotor levitation and control at a loop time of 50 s. Using a 1-GHz processor, the code controls a five-axis system in either a decentralized or a more elegant centralized (model control) mode at a loop time of 56 s.
General Public Release

Space Mission Architecture and Risk Analysis Tool (SMART)   NPO-49732-1

SMART supports a high-level system trade study on a complex mission, such as a potential Mars Sample Return (MSR) mission, in an intuitive and quantitative manner. SMART offers a unique capability of handling correlated redundancies and accurately evaluating the probability of mission success, as well as its sensitivity to the reliability of mission components.
Open Source

Station Spacewalk Game App   ARC-16779-1

This video game features simulations of Extravehicular Activities (EVAs) conducted by NASA astronauts on missions to the International Space Station.
General Public Release

SysML System Model for the Thirty-Meter Telescope (TMT)   NPO-50126-1

SysML is a standard, visual, and general-purpose system modeling language developed by the Object Management Group (OMG). MagicDraw from NoMagic is used as a modeling tool.
Open Source

System/Observer/Controller Identification Toolbox (SOCIT)   LAR-15241

SOCIT is a collection of functions, written in MATLAB language and expressed in M-files, that implements a variety of modern system identification techniques. For an open-loop system, it features functions for identification of a system model and corresponding forward and backward observers directly from input and output data. For a closed-loop system, SOCIT identifies an open-loop model, an observer, and corresponding controller gain directly from input and output data.
U.S. Release Only

TaskForce: A Software Task Design and Execution Framework   MSC-26281-1

The mission of TaskForce is to provide a rapid prototyping framework for a component-based programming model. Users of the framework will develop processing elements (called Tasks) in Python. These Tasks can then be composed together with other Tasks to form Blocks. Each Block can have not only Tasks, but other Blocks as well. Using this composition pattern allows a developer to create a hierarchical application structured from these reusable elements. Tasks and Blocks can be connected together and pass Events. In this fashion, a series of Tasks could be "chained" together to execute in serial fashion, or even create a more complex web of interaction.
Open Source

TetrUSS Computational Fluid Dynamics Software (TetrUSS)   LAR-16882-1

The most awarded software in the history of NASA, TetrUSS is a suite of computer programs used for fluid dynamics and aerodynamics analysis and design. The software is widely used in other government organizations, the aerospace industry, academia, and non-aerospace industries such as automotive, bio-medical, and civil engineering.
U.S. Release Only

Thermodynamically Coupled Air-Droplet Icing Wind Tunnel Model (TADICE)   LEW-19874-1

This one-dimensional numerical model simulates icing wind tunnels by modeling the thermodynamic interactions between the water/ice particles of an icing cloud and the flowing air. The goal of the model is to better understand the complex interactions between the known test parameters at the tunnel inlet and have greater confidence in the conditions at the test section. The model can simulate supercooled liquid and standard water clouds.
U.S. Release Only

Three-dimensional (3D) Reaction Control System (RCS) Plume Model (RPM3D) Software   MSC-26460-1

This software computes 3D-distributions of plume load and mass flux, impingement heating, and surface temperature on complex surface geometries from multiple plume sources. RPM3D is a 3D version of the original RCS Plume Model (RPM) code with extended options and capabilities. This version is used to evaluate the plume impingement heating effects from proximity operations of vehicles visiting the space station.
U.S. Release Only

Total Verification System and C++ Based Verification Test Bench   GSC-16013-1

This technology verifies complex space flight digital designs in a more thorough manner than was previously possible while offering cost savings and reduced schedule time. The software combines a custom-designed GSE unit, the Total Verification System, along with a powerful test bench environment that uses C++. Together, these elements allow a high level of code reuse between all phases of the design and test cycle.
U.S. Government Purpose Release

Design and Integration Tools

Transport Class Model (TCM) Aircraft Simulation Software   LAR-18322-1

This six-degree-of-freedom, flat-earth dynamics, non-linear, and non-proprietary aircraft simulation is a representation of a generic mid-sized twin-jet transport aircraft.
General Public Release

TRAVIST: Tensegrity Rover Analysis and Visualization Toolkit   LAR-20224-1

The Tensegrity Rover Analysis and Visualization Toolkit (TRAVIST) is a software package for the design, analysis, and visualization of TANDEM-class tensegrity rovers. The Tension Adjustable Network for Deploying Entry Membrane (TANDEM) is a multifunctional rover concept which combines tensegrity robotics with deployable heatshield technology to create a comprehensive entry, descent, landing, and locomotion (EDL-L) vehicle for planetary exploration.
General Public Release

TREETOPS   MFS-33566-1

TREETOPS is a time history simulation of the motion of a complex multi-body flexible structures with active control elements. The name TREETOPS refers to the class of structures that may be simulated by the program, i.e., those having a tree topology (where loop closures are handled with a cut graph technique). TREETOPS offers the user an advanced capability for analyzing the dynamics and control-related issues of such structures.
U.S. Government Purpose Release

Trick Simulation Environment   MSC-25665-1

The Trick Simulation environment is a generic simulation toolkit used for constructing and running simulations. The Trick Interface Code Generator (ICG), a utility that provides math model class and structure layout data, has been rewritten and is based off of the open-source clang/llvm project. The numerical integrators have been replaced with a common set of integrators, and several core components have been enhanced from previous Trick versions. Trick can be downloaded at: http://code.nasa.gov/#/
Open Source

Trick Variable Server Input Output (TVS_IO)   MSC-26988-1

Trick Variable Sever Input Output or TVS_IO (sometimes referred to as TVS-IO or TVSIO) is a NASA Core Flight System (CFS) to Simulation interface software package which integrates with the CFS System and/or the Trick Simulation Environment, and allows bidirectional communication as well as translation between simulation variables and Flight Software (FSW) messages
Open Source

TrickCAT   MSC-26675-1

A Trick-based framework for writing real-time EtherCAT applications using the EC-Master driver from Acontis Technologies.
U.S. Government Purpose Release

TrickHLA: An IEEE 1516 High Level Architecture (HLA) Simulation Interoperability Standard Implementation for Trick Base Simulations   MSC-26718-1

This software abstracts away the details of using the HLA, allowing the user to concentrate on the simulation. The TrickHLA software is data driven and provides a simple application programming interface making it relatively easy to take an existing Trick simulation and make it HLA aware (i.e. a distributed simulation).
Open Source

Uncertainty Quantification Toolbox (UQTools)　　　　　　　　　LAR-17855-1

UQTools is a MATLAB-based software package designed to efficiently analyze dynamic systems subject to parametric uncertainty. UQTools accepts uncertainty models based upon both probabilistic and non-probabilistic definitions, and it realizes several complementary methods for performing a variety of uncertainty quantification tasks.

U.S. Release Only

USM3D　　　　　　　　　　　　　　　　　　　　　　　　　LAR-16670-GS

USM3D is a tetrahedral unstructured flow solver that has become widely used in industry, government, and academia for solving aerodynamic problems. Since its first introduction in 1989, USM3D has steadily evolved from an inviscid Euler solver into a full viscous Navier-Stokes code. The technology has been a part of the NASA TetrUSS system.

U.S. Release Only

Vehicle Sketch Pad (VSP)　　　　　　　　　　　　　　　　　LAR-17491-1

The Vehicle Sketch Pad (VSP) is an aircraft geometry tool for rapid evaluation of advanced design concepts. Fast and accurate geometry modeling allows the designer to use more complex analysis methods earlier in the design process and reduces reliance on empiricism in conceptual design. VSP includes tools to model and export the internal structural layout.

Open Source

Versatile ImpulSive Interplanetary Trajectory OptimizeR (VISITOR)　　LAR-18538-1

The design of trajectories for interplanetary missions represents one of the most complex and important problems to solve during conceptual space mission design. To facilitate conceptual interplanetary mission sizing activities, it is essential to obtain sufficiently accurate trajectories in a fast and repeatable manner. To this end, the VISITOR software tool was developed. This tool modularly augments a patched conic, multiple gravity-assist with one deep space maneuver (MGA-1DSM) trajectory model with a mass model, launch window analysis, and the capability to simulate realistic arrival and departure operations. The tool was validated against seven flown missions. VISITOR is well-suited for the conceptual design of interplanetary trajectories and facilitates future improvements due to its modular structure.

General Public Release

Video Stream Manager (VSM)　　　　　　　　　　　　　　　MSC-26618-1

The Video Stream Manager (VSM) is a standalone Python application for optimizing the use of Engineering DOUG Graphics for Exploration (EDGE) [MSC-24663-1] video streaming resources. VSM detection of resources is automatic; there are no complicated configuration files to maintain, and finer-grained control is possible if desired. New clients and cameras can be added and readily used without modifying or restarting the VSM.

Open Source

Virtual ADAPT　　　　　　　　　　　　　　　　　　　　　ARC-18001-1

Virtual ADAPT is a MATLAB/Simulink simulation of the Advanced Diagnostics and Prognostics Testbed (ADAPT) located at NASA Ames Research Center. ADAPT is an electrical power system testbed that emulates the power distribution systems on spacecraft. It allows users to inject faults in order to study how faults affect the operation of the electrical power system and to evaluate automated diagnostics technologies. Virtual ADAPT provides a high-fidelity simulation of this capability. It includes dynamic models of all the components of ADAPT and enables all faults that can be injected into the actual testbed to be injected into the simulation, including some that would be difficult or unsafe to do in the actual hardware. In this way, simulated fault scenarios can be quickly generated under many possible conditions, generating simulated data that closely matches what the behavior of the actual testbed would be. This simulated data can then be used for diagnostics algorithm development and testing before testing on the actual hardware or deploying to a real application.

Open Source

Design and Integration Tools

Virtual Environment Computational Training Resource (VECTR)　　　KSC-14010

VECTR is a virtual reality platform, built with commercial off-the-shelf hardware, designed to augment the training process for various operations at KSC. VECTR utilizes existing virtual reality hardware and real-time game engine software to create digital training environments where engineers and technicians can practice working with predefined systems and procedures for current and future operations. VECTR is a flexible, scalable platform, and all aspects of the VECTR virtual environment can be changed and updated within the software by a developer, even if the hardware hasn't yet been built in the real world.
General Public Release

Virtual Environment Computational Training Resource (VECTR) V.2　　　KSC-14415

VECTR2 is an overhaul of the original VECTR software, and it's use cases go beyond just training in that it can be used for design reviews, public outreach, virtual meetings, collaboration and more. VECTR2 is a flexible, scalable platform that allows for model updates, if engineering designs change, and scenario updates, if a procedure changes. All aspects of the VECTR2 virtual environment can be changed and updated within the software by a developer, even if the hardware hasn't yet been built in the real world. VECTR2 gives engineers a suite of tools to use such as measurement, annotation, and model manipulation, to interact within the customizable shared VR Spaces. These multi-user environments can be saved and later re-visited. Integration with RMIT (Rapid Model Import Tool) allows users to import almost any 3D model file type into their virtual environments as well.
U.S. Government Purpose Release

Virtual Environment Computational Training Resource (VECTR): OSIRIS-Rex　　　KSC-14272

VECTR is a virtual reality platform, built with commercial off-the-shelf hardware, designed to augment training processes. VECTR is a flexible, scalable platform that allows for model updates if engineering designs change, and scenario updates if a procedure changes. This latest version highlights operations in the Payload Hazardous Safety Facility (PHSF) of the OSIRIS-REx spacecraft before it gets launched and also demonstrates the touchdown on Bennu for sample collection and return.
U.S. Government Purpose Release

Visual Studio Code Extension for PVS　　　LAR-19642-1

Visual Studio Code Extension for PVS (vscode-pvs) is a plugin extension for Visual Studio Code that provides an Integrated Development Environment (IDE) for the Prototype Verification System (PVS).
Open Source

Web-based Space Mission Visualization　　　MFS-34033-1

This software suite consists of demonstration web-apps for orbital trajectories around the Earth and planets around the Sun. Files include single page applications implemented in HTML, JavaScript, functional calls to 3D graphics code libraries including X3Dom and ThreeJS, supporting data files, and some documentation.
Open Source

Weight Analysis of Turbine Engine: An Object-Oriented Version (WATE++)　　　LEW-19687-1

WATE++ is an object-oriented computer code for gas turbine engine weight estimation; it calculates the weight and dimension of each major gas turbine engine component. It is used to create engine architecture that could achieve an engine thermodynamic cycle produced by a thermodynamic cycle code. The thermodynamic cycle data, the material properties, and design rules for geometric, stress, and turbo-machinery stage-loading limits were used to determine an acceptable engine flowpath and weight.
U.S. Release Only

Design and Integration Tools

WinASSIST: Windows Abstract Semi-Markov Specification Interface to the SURE Tool   LAR-16060-1

WinASSIST uses a rule-oriented language to automatically generate input files for the SURE/WinSURE program. The user describes the failure behavior and recovery behavior of a fault-tolerant computer system in an abstract language. WinASSIST then automatically generates a corresponding semi-Markov model. The abstract language allows efficient description of large, complex systems
Open Source

Windows Semi-Markov Range Evaluator (WinSURE)   LAR-16059-1

This package is used by aerospace flight software developers to predict the reliability of flight-critical computer processes.
Open Source

Design and Integration Tools

Electronics
and Electrical Power

Solar Arrays, Batteries, Cabling, Grounding, Converters, Electrical Analysis

When it comes to the heat of extreme environments like Venus, electronics can get fried within a few minutes of arrival. But NASA researcher Phil Neudeck and his team have developed extremely durable silicon carbide semiconductor integrated circuits to survive those harsh conditions. Since the electronics were successfully tested in the high-pressure, high-temperature extreme environments chamber at NASA's Glenn Research Center in Cleveland, there is now a path forward for Venus landers to survive and operate scientific experiments on the planet's surface for longer durations.

Featured Software

Solenoid Inductance Calculator KSC-12253

The Solenoid Inductance Calculator can be used to compute the inductance approximation of a cylindrical solenoid of arbitrary dimensions. The technology's calculation method (1) uses magnetic vector potential to provide a more precise estimate of inductance and (2) is not limited to a specific range of coil geometry values.

General Public Release

CCSDS Optical Communications High Photon Efficiency Telemetry Signaling Transmit Waveform VHDL/Verilog LEW-20090-1

This technology is a VHDL and Verilog implementation of the Consultative Committee for Space Data Systems (CCSDS) Optical Communications High Photon Efficiency Telemetry Signaling waveform. The CCSDS 142.0-B-1 Blue Book from August 2019 is implemented. The implementation includes a data source, transfer frame synchronization marker attachment, slicer, randomizer, cyclic redundancy check, termination bit attachment, convolutional encoder, code interleaver, accumulator, pulse position modulation symbol mapper, channel interleaver, codeword sync marker attachment, symbol repeater, slot mapper, and guard slot insertion.

U.S. and Foreign Release

STRS Adaptive Coding and Modulation Waveform for Space Communication LEW-19478-1

An Adaptive Coding and Modulation Waveform for Space Communication has been developed and demonstrated on a space-qualified software-defined radio. The waveform utilizes the commercial Digital Video Broadcasting-Second Generation standard to provide a suite of modulation and encoding schemes, which allows the communication link to be dynamically adjusted to optimize performance. The waveform utilizes the Space Data Link Protocol (Consultative Committee for Space Data Systems standard) to control the transmitter's mode of operation, using a BPSK/QPSK receiver. The waveform includes the ability to automatically compensate for non-linear channel impairments to improve the performance of high-order modulations.

U.S. Release Only

Capture Test Waveform for the SCaN Testbed Harris SDR LEW-19286-1

The Capture Test Waveform is a software application designed for space-based reconfigurable radios. The innovation allows snapshots of a radio's receiver environment for any number of objectives, such as interference mitigation or radio frequency mapping. Digital samples are acquired and stored in the radio's memory for processing, be that on-board the spacecraft or after download to the ground. The application is labeled "test waveform" because it does not perform any standard communication link functions, such as carrier recovery or demodulation. Depending on the radio's resources and architecture, this application could be run in parallel with a standard communications link waveform application.
U.S. Release Only

CCSDS Optical Communications High Photon Efficiency Telemetry Signaling Transmit Waveform VHDL/Verilog LEW-20090-1

This technology is a VHDL and Verilog implementation of the Consultative Committee for Space Data Systems (CCSDS) Optical Communications High Photon Efficiency Telemetry Signaling waveform. The CCSDS 142.0-B-1 Blue Book from August 2019 is implemented. The implementation includes a data source, transfer frame synchronization marker attachment, slicer, randomizer, cyclic redundancy check, termination bit attachment, convolutional encoder, code interleaver, accumulator, pulse position modulation symbol mapper, channel interleaver, codeword sync marker attachment, symbol repeater, slot mapper, and guard slot insertion.
U.S. and Foreign Release

CCSDS Optical Communications High Photon Efficiency Transmit Downlink Waveform Matlab Model LEW-19882-1

This technology is a Matlab model of the Consultative Committee for Space Data Systems (CCSDS) Optical Communications High Photon Efficiency downlink transmit waveform. The model implements the CCSDS 141.1-R-1-v10 Draft Red Book from April 25, 2018. This includes a data source, transfer frame synchronization marker attachment, slicer, randomizer, cyclic redundancy check, termination bit attachment, convolutional encoder, code interleaver, accumulator, pulse position modulation (PPM) symbol mapper, channel interleaver, codeword sync marker attachment, symbol repeater, slot mapper, and guard slot insertion. The model can be used to verify FPGA implementations of the CCSDS standard.
U.S. Government Purpose Release

Electrical Modeling and Thermal Analysis Toolbox (EMTAT) LEW-20097-1

The Electrical Modeling and Thermal Analysis Toolbox (EMTAT) is a MATLAB/Simulink based building block graphical tool used to create simulations of electrical/power systems. EMTAT is specifically designed to simulate electric/electrified propulsion systems at the level of fidelity (time scale) appropriate to capture the interaction with turbomachinery. EMTAT contains blocks that represent electrical components (batteries, motors/generators, inverters, etc.) modeled using either power flow or physics based representations. EMTAT is compatible with the Toolbox for the Modeling and Analysis of Thermodynamic Systems (T-MATS) for simulations that require mechanical components (turbomachinery, shafts, propellers, etc.). For such mixed simulations (i.e., those containing both electrical components and turbomachinery), the EMTAT blocks can use the T-MATS solver, allowing the relevant electrical and mechanical variables to be solved simultaneously.
Open Source

Electrical Power System – Sizing and Analysis Tool (EPS-SAT)　　　　LEW-20017-1

The Electrical Power System – Sizing and Analysis Tool (EPS-SAT) is a tool whose purpose is to analyze electrical power system architectures in order to better direct investment dollars and to expose the strengths and weaknesses of various designs. The software uses on- and off-design modes to complete this analysis. In on-design, the electrical power system components are sized (to estimate system mass, loss, and efficiency). In off-design, the system's performance (such as loss, and efficiency) is calculated at points in the power system's operating range. EPS-SAT includes a Newton-Raphson solver, basic and detailed electrical power system components, and a library of study tools. By using these elements of EPS-SAT, a user can size an electrical power system, perform system trade studies, and examine system response at off-nominal design points.
U.S. Government Purpose Release

FPGA Code Development for the iPAS STRS Radio　　　　LEW-19389-1

This innovation is FPGA VHDL code written as part of the iPAS STRS radio development. The FPGA design receives and processes commands and provides command control and data to the test waveform. It also receives and transmits streaming data from/to the embedded processor.
U.S. Government Purpose Release

NASA Universal Asynchronous Receiver Transmitter (UART)
Intellectual Property (IP) and VHDL Code　　　　MSC-27118-1

The NASA_UART_Example is an Aldec Active-HDL project that contains the Intellectual Property (IP) files for a NASA developed Universal Asynchronous Receiver Transmitter (UART) and supporting files to implement an example of using the UART IP. The source files are a combination of Active-HDL block diagrams, Active-HDL state machines, and VHDL code. The block diagram and state machines compile down to VHDL code. All the source and compiled VHDL files are provided.
U.S. Release Only

Packet to Electrical Ground Support Equipment (EGSE) Interface Converter, Version 4.0　　　GSC-16586-1

Developed using platform-independent language, this interface converter packet allows already-existing EGSE equipment to be supported on Windows and UNIX operating systems. The software is set up and controlled using XML-formatted files that define interface connections and data content.
U.S. Government Purpose Release

Physics-Model-Based Wiring Fault Detection Toolbox for MATLAB　　　　ARC-17046-1

Providing a toolbox of functionality for MATLAB, this NASA-developed software detects precursor wiring faults (e.g., chafing) in shielded impedance-controlled cabling using measurements from off-the-shelf, time-domain reflectometry or vector-network analyzer hardware. The technology combines high-fidelity analytical physics models for signal propagation with fast Bayesian inference algorithms for intrinsic cable and fault-parameter retrieval.
Open Source

Real-Time Executive for Multiprocessor Systems (RTEMS)
RAD750 Board Support Package (BSP)　　　　GSC-17526-1

The innovation is a board support package that provides a port of the open-source Real-Time Executive for Multiprocessor Systems (RTEMS) real-time operating system and a full set of hardware drivers for the BAE Systems Inc. RAD750 single board computer.
U.S. Government Purpose Release

Solenoid Inductance Calculator   KSC-12253

The Solenoid Inductance Calculator can be used to compute the inductance approximation of a cylindrical solenoid of arbitrary dimensions. The technology's calculation method (1) uses magnetic vector potential to provide a more precise estimate of inductance and (2) is not limited to a specific range of coil geometry values.
General Public Release

Space Telecommunications Radio System (STRS) Reference Implementation (RI)   LEW-19083-1

The STRS Reference Implementation is a demonstration of the STRS architecture. The STRS architecture standard for software defined radios is an open architecture for NASA space and ground radios. The standard provides a common, consistent framework to develop, qualify, operate, and maintain complex reconfigurable and reprogrammable radio systems. The reference implementation allows verification of capabilities and provides lessons learned for the improvement of STRS Architecture Standard 1.02.
U.S. Government Purpose Release

STRS Adaptive Coding and Modulation Waveform for Space Communication   LEW-19478-1

An Adaptive Coding and Modulation Waveform for Space Telecommunications Radio System (STRS) has been developed and demonstrated on a space-qualified software-defined radio. The waveform utilizes the commercial Digital Video Broadcasting-Second Generation standard to provide a suite of modulation and encoding schemes, which allows the communication link to be dynamically adjusted to optimize performance. The waveform utilizes the Space Data Link Protocol (Consultative Committee for Space Data Systems standard) to control the transmitter's mode of operation, using a BPSK/QPSK receiver. The waveform includes the ability to automatically compensate for non-linear channel impairments to improve the performance of high-order modulations.
U.S. Release Only

STRS Modular and Portable QPSK Transceiver Waveform for Software-Defined Radios   LEW-19723-1

A QPSK transceiver waveform has been developed and implemented on a commercially available ground-based software-defined radio platform for the Space Telecommunications Radio System (STRS). The waveform utilizes legacy NASA forward-error correction codes and Consultative Committee for Space Data Systems (CCSDS) data framing standards. It is controlled via a Web interface and allows the user to multiplex between test (pseudo-random) and network-sourced data. The product consists of two main components: (1) the digital logic (VHDL) implementation for the field-programmable gate array (FPGA) that does the required signal processing functionalities and (2) the command-and-control software portion that leverages the open-source Core Flight Executive (cFE) software suite and provides a graphical user interface to the waveform.
U.S. Release Only

Environmental Science
Earth • Air • Space • Exoplanet

Terrestrial Environments, Planetary Atmospheric
Modeling, Radiation Shielding

A green chile pepper grows as part of the Plant Habitat-04 investigation aboard the International Space Station. This is the first time chile peppers are being grown aboard the orbiting laboratory, and it's one of the most complex plant experiments on the station to date because of the long germination and growing times. Astronauts will sample some of the peppers and return the rest to Earth for scientific analysis.

Featured Software

Orbital Debris Engineering Model (ORDEM), Version 3.1.2   **MSC-25457-1**

ORDEM offers flux as a function of debris size and year. The technology can be operated in spacecraft mode or telescope mode. An upgraded user interface uses project-oriented organization and provides graphical representations of numerous output data products.
General Public Release

EarthKit   **NPO-49145-1**

EarthKit provides a framework for collaboration among researchers in Earth science. It offers a set of software tools for sharing any user's research environment via the web and managing workflows that run in the cloud. By leveraging cloud computing services in this novel way, EarthKit can instantly replicate a research computing environment (software, data, operating system, and hardware).
Open Source

Earth Global Reference Atmospheric Model 2016 (Earth GRAM 2016)   **MFS-32780-2**

Earth GRAM 2016 is a computer code that can run on a variety of platforms including PCs and UNIX stations. The model provides values for atmospheric parameters such as density, temperature, winds, and constituents for any month and at any altitude and location within Earth's atmosphere. Earth GRAM 2010 is also currently supported.
General Public Release

Advanced Land Image Assessment System (ALIAS)　　　GSC-15185-1

ALIAS supports radiometric and geometric multispectral image processing for the Advanced Land Imager (ALI) instrument onboard NASA's Earth Observing-1 (EO-1) satellite. The radiometric subsystem characterizes and (where possible) corrects: detector operability; gain; bias; coherent, impulse, and random noise; signal-to-noise ratios; saturation levels; striping and banding; and the stability of detector performance. Geometric processing functions support sensor alignment calibrations; sensor chip assembly alignments; modulation transfer function characterizations; image-to-image characterizations; and geodetic accuracy assessments. Please visit the following URL for more information: http://opensource.gsfc.nasa.gov/projects/Alias/index.php

Open Source

Algorithm for Automated Sargassum Detection for Landsat-8 OLI Imagery　　　SSC-00505

This methodology and software were implemented to automatically detect Sargassum spp. (a floating aquatic seaweed) in 30-meter LANDSAT-8 Operational Land Imager (OLI) imagery. This Sargassum spp. detection is an extended form of Hus approach to derive a floating algae index (FAI), which is defined as the difference between the reflectance at the near infrared band (NIR, 859 nm) and the linear baseline between the red band (645 nm) and short-wave infrared band (SWIR, 1240 or 1640 nm).

General Public Release

Badhwar-O'Neill 2020 Galactic Cosmic Ray Model (BON2020)　　　MSC-26835-1

The Badhwar-O'Neill (BON) model has been used for some time to describe the galactic cosmic ray (GCR) environment encountered in deep space by astronauts and sensitive electronics. This package contains the BON2020 model. The previous version of the model, BON2014, was calibrated to available measurements to reduce model errors for particles and energies of significance to astronaut exposure. Although subsequent studies showed the model to be reasonably accurate for such applications, modifications to the sunspot number (SSN) classification system and a large number of new high-precision measurements suggested the need to develop an improved and more capable model. The new BON2020 model relies on daily integral flux from the Advanced Composition Explorer Cosmic Ray Isotope Spectrometer to describe solar activity.

General Public Release

CEOS Data Cube Platform, Version 2 (CEOS2)　　　LAR-18928-1

The Committee on Earth Observation Satellites (CEOS) has long recognized a need for data processing infrastructure to support Earth science objectives in developing countries. Forest preservation initiatives, carbon measurement initiatives, water management and agricultural monitoring are just a few examples of causes that can benefit greatly from remote sensing data. Currently, however, many developing nations lack the in-country expertise and computational infrastructure to utilize remote sensing data. The CEOS Data Cube Platform provides a flexible model to address these needs. The platform provides a data ingestion framework that includes support for automated ingestion of a wide variety of remote sensing data products. The data products are ingested into an N-dimensional data array that abstracts away management of distinct acquisitions. The platform has a tiered API for data processing and a data/application platform layer for higher-level access.

Open Source

Coastal Salinity and Temperature (CSalT) Web Application　　　SSC-00492

This Coastal Salinity and Temperature Monitoring (CSalT) Web application's objective is to provide daily access to salinity and temperature data on a continuous and unrestricted basis to authorized users. Numerical model data from multiple sources are collected and integrated with NASA remotely sensed satellite data to provide up-to-date and historical information on water temperature, salinity, and oyster lease locations for coastal environments along the Gulf of Mexico.

General Public Release

Environmental Science (Earth, Air, Space, Exoplanet)

Common Metadata Repository (CMR)   GSC-17610-1

CMR is a spatial and temporal metadata registry that enables the science community to more easily discover, use, and exchange NASA's data and services. The CMR's main objective is to enable broader use of NASA's Earth-observing systems' (EOSDIS) data. It allows users to more efficiently and reliably search and access data and services and increases the potential for interoperability with new tools and services. The CMR stores metadata from a variety of science disciplines and domains, including climate variability and change, carbon cycle and ecosystems, Earth surface and interior, atmospheric composition, weather, and water and energy cycle. To ensure the quality of the metadata, the CMR system contains a tool called the Metadata Management Tool (MMT) which enables metadata providers to develop standards-compliant, high-quality metadata.
Open Source

Crisis Mapping Toolkit (CMT), Version 1   ARC-17472-1

The CMT is a collection of tools for processing geospatial data (images, satellite data, etc.) into cartographic products that improve the understanding of large-scale crises such as natural disasters. The cartographic products produced by CMT include flood inundation maps, maps of damaged or destroyed structures, forest fire maps, and population density estimates. CMT is designed to rapidly process large-scale data using Google Earth Engine and other geospatial data systems.
Open Source

DELTA: Deep Earth Learning, Tools, and Analysis   ARC-18446-1

A toolkit for applying deep learning to satellite imagery. Scientists label training imagery on a supported satellite, and the toolkit learns a deep neural network to address the problem. DELTA makes use of pre-trained autoencoders on supported satellites to jump-start training through a learned compressed representation of the data source. DELTA will be applied initially to flood mapping, as a component of the open-source Crisis Mapping Toolkit.
Open Source

Desktop Exploration of Remote Terrain (DERT)   ARC-17647-1

Desktop Exploration of Remote Terrain (DERT) is a software tool for exploring large Digital Terrain Models (DTMs) in 3D. It aids in understanding topography and spatial relationships of terrain features, as well as performing simple analysis tasks relevant to the planetary science community.
Open Source

Dorado-streamlit   GSC-18815-1

This repository contains observer web tools for the Dorado mission, including an interactive exposure time calculator. It is built using Streamlit, a framework for easily turning Python code into interactive data-driven web apps.
Open Source

Earth Global Reference Atmospheric Model 2010 (Earth GRAM 2010)   MFS-32780-1

Earth GRAM 2010 is an open-source Fortran computer code that can run on a variety of platforms including PCs and UNIX stations. The model provides values for atmospheric parameters such as density, temperature, winds, and constituents for any month and at any altitude and location within Earth's atmosphere. Versions from 1999 and 2007 are also available.
General Public Release

Earth Global Reference Atmospheric Model 2016 (Earth GRAM 2016)   MFS-32780-2

Earth GRAM 2016 is a computer code that can run on a variety of platforms including PCs and Linux stations. The model provides values for atmospheric parameters such as density, temperature, winds, and constituents for any month and at any altitude and location within the Earth's atmosphere. Earth GRAM 2010 is available in Fortran.
General Public Release

Earth Science Datacasting, Version 2.0   NPO-47725-1

This software gives users control to download only the Earth science data files that are required for a particular application. The tool is essentially a simple, yet powerful informed pull and visualization mechanism. It is modeled on the server-client architecture used in podcasting and leverages existing NASA capabilities. On the server side, the latest data granule is placed in an online store and an XML feed is created for the granule. The XML feed is based on the RSS 2.0 and GeoRSS 1.0 standard, with additional namespaces for describing Earth science data (dataset- and granule-level descriptions).
U.S. Government Purpose Release

Earthdata Search Web Application   GSC-17399-1

Earthdata Search is a Web application enabling users to quickly and intuitively discover, search, visualize, and access Earth Science data in a highly visual manner. It interfaces with and demonstrates current state-of-the-art services provided by NASA EOSDIS such as the Common Metadata Repository (CMR) for sub-second search results, the Global Imagery Browse Services (GIBS) for fast-tiled imagery visualizations of data, and OPeNDAP for data access, transformation, and subsetting.
Open Source

EarthKit   NPO-49145-1

EarthKit provides a framework for collaboration among researchers in Earth science. It offers a set of software tools for sharing any user's research environment via the web and managing workflows that run in the cloud. By leveraging cloud computing services in this novel way, EarthKit can instantly replicate a research computing environment (software, data, operating system, and hardware).
Open Source

Electric Propulsion Interactions Code (EPIC)   MFS-32165-1

EPIC is an interactive computer toolset that enables the construction of a 3D spacecraft model and the assessment of a variety of interactions between the model's subsystems and the plume from an electric thruster. EPIC unites different computer tools to address the many complexities associated with spacecraft/plume interaction processes.
U.S. Release Only

ElectroStatic Return of Contaminants (ESR) Tool   MFS-32011-1

The ESR tool is a first-generation computational code created for the purpose of computing the return characteristics of spacecraft-generated contaminants. The code computes the Debye sheath (if necessary), the returned contaminant mass rate, returned mass flux, returned mass ratio, return velocity, and surface sputter (where applicable). To help the user, default values have been supplied for all program inputs.
U.S. Release Only

Emission of Solar Protons (ESP) Model   MFS-31315-1

This model predicts total solar proton fluence levels for interplanetary space in the energy range of 1 to 300 MeV, which is the range required for both solar cell and electronics applications.
U.S. Release Only

Exoscene
GSC-18656-1

Exoscene is a Python software library of classes and utility functions for simulating direct images of exoplanetary systems. Exoscene can model the orbital position and Lambert sphere phase function of an exoplanet based on its user-defined Keplerian orbit and observing date (or series of observing dates). It enables a user to visualize the time-dependent, sky-projected position and relative brightness of an exoplanet observed in reflected starlight. Exoscene also provides functions for resampling model images to different spatial resolutions and for applying statistical noise models to simulate detector exposures.
Open Source

Fortran Argument Parser
GSC-18159-1

A software package to simplify handling of command line arguments from within Fortran programs. The design is largely based upon a similar package in Python called argParser. These tools allow developers to specify expected command line arguments and associate each argument with a specific behavior, and the package is extensible allowing developers to define new behaviors for their options.
Open Source

Fortran Template Library (gFTL)
GSC-17742-1

This innovation creates the capability for Fortran software developers to routinely declare and use specialized software containers for arbitrary types of data. The capability is somewhat analogous to that of the C++ Standard Template Library but with important differences. Although the number of containers are expected to grow, the current supported cases are Vector, Map, and Set. Contained items can be of any intrinsic type or user-defined derived type. The user can also indicate that the contained objects are polymorphic and/or pointers with corresponding implications for the semantics of using those containers.
Open Source

General EQFlux
GSC-14791-1

The Windows EQFlux computer program converts solar-cell damage resulting from hard-particle radiation into the equivalent fluence on MeV electrons. Please visit the following URL for more information:
http://opensource.gsfc.nasa.gov/projects/eqflux/index.php
Open Source

GeoCam, Version 2
ARC-16088-1A

GeoCam is a geospatial system for disaster response that consists of (1) low-cost consumer hardware (i.e., a digital camera or cellphone, position/orientation sensors, and an optional embedded controller) and (2) a Web-based workflow that enables images and other geo-referenced data to be shared and viewed in a variety of ways. GeoCam includes software that computes image location and provides for geo-rectification, KML-formatted geospatial data generation, image management, and geo-referenced data sharing.
Open Source

GeoRef, Version 1
ARC-17943-1

A Web-based software application designed to increase the efficiency and precision in geo-locating photographs taken by astronauts from the International Space Station. GeoRef provides highly automated processes for calculating the latitude and longitude coordinates of the center point of the image and producing geo-referenced map overlays for the image. The georeferenced images produced by GeoRef are designed to support the needs of educational, Earth science, and disaster response users.
Open Source

Global Precipitation Space and Ground Radar Comparison Software   GSC-15469-1

Designed to support a prototype validation network for the Global Precipitation Measurement (GPM) space-flight mission, this space and ground radar comparison software collects data from the Precipitation Radar instrument flying on the Tropical Rainfall Measuring Mission (TRMM) spacecraft. Please visit the following URL for additional information: http://opensource.gsfc.nasa.gov/projects/GPM/
Open Source

Global Reference Atmospheric Model (GRAM) Suite   MFS-33888-1

The GRAM Suite is an engineering-oriented atmospheric model that estimates mean values and statistical variations of atmospheric properties for planetary destinations. GRAM outputs include atmospheric density, temperature, pressure, winds, and chemical composition along a user-defined path. The GRAMs have been rearchitected from Fortran to a common object-oriented C++ framework. This new architecture creates a common GRAM library of data models and utilities. Version 1.1 of the GRAM Suite contains the rearchi-tected Neptune-GRAM and Titan-GRAM.
General Public Release

GLOBE Program's Citizen Science Cloud App for iOS   GSC-17391-1

The Global Learning and Observations to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program. GLOBE members currently enter their scientific data using a data entry tool on GLOBE's site. This app allows GLOBE and non-GLOBE members and GLOBE to enter cloud observations into their mobile devices and send their observations to the GLOBE database. Users may enter the data while the mobile device is not connected to the Internet, data will be sent to GLOBE on user command when the device is back online.
General Public Release

GLOBE Program's Data Entry App for Android   GSC-17390-1

The Global Learning and Observations to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program. The GLOBE Program's Data Entry App for Android enables members to enter data to via their Android devices and while in the field (where they may not have Internet connection). Their data will be stored locally on their Android devices and sent to the GLOBE database once their devices get connected to Internet. This project also facilitates data entry by leveraging mobile capabilities including GPS, photography, and date/time.
General Public Release

GLOBE Program's Data Entry App for iOS   GSC-17389-1

The Global Learning and Observations to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program. The GLOBE Program's Data Entry App for iOS enables members to enter data via their iOS devices and while in the field (where they may not have Internet connection). Their data will be stored locally on their iOS devices and sent to the GLOBE database once their devices get connected to Internet. This project also facilitates data entry by leveraging mobile capabilities including GPS, photography, and date/time.
General Public Release

Hazards and Population Mapper (HazPop) Mobile Application for iOS Platform   GSC-17605-1

HazPop is a free app developed by the NASA Socioeconomic Data and Applications Center (SEDAC). It enables users to easily display recent natural hazard data in relationship to population, major infrastructure, and satellite imagery. Hazards data include the location of active fires over the past 48 hours; earthquake alerts over the past seven days; and yesterday's air pollution data measured from space. The app shows the location of major dams and nuclear power plants and provides more detailed information and imagery for these facilities where available. By drawing a circle around a point or area of interest on the map, users can obtain an estimate of the total population and land area enclosed within. This app is available for download at: https://itunes.apple.com/us/app/hazards-population-mapper/id1092168898?mt=8
General Public Release

Environmental Science (Earth, Air, Space, Exoplanet)

HDFView Plugin
GSC-14948-1

This Java-language software plug-in to HDFView provides an interface for two versions of hierarchical data formats (HDF 4 and HDF 5). Please visit the following URL for more information: http://opensource.gsfc.nasa.gov/projects/HDF/index.php

Open Source

ICESat-2 Standard Data Products Subsetter
GSC-17780-1

This software was designed to subset ICESat-2 Standard Data Products. It reads in a single HDF5 ICESat-2 data granule, uses rules in a control file to reduce the set of parameters according to the rules in the control file, and writes out the resulting file.

Open Source

InSAR Scientific Computing Environment
NPO-47557-1

This software uses the next generation of geodetic imaging processing technology for InSAR sensors, which is needed to provide flexibility and extensibility in reducing measurements from radar satellites and aircraft to new geophysical products.

U.S. Government Purpose Release

Interactive Spacecraft Charging Handbook with Integrated, Updated Spacecraft Charging Models (ISCCH), Version 3.1
MFS-31675-1

The ISCCH is an interactive, Web-based multimedia product that offers updated and integrated spacecraft charging models. The software guides the non-expert using the power of sophisticated analysis tools.

U.S. Release Only

Kepler Community Data Analysis Tools
ARC-16805-1

The Kepler archive contains time-series data calibrated and reduced from detector pixels. The pipelined reduction includes the removal of time-series trends systematic to a spacecraft and its environment.

Open Source

Landslide Hazard Assessment for Situational Awareness (LHASA)
GSC-17452-1

This framework integrates a regional landslide susceptibility map and satellite-based rainfall estimates into a binary decision tree model, considering both daily and antecedent rainfall. Using a regionally distributed, percentile-based threshold approach, the model outputs a pixel-by-pixel nowcast in near real time at a resolution of 30 arcseconds to identify areas of moderate and high landslide hazard.

Open Source

Landslide Hazard Assessment for Situational Awareness (LHASA) Version 2.0
GSC-18595-1

In order to advance LHASA's capabilities to characterize landslide hazards and impacts dynamically, we have implemented a new approach that leverages machine learning, new parameters, and new inventories. LHASA 2.0 uses the XGBoost machine learning model to bring in dynamic variables as well as additional static variables to better represent landslide hazard globally. Global rainfall forecasts are also being evaluated to provide a 1-3 day forecast of potential landslide activity. Additional factors such as recent seismicity and burned areas are also being considered to represent the preconditioning or changing interactions with subsequent rainfall over affected areas.

Open Source

Lightning Forecasting Algorithm (LFA)
MFS-33225-1

LFA is an algorithm that may be implemented within any cloud-allowing or cloud-resolving numerical forecast model that converts gridded forecasts of updraft speeds and graupel hydrometeor mixing ratios in the mixed phase layer into gridded estimates of total lightning flash rate density.

General Public Release

Environmental Science (Earth, Air, Space, Exoplanet)

Low-Altitude Trapped Radiation Model, Version 1   MFS-31309-1

Accurate models of the Earth's trapped energetic proton environment are required for both piloted and robotic space missions. As astronomical and remote sensing detectors become more sensitive, proton flux can induce unwanted backgrounds in the instrumentation. The Low-Altitude Trapped Radiation Model, based on nearly 20 years of data from the TIRO/NOAA weather satellites, predicts the integral omnidirectional proton flux in three energy ranges. The model contains a true solar cycle variation and accounts for the secular variation in the Earth's magnetic field.
U.S. Release Only

Magnetogram Forecast (Mag4) 2018   MFS-32802-1

Forecasting from a magnetogram of a sunspot active region, this algorithm predicts solar eruptions anticipated within the next 24 to 48 hours. The technology essentially transforms available solar scientific data into forecasting tools for severe space weather conditions.
General Public Release

Mars Global Reference Atmospheric Model 2010 (Mars GRAM 2010)   MFS-33158-1

Mars GRAM is an engineering-level atmospheric model widely used for diverse mission applications, including systems design, performance analysis, and operations planning for aerobraking; entry, descent, and landing; and aerocapture.
General Public Release

Marshall MRMS Mosaic Python Toolkit (MMM-Py)   MFS-33236-1

MMM-Py reads, analyzes, and displays three-dimensional national mosaicked reflectivity data produced by NOAA's National Severe Storms Laboratory (NSSL). MMM-Py can read MRMS mosaics from either their unique binary format or their converted NetCDF format; it can also read and properly interpret the current mosaic design (4 regional tiles), as well as mosaics produced prior to late July 2013 (8 tiles). The technology can easily stitch multiple tiles together to provide a larger regional or national picture of precipitating weather systems. Composites, horizontal/vertical cross-sections, and combinations thereof are easily displayed using as little as one line of code.
Open Source

MATLAB-Based Solar System Ephemeris Toolbox   KSC-12544

This set of MATLAB functions has been used to generate state data (position and velocity) for the Sun, the Earth's moon, and all of the other planets in the solar system. Provided by the Jet Propulsion Laboratory's Solar System Dynamics Group, the technology uses Chebychev polynomial fits of numerical integration results for solar system motion. Essentially, the toolbox functions as the MATLAB equivalent of JPL Fortran routines used to construct binary ephemeris files, verify correct installation, and generate state data.
General Public Release

Mekong River Total Suspended Sediment Software Applications (Mekong_TSS)   SSC-00507

The Mekong River Total Suspended Sediment Software Application (TSS_Mekong) computes the total suspended sediment (TSS) concentrations of the Mekong River from data of the Operational Land Imager (OLI), flying on board of the LANDSAT-8. In this application, computation of TSS follows a two-step process which includes; 1) generating the remote sensing reflectance and/or surface reflectance products using SeaDAS, a NASA comprehensive image analysis package for the processing, display, analysis, and quality control of ocean color data, and 2) running the programgen_tss on the SeaDAS output files to generate the total suspended sediment (TSS) images. The TSS_Mekong was developed with in-situ measurements of the Mekong River waters, acquired by NASA, the Naval Research Laboratory (NRL) and Khon Kaen University of Thailand personnel during March 2016.
General Public Release

Environmental Science (Earth, Air, Space, Exoplanet)

Meteoroid Engineering Model (MEM), Version 3 — MFS-32205-2

MEM 3 is NASA's most current and accurate model of the meteoroid environment. It describes potentially hazardous meteoroids in the inner solar system and provides the flux, directionality, speed, and bulk density of meteoroids encountered along a user-specified spacecraft trajectory.
General Public Release

Multiple-Doppler Radar Analysis Toolkit (MultiDop) — MFS-33436-1

MultiDop merges three-dimensional variational analysis (3DVAR) software code developed by the University of Oklahoma with the Department of Energy's Python Atmospheric Radiation Measurement Radar Toolkit (Py-ART) software framework. This enables end users to ingest, correct, and grid their weather radar data using Py-ART, and then pass the radar volumes to MultiDop to synthesize, analyze, and display the 3D winds. By using the software developed in this effort, an entire science analysis project can be done using a shareable Jupyter notebook.
Open Source

NASA Ames Legacy Mars Global Climate Model — ARC-18547-1

This model uses a modified version of the ARIES/GEOS dynamical core coupled with a set of Mars physics packages to simulate the martian climate. The physics packages include the treatment of surface properties, a ground temperature model, a planetary boundary layer scheme, water and carbon dioxide sublimation/condensation physics, a water ice cloud microphysical scheme, the use of a moment method for tracer transport, a semi-interactive dust tracking scheme, and a two-stream radiative transfer code based on correlated-k's.
Open Source

NASA Forecast Model Web (NFMW) Map Service — GSC-15276-1

NFMW reads weather forecast models outputs; subsets the data to the region of interest; interpolates the data to the specified size; generates a visualization of the data using colors, contour lines, or arrows; and sends the visualization to the client. More information can be found at: http://opensource.gsfc.nasa.gov/projects/NFMW/
Open Source

NASA NeMO-Net, the Neural Multi-Modal Observation and Training Network — ARC-18500-1

A convolutional neural network (CNN) designed for marine ecosystem classification. The CNN takes as input 2D satellite and drone images as well as 3D reconstructions of underwater environments and generates classification maps for those environments as output. These classification maps can be used to better understand and protect coral reefs globally. One component of NeMO-Net is a citizen science game for mobile devices and personal computers. Through playing this game, players help NASA classify coral reefs and other aquatic ecosystems by painting on 2D and 3D images of coral. The application educates players on how to identify the different types of coral and player classifications are used to train the CNN to classify aquatic ecosystems autonomously.
General Public Release

NASA Visualization Explorer (NASA Viz) for Android — GSC-17628-1

NASA Viz is an intuitive interactive Android application and an extension of the NASA Viz iPad and iPhone versions. The application delivers science stories with multimedia content linking high-quality explorable images, descriptive text, visualizations, videos and interviews with a fresh look and feel. App features include: credit information for each story, the ability to share stories with social media and to create lists of stories that can be shared with other users, and the ability to explore stories by keywords and search.
General Public Release

NASA/Air Force Spacecraft Charging Analyzer Program (NASCAP-2K), Version 4.3   MFS-32056-1

NASCAP-2K is the next-generation spacecraft charging analysis code. The technology is a comprehensive update to the original NASCAP spacecraft charging codes written twenty years ago. A collaboration of NASA and the U.S. Air Force Research Lab (AFRL), the software builds upon the Air Force's DynaPAC charging algorithms and will replace 3D spacecraft charging codes for all environments.
U.S. Release Only

Neo-Geography Toolkit (NGT), Version 2   ARC-16341-1A

NGT is a collection of automated processing tools that can transform raw geospatial raster data from remote sensing instruments into useful cartographic products, including visible image base maps and topographic models.
Open Source

Neptune Global Reference Atmospheric Model (Neptune-GRAM), Version 1.0   MFS-32296-1

From surface to orbital altitudes, this Fortran-based program provides engineering estimates of density, temperature, pressure, and winds for the Neptune atmosphere.
General Public Release

Obs4MIPS   GSC-16848-1

This technology is a front end to the Climate Model Output Rewriter (CMOR2) software package. The technology converts a variety of standard data formats (e.g., netcdf3, netcdf4, Grads control files, and MATLAB data files) to allow publication on the Earth System Grid Federation (ESGF) data node.
Open Source

Orbital Debris Engineering Model (ORDEM), Version 3   MSC-25457-1

ORDEM offers flux as a function of debris size and year. The technology can be operated in spacecraft mode or telescope mode. An upgraded user interface uses project-oriented organization and provides graphical representations of numerous output data products.
General Public Release

Parallel Fortran Logger (pFlogger)   GSC-18012-1

A software logging facility that is tailored to the needs of parallel Fortran software. The facility greatly simplifies the process of logging routine messages within a scientific simulation across multiple processes in a manner that is configurable at run time. Messages can be annotated with different severity levels such that low-level diagnostic information can be generally suppressed except when desired.
Open Source

Particle Trajectory with Shepard's Interpolation for Raindrops   KSC-13800

A particle trajectory model, Particle Trajectory with Qshep interpolation (PTQ), was previously developed to describe the path of rocket plume ejected particles on the lunar surface, predicting the distance particles travel and their impact velocities. A modification of PTQ was made to support the study of the disdrometer-derived Z-R relation. The new version, Particle Trajectory with Shepards interpolation for Raindrops (PTS-R), incorporates an empirical relation between particle diameter D and the drag shape factor Sf to account for the fact that raindrops, unlike lunar soil particles, change shape in response to aerodynamic forces. A relationship was empirically determined relating Sf to particle diameter D for raindrops. The software also supports the original plume driven dust/soil particle application.
General Public Release

Phenological Parameters Estimation Tool (PPET) SSC-00321

A set of algorithms implemented in MATLAB that estimates key vegetative phenological parameters. For a given year, the PPET software package takes in temporally processed vegetation index data (3-D spatio-temporal arrays) generated by the Time Series Product Tool (TSPT) and outputs spatial grids (2-D arrays) of vegetation phenological parameters. As a precursor to PPET, the TSPT uses quality information for each pixel of each date to remove bad or suspect data, and then interpolates and digitally filters the time series to produce a continuous, smoothed vegetation index product in which data voids are eliminated. Both the TSPT and PPET use Moderate Resolution Imaging Spectroradiometer (MODIS) satellite multi-spectral data as a default, but each software package is easily modifiable and could be used with any high-temporal-rate remote sensing system that is capable of producing vegetation indices. MATLAB, MATLAB Runtime Library and ERDAS IMAGINE are required to run the software.
U.S. Government Purpose Release

Python Advanced Microwave Precipitation Radiometer Data Toolkit (PyAMPR) MFS-33219-1

This toolkit reads geolocated brightness temperature data (in ASCII format) from any flight of the AMPR airborne instrument. A python script pulls out timing, brightness temperatures, and other information from each channel/geolocation and store them as attributes using the appropriate type of array. The approach consists of ingesting the entire file as a text string and then parsing and converting as necessary. The file is read and the data are populated when the class is instantiated with the full path and name of an AMPR file. Numerous visualization methods are provided, including track plots, strip charts, and Google Earth KMZs. In addition, polarization deconvolution is available.
Open Source

Python Interface to Cyclone Global Navigation Satellite System (CYGNSS) Wind Dataset MFS-33273-1

CYGNSS is a NASA Earth science mission that launched in December 2016. This software, which is written in the Python language, was developed to facilitate the ingest, analysis, and display of CYGNSS data.
Open Source

Python Interface to Dual-Pol Radar Algorithms (DualPol) MFS-33274-1

This is an object-oriented Python module that facilitates precipitation retrievals (e.g., hydrometeor type, precipitation rate, precipitation mass, particle size distribution information) from polarimetric radar data. It leverages existing open-source radar software packages to perform all-in-one retrievals that are then easily visualized or saved using existing software.
Open Source

Python Polarimetric Radar Beam Blockage Calculation (PyBlock) MFS-33284-1

This Python package calculates beam blockage in polarimetric weather radar data using the specific differential phase (KDP) and fully self-consistent (FSC) methods of Timothy J. Lang et al. (2009; J. Atmos. Oceanic Technol.). This information can be used to correct the radar data when the radar beams intersect objects like trees, buildings, and mountains.
Open Source

Python Turbulence Detection Algorithm (PyTDA) MFS-33237-1

PyTDA, an MSFC-based implementation of the National Center for Atmospheric Research (NCAR) Turbulence Detection Algorithm (NTDA), can be used for convective-scale analysis, situational awareness, and forensic meteorology. The software provides Python functions that will estimate turbulence from Doppler radar data. It is written in the Python programming language.
Open Source

Radbelt: Astropy-friendly Wrapper for the AE-8/AP-8 Van Allen Belt Model GSC-18816-1

This is a small Python library to model the fluxes of charged particles trapped in the Van Allen belt. It provides a fast, simple, and convenient Python interface to the International Geomagnetic Reference Field (IGRF) model and NASA's AE-8/AP-8 models of electron and proton fluxes, which are both implemented in Fortran.
Open Source

Radiation Environment Array Charge Transport (REACT) MFS-32001-1

The REACT detector array charge collection model is useful in the design of optical sensor missions.
U.S. Release Only

Regional Hydrologic Extremes Assessment System (RHEAS) Software Framework NPO-49821-1

This software automates the deployment of nowcasting and forecasting hydrologic simulations and ingests satellite observations (through data assimilation), and it also allows the coupling of other environmental models and facilitates delivery of data products to users via a GIS-enabled database.
Open Source

SAIC Algorithm Test Bed for Asteroid Detection (SALTAD), Version 1.5 GSC-16050-1

Composed of a series of C-language models, the SALTAD software package processes multi-frame image data to detect moving asteroids in a star-cluttered background. The software is highly modularized for interfacing with existing near-Earth asteroid search facility software.
U.S. Release Only

Simple Thermal Environment Model (STEM) User's Guide MFS-31728-1

Helpful in the thermal analysis of near-Earth spacecraft, the STEM User's Guide is a Fortran-based program that provides engineering estimates of top-of-atmosphere albedo and outgoing longwave radiation.
U.S. Release Only

Single Doppler Retrieval Toolkit (SingleDop) MFS-33272-1

SingleDop is a software module, written in the Python programming language, that will retrieve two-dimensional low-level winds from either real or simulated Doppler radar data. It mimics the functionality of the algorithm described in the following reference: Xu et al., 2006: Background error covariance functions for vector wind analyses using Doppler-radar radial-velocity observations. Q. J. R. Meteorol. Soc., 132, 2887-2904. The interface is simplified to a single line of code in the end user's Python scripts, making implementation of the algorithm in their research analyses very easy. The software package also interfaces well with other open-source radar packages, such as the Python ARM Radar Toolkit (Py-ART; https://github.com/ARM-DOE/pyart). Simple visualization (including vector and contour plots) and save/load routines (to preserve analysis results) are also provided.
Open Source

Space Physics Data Facility (SPDF) Web Services GSC-14730-1

These Web services provide a distributed programming interface to a portion of the Space Physics Data Facility (SPDF) software. The technology conforms to all applicable Web service specifications of the World Wide Web Consortium. Please visit the following URL for additional information: http://spdf.gsfc.nasa.gov/
Open Source

Space Weather Android App GSC-16321-1

Developed for the Community Coordinated Modeling Center, this Android application displays space weather information. Users can swipe between space weather data products to see the latest available data; pan and zoom to see a detailed view of any particular product; rearrange and add space weather data products to the application layout; and browse a data catalog by category.
General Public Release

Spacecraft Materials Selector (SMS) Expert System MFS-31328-1

The SMS knowledge base is a preliminary design tool that provides estimates of environmental exposures and/or materials performance. Inputs may launch date, altitude, inclination, mission duration, and certain characteristics of satellite motion.
U.S. Release Only

Terrestrial Observation and Prediction System (TOPS) Biogeochemical Cycle Model ARC-16197-1A

TOPS is a modeling software that integrates data from satellites, weather stations, climate models with ecosystem models to produce nowcasts and forecasts of ecological conditions. The key tools used in producing the nowcasts and forecasts are simulation models including biogeochemical and ecosystem models that estimate the states (vegetation leaf area, biomass, soil moisture, snow, etc.) and functions (evapotranspiration, photosynthesis, etc.) of various kinds of plant canopies (forests, crops, grass, shrubs). These ecological nowcasts and forecasts are akin to current and forecast weather conditions. Upon further refinement and testing, the ecological nowcasts and forecasts are useful for making a variety of management decisions such as irrigation scheduling, timing of field operations, preparing for floods/droughts and vector-borne diseases, and crop phenology and production.
U.S. and Foreign Release

The Charge Collector (TCC), Version 2.1 MFS-32019-1

TCC is a compilation of spacecraft charging tools including design guidelines and a variety of information from government/industry/academic databases and reports.
U.S. Release Only

Time Series Product Tool (TSPT) 3.0 SSC-00404

The Time Series Product Tool (TSPT) is custom designed software developed to compute and display superior quality Normalized Difference Vegetation Index (NDVI) images from satellite data products for enabling or aiding rapid regional surveillance of canopy greenness for crops, forests, and other vegetative surfaces. TSPT was developed in the MATLAB programming environment, and allows users to compute and display various Moderate Resolution Imaging Spectroradiometer (MODIS) products as single time frame and multi-temporal change images, as time series plots at a selected location, or as temporally processed image videos. This is significant because the labor involved with manually creating these types and quantities of products is considerable; however, by using the TSPT software tool, this process becomes simplified, efficient, and largely automated.
U.S. Government Purpose Release

Titan Global Reference Atmospheric Model (Titan-GRAM), Version 1.0 MFS-32297-1

Titan GRAM is a Fortran-based program that provides engineering estimates of density, temperature, pressure, and winds for the Titan atmosphere. More information on the Space Environments and Effects (SEE) Program can be found at: http://see.msfc.nasa.gov/
General Public Release

TPSSizer (aka TPSSZR): Vehicle TPS sizing program using FIAT   ARC-15016-1A

A Thermal Protection System (TPS) sizing tool developed at ARC for use in conceptual level through detailed design level analysis. TPS sizing methodologies and data exchange interfaces with supporting disciplines were developed for TPSSizer. Additionally, the tool introduced improvement with the automatic generation of TPS stackups, automatic generation of aerothermal environment files, maintenance of consistent material properties descriptions, the capability to simultaneously evaluate multiple nominal and abort flight trajectories and the development of methodologies for the application of appropriate design margins.

U.S. and Foreign Release

Trapped Proton Model (TPM)   MFS-31329-1

TPM determines the differential omnidirectional proton flux from 1 to 100 MeV. At high altitudes, the model is based on CRRESPRO developed by AFRL; at low altitudes, the model is based on data from the TIROS/NOAA (POES) low-altitude polar-orbiting satellites. The model contains a true solar cycle variation and also contains sub-models for quiet and active magnetospheric states.

U.S. Release Only

Trapped Radiation Models: Uncertainties for Spacecraft Design   MFS-31319-1

The focus of this software development effort was to help spacecraft and payload designers to account for uncertainties in predictive models of the Earth's trapped radiation environment. A tool was needed for more accurately determining radiation requirements and risks, which are essential elements for producing less expensive, more reliable spacecraft.

U.S. Release Only

Venus Global Reference Atmospheric Model (Venus GRAM 2005), Version 1.0   MFS-32314-1
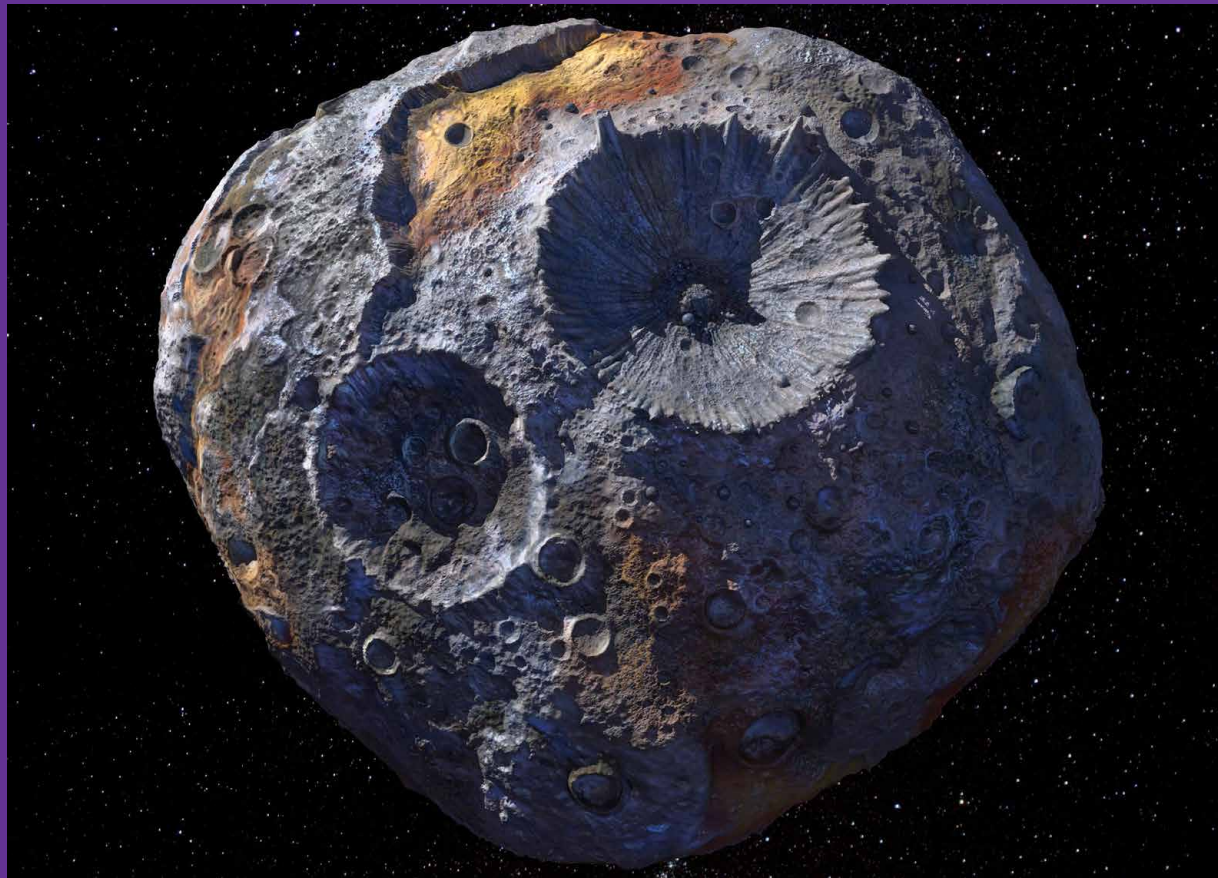
Venus GRAM 2005 is a Fortran-based program that provides engineering estimates of density, temperature, pressure, and winds for the Venus atmosphere.

General Public Release

Materials and Processing

Parts, Manufacturing, Production Processes, Composites

This artist's concept depicts the 140-mile-wide (226-kilometer-wide) asteroid Psyche, which lies in the main asteroid belt between Mars and Jupiter. Psyche is the focal point of NASA's mission of the same name. The Psyche spacecraft is set to launch in October 2023 and arrive at the asteroid in 2029, where it will orbit for 21 months and investigate its composition. Scientists think Psyche, unlike most other asteroids that are rocky or icy bodies, is made up of mostly iron and nickel – similar to Earth's core. Exploring the asteroid could give valuable insight into how our own planet and others formed.

Featured Software

NASA Multiscale Analysis Tool (NASMAT)   LEW-20244-1

NASMAT serves as a state-of-the-art, "plug and play" software package that utilizes multiscale recursive micromechanics as a platform for massively multiscale modeling of hierarchical materials and structures subjected to thermomechanical loads on high-performance computing systems.

U.S. and Foreign Release

T0TEM: T0 Test Evaluation Module   MFS-33829-1

The T0TEM (T0 Test Evaluation Module) is an analysis software for transition temperature tests performed under ASTM E1921 – Standard Test Method for Determination of Reference Temperature, T0, for Ferritic Steels in the Transition Range. T0 is the temperature at which a ferritic steel transitions from mostly ductile tearing to unstable cleavage failure mode. This software analyzes test results to determine T0, the master curve, confidence bounds, validity, margin adjustment, and inhomogeneity by simple, bi-modal, and multi-modal methods. T0TEM also allows for batch analysis, raw data output, and plot creation.

General Public Release

Predict the Behavior of Blackbody Heated Surfaces   DRC-015-017

In the analysis of radiation, it is helpful to be able to predict the heat transfer rate and the spectral distribution of emitted energy. This set of routines is written in Microsoft Visual Basic for Applications (VBA) and incorporates functions specific to Microsoft Excel that are useful for predicting the radiative behavior of heated surfaces. These routines include functions for calculating engineering quantities of primary importance to engineers and scientists such as radiative flux and spectral distributions.

General Public Release

Abaqus User Subroutine Verification (abaverify)   LAR-18938-1

abaverify is a collection of Python scripts that is used for testing and verifying the behavior of user subroutines for the commercial finite element code Abaqus.
Open Source

Acoustic Emission Analysis Applet (AEAA) Software   LEW-19032-1

Post-processing software has been developed at NASA that is tailored for novel analysis of composite pressure vessel acoustic emission (AE) data. The software can be used with data acquired from Digital Wave, Inc., and Mistras Group (Physical Acoustics, Inc.) hardware.
U.S. Release Only

AladynPi: Adaptive Neural Network Molecular Dynamics Simulation Code with Physically Informed Potential: Computational Materials Mini-Application   LAR-19727-1

A basic molecular dynamics codes written in FORTRAN 2008, which is designed to demonstrate the use of artificial neural networks (ANNs) in atomistic simulations. The role of ANNs is to efficiently reproduce the very complex energy landscape resulting from the atomic interactions in materials with the accuracy of the more expensive quantum mechanics-based calculations. AladynPi code is being released to serve as a training testbed for students and professors in academia to explore possible optimization algorithms for parallel computing on multiprocessor computers or computers equipped with graphic processing units.
Open Source

Composite Damage (CompDam) Progressive Damage Analysis Software   LAR-18832-1

This software predicts damage onset, damage progression, and structural collapse of structures manufactured of fiber-reinforced plastic laminates. The modeling of damage progression is undertaken at the meso-scale, where each ply of a laminate is represented as a homogeneous orthotropic continuum. All composite damage mechanisms (matrix cracking, fiber breaking and kinking, and delamination) and their interactions are also represented. The software is implemented as user-written subroutines for utilization with the Abaqus commercial finite element code. Input for CompDam includes ply-level material properties and interface properties obtained from standard material characterization tests.
Open Source

Floating Node Method Composites Simulation Toolbox (FNMCST)   LAR-19000-1

The FNMCST toolbox is a research code used to investigate and develop a high-fidelity numerical approach and advanced physical models to simulate damage progression in composite materials in 3D with high fidelity.
U.S. Release Only

MATLAB Software Associated with "Practical Micromechanics of Composite Materials" Book, Elsevier Publishing   LEW-20181-1

This MATLAB software toolset was developed for use in solving the example and exercises provided in the book entitled "Practical Micromechanics of Composite Materials," authored by Prof. J Aboudi, S. M. Arnold and B.A. Bednarcyk. The MATLAB scripts and functions calculate composite effective properties, margins of safety, and progressive damage of unidirectional and/or composite laminates using classical ply-based lamination theory, stand-alone micromechanics theories (such as Mori-Tanka, MOC, GMC, HFGMC along with failure theories and margin of safety calculations) or micromechanics-based classical lamination theory to illustrate their utility for the design and analysis of advanced composites.
Open Source

Microscopy Segmentation Models
LEW-20249-1

A new technique was developed for creating highly accurate microscopy image segmentation models with less training data. This technique uses transfer learning from classification models that were pretrained on the massive microscopy image database from the NASA ASG lab. Developing accurate segmentation models is significant because it is the first and hardest step in automatically quantifying microstructure features which is critical to linking the processing-structure-property relationships of materials. By quantitatively understanding these relationships, one may discover and develop new materials through traditional or data-driven methods.

Open Source

MicroStructPy: A Microstructure Mesh Generator for Heterogeneous Materials
MSC-26527-1

This technology is software that generates meshes of materials composed of dissimilar constituents. Example materials include carbon fiber composites, metallic alloys, ceramics, and rocks. These meshes are unstructured, meaning the mesh elements are triangular in 2D and tetrahedral in 3D.

Open Source

NASA Multiscale Analysis Tool (NASMAT)
LEW-20244-1

NASMAT serves as a state-of-the-art, "plug and play," software package utilizes multiscale recursive micromechanics as a platform for massively multiscale modeling of hierarchical materials and structures subjected to thermomechanical loads on high-performance computing systems.

U.S. and Foreign Release

Optimal Feature Selection Tool with Machine Learning
LEW-20350-1

The design tool was developed to choose the optimum set of critical features of data that should be controlled to achieve desired target variable for a given acceptable uncertainty. The tool can conduct data science approaches such as exploratory data analysis, low variance threshold, filter, wrapper, and embedded feature selection technique. The integrated techniques can be applied to determine the critical features that should be controlled to achieve target properties for material systems.

Open Source

ParaGrandMC: Parallel Grand Canonical Monte Carlo Simulation Code, Version 2
LAR-19893-1

This is version 2 of ParaGrandMC is a highly parallelized code in FORTRAN for simulating the thermodynamic evolution of metal alloy systems at atomic level, and predicting their thermodynamic state, phase diagram, chemical composition and mechanical properties. The approach taken is based on evolving an initially given atomic system (defined through a list of atomic coordinates of all participating atoms) using Monte Carlo and Molecular Dynamics algorithms. Atomic configurations, in terms of coordinates of all atoms, are stored periodically for a post-processing analysis, such as phase identification, lattice parameter estimates, free energy integration, etc. The numerical implementation is highly parallelized, allowing simulations of multimilion atom systems. The current release has two new interatomic potentials added: Bond Order Potential (BOP), and Physically Informed Neural Network Potential (PINN). In addition, capabilities to compute diffusivity, thermal conductivity, and viscosity are also introduced.

U.S. Release Only

Porous Microstructure Analysis (PuMA)   ARC-17920-1

PuMA software has been developed in order to compute effective material properties and perform material response simulations on digitized microstructures of porous media. PuMA is able to import digital 3D images obtained from X-ray microtomography or to generate artificial microstructures that mimic real materials. PuMA also provides a module for interactive 3D visualizations. Version 3 includes modules to compute simple morphological properties such as porosity, volume fractions, pore diameter, and specific surface area. Additional capabilities include the determination of effective thermal and electrical conductivity (including the ability to simulate local anisotropy), effective diffusivity and tortuosity from the continuum to the rarefied regime, and techniques to determine local material orientation.

U.S. and Foreign Release

Predict the Behavior of Blackbody Heated Surfaces   DRC-015-017

In the analysis of radiation, it is helpful to be able to predict the heat transfer rate and the spectral distribution of emitted energy. This set of routines is written in Microsoft Visual Basic for Applications (VBA) and incorporates functions specific to Microsoft Excel that are useful for predicting the radiative behavior of heated surfaces. These routines include functions for calculating engineering quantities of primary importance to engineers and scientists such as radiative flux and spectral distributions.

General Public Release

Scalable Implementation of Finite Elements by NASA (ScIFEN)   LAR-18720-1

The ScIFEN package is a parallel finite element analysis code that enables scalable solutions to computational mechanics problems by leveraging several open-source high-performance computing libraries for numerical linear algebra routines and parallel input/output. ScIFEN supports different finite element types, nonlinear material models, and boundary conditions and contains both implicit and explicit time-integration procedures called ScIFEi and ScIFEx, respectively.

U.S. Release Only

Scalable Implementation of Finite Elements by NASA (ScIFEN), Version 2   LAR-19121-1

ScIFEN 2 is a 3D solid mechanics C++ code that provides a parallel implementation of the finite element method (FEM). ScIFEN includes several standard linear and non-linear material models including linear elastic isotropic, linear hardening plasticity, and crystal plasticity models. It supports various applied loadings including prescribed displacements and forces, surface tractions and pressures, and body forces. ScIFEN supports both implicit time integration (ScIFEi driver) and explicit time integration (ScIFEx driver). ScIFEN relies on several open-source libraries for scalability and efficiency, including PETSc, HDF5, and MOAB.

U.S. Release Only

Tool for Analysis of Surface Cracks (TASC)   MFS-33082-1

Created using the commercial math analysis software MATLAB, TASC enables the easy computation of nonlinear J-integral solutions for surface-cracked plates in tension by accessing and interpolating between the 600 nonlinear surface crack solutions documented in NASA/TP-2011-217480. The only required inputs to the program are the surface crack dimensions, plate cross-section dimensions, and material properties. TASC provides a convenient and easy-to-use interface for the solution set that allows a novice user to obtain a fast and reliable fracture toughness solution.

Open Source

T0TEM: T0 Test Evaluation Module   MFS-33829-1

The T0TEM (T0 Test Evaluation Module) is an analysis software for transition temperature tests performed under ASTM E1921 – Standard Test Method for Determination of Reference Temperature, T0, for Ferritic Steels in the Transition Range. T0 is the temperature at which a ferritic steel transitions from mostly ductile tearing to unstable cleavage failure mode. This software analyzes test results to determine T0, the master curve, confidence bounds, validity, margin adjustment, and inhomogeneity by simple, bi-modal, and multi-modal methods. T0TEM also allows for batch analysis, raw data output, and plot creation.

General Public Release

Operations

Ground Software, Telemetry, Command and Control, Global Positioning Systems, Extravehicular Activity, Radio, Communications

This artist's concept shows what Deep Space Station-23, a new antenna dish at the Deep Space Network's complex in Goldstone, California, will look like when complete in several years. DSS-23 will communicate with NASA's deep space missions using radio waves and lasers. Retractable covers will be able to fan out across the mirrors at the center of the dish to protect them from the elements.

Featured Software

Debris Assessment Software (DAS), Version 3.2.4   **MSC-26690-1**

The Debris Assessment Software (DAS) is provided by the NASA Orbital Debris Program Office as a means of assessing, during the planning and design phase, space missions' compliance with NASA's requirements for reduction of orbital debris. DAS is designed to assist NASA programs in performing orbital debris assessments, as described in NASA Technical Standard 8719.14, Process for Limiting Orbital Debris. The software reflects the structure of the standard and provides the user with tools to assess compliance with the requirements. If a program is noncompliant, DAS may also be used to explore debris mitigation options to bring a program within requirements.
General Public Release

**GNSS-Inferred Positioning System and Orbit Analysis
Simulation Software (GIPSY-OASIS)**   **NPO-19636-1**

GIPSY-OASIS is widely used for geophysical and global positioning system research.
U.S. Government Purpose Release

**Consultative Committee for Space Data Systems (CCSDS)
File Delivery Protocol (CFDP) Software Library, Version 3.1**   **GSC-14993-1**

This library provides for the reliable transfer of large data blocks to and from spacecraft. It implements the international standard CFDP protocol, can be used from mission to mission, and supports both ground and flight software.
U.S. Government Purpose Release

3D-Nc: Expected Collision Rates for Tracked Satellites GSC-18593-1

The NASA Conjunction Assessment Risk Analysis (CARA) team has recently developed new algorithms and software to estimate collision rates and probabilities between Earth-orbiting satellites. The formulation entitled "Expected Collision Rates for Tracked Satellites" provides an innovative method to estimate collision risks based on the expected collision rate and number of collisions, which are both closely related to the collision probability. The new formulation accounts for the non-linear orbital motion of the satellites and derives expressions that form the basis for Monte Carlo simulations, as well as semi-analytical approximations applicable to single- and multi-encounter interactions.
Open Source

Craftsman MSC-25958-1

This is a software toolkit for flexible tool use by robotic manipulators. The suite of state-of-the-art algorithms is focused on extending current pick-and-place planning and control methods to enable robust tool usage by humanoid and other armed robots. The system provides more intuitive tools for the user of the robotic manipulator, including visualization tools for defining tool use scenarios, including Cartesian tolerances along trajectories and expected forces/torques on the tool tip. This allows robots to be more capable and more reliable during long-term autonomous tasks by significantly improving the ability of remote supervisors to command complex tool-usage tasks, by enabling robots to operate safely alongside humans during shared tasks, and by providing a general tool usage framework that works with novel tools and with any robot configuration. Download at: https://bitbucket.org/traclabs/craftsman
Open Source

Astrobee Control Station ARC-17994-1A

An extension of the Visual Environment for Remote Virtual Exploration (VERVE) that has been customized to operate the Astrobee robot on the International Space Station (ISS). The Astrobee robot has two purposes: it is a remotely-operated mobile camera and survey instrument for ground controllers, and it is an extensible zero gravity research platform for guest scientists. Ground controllers use the Astrobee Control Station to fly Astrobee, control its instruments, watch live video from its cameras, monitor its position and other telemetry, and download and delete collected data. Guest Scientists use the Astrobee Control Station to start and stop their experiments onboard Astrobee, and to monitor custom data and telemetry from their experiments.
Open Source

Astrobee Control Station Binary ARC-17994-1B

An extension of the Visual Environment for Remote Virtual Exploration (VERVE) that has been customized to operate the Astrobee robot on the International Space Station (ISS). The Astrobee robot has two purposes: it is a remotely-operated mobile camera and survey instrument for ground controllers, and it is an extensible zero gravity research platform for guest scientists. Ground controllers use the Astrobee Control Station to fly Astrobee, control its instruments, watch live video from its cameras, monitor its position and other telemetry, and download and delete collected data. Guest Scientists use the Astrobee Control Station to start and stop their experiments onboard Astrobee, and to monitor custom data and telemetry from their experiments. The Binary for US/Foreign version may be distributed to NASA researchers, third party schools, colleges and universities provided that all use of RTI software is limited solely to research activities associated with the Astrobee.
U.S. and Foreign Release

Autonomous eXplorer Control System (AXCS) ARC-16721-1

AXCS enables smartphones and other mobile devices to be utilized as a ground-based test bed for operations in extreme environments. For NASA, the technology is currently being used to evaluate hardware for balloon launches. The software's tool kits provide environmental and situational measurements, command and data handing (CD&H) functions, events timing, data logging, and communications with external devices.
Open Source

CalSimHydro
NPO-48235-1

This Web-based, Google Earth-enabled interactive interface provides a tool for configuring, running, viewing, and downloading the results of a CalSim 3.0 Hydrology Preprocessor program. The software allows the user to (1) interact with a map of water budget areas (WBAs) and display data for a selected WBA in tabular form or as a time series plot; (2) edit input and run a CalSim 3.0 Hydrology Preprocessor; and (3) compare results with base-run output and download the output file. CalSimHydro will be delivered to the California Department of Water Resource (DWR) and released as a part of the CalSim 3.0 system.
U.S. Government Purpose Release

CARA SDK: Two-Dimension Probability of Collision (Pc) Calculation
GSC-18016-1

The two-dimension probability of collision (Pc) calculation module set is one of the Conjunction Assessment Risk Analysis (CARA) Software Development Kit (SDK). It implements the calculation of the probability of collision of two satellites given the state estimates and covariances, following the methodology of Foster and Estes (1992).
Open Source

Command, Control, Communications, and Intelligence (C3I) Delay/Disruption-Tolerant Networking (DTN) Software
LEW-18493-1

This code is a DTN implementation of the Constellation Program's C3I software.
U.S. Government Purpose Release

Command, Control, Communications, and Intelligence (C3I) Networking Software
LEW-18494-1

This implementation of the Constellation Program's C3I software has provided an environment for the prototype testing of a variety of networking protocols.
U.S. Government Purpose Release

Command, Control, Communications, and Intelligence (C3I) Voice Exchange Software
LEW-18495-1

This implementation of the Constellation Program's C3I software has provided an environment for the prototype testing of a variety of voice exchange components.
U.S. Government Purpose Release

Conjunction Consequence Assessment
GSC-18068-1

Determines the likelihood of a catastrophic collision and estimates the amount of debris likely to be produced by a particular satellite conjunction should a collision actually occur. Includes methodologies to produce a PDF of reasonable mass values for the secondary object so that the equations for catastrophic collision determination and debris production estimation can be employed, following the work of Hejduk et al. (2017).
Open Source

Consultative Committee for Space Data Systems (CCSDS) File Delivery Protocol (CFDP) Software Library, Version 3.1
GSC-14993-1

This library provides for the reliable transfer of large data blocks to and from spacecrafts. It implements the international standard CFDP protocol, can be used from mission to mission, and supports both ground and flight software.
U.S. Government Purpose Release

Debris Assessment Software (DAS), Version 3.2.3   MSC-26690-1

The Debris Assessment Software (DAS) is provided by the NASA Orbital Debris Program Office as a means of assessing, during the planning and design phase, space missions' compliance with NASA's requirements for reduction of orbital debris. DAS is designed to assist NASA programs in performing orbital debris assessments, as described in NASA Technical Standard 8719.14, Process for Limiting Orbital Debris. The software reflects the structure of the standard and provides the user with tools to assess compliance with the requirements. If a program is noncompliant, DAS may also be used to explore debris mitigation options to bring a program within requirements.
General Public Release

Dorado-Scheduling   GSC-18694-1

Dorado is a proposed space mission for ultraviolet follow-up of gravitational wave events. This repository contains a simple target of opportunity observation planner for Dorado. Features include: 1. Global: jointly and globally solves the problems of tiling (the set of telescope boresight orientations and roll angles) and the scheduling (which tile is observed at what time), rather than solving each sub-problem one at a time. 2. Optimal: generally solves all the way to optimality, rather than finding merely a "good enough" solution. 3. Fast: solve an entire orbit in about 5 minutes. 4. General: does not depend on heuristics of any kind. 5. Flexible: problem is formulated in the versatile framework of mixed integer programming
Open Source

DTN Marshall Enterprise   MFS-33978-1

DTN Marshall Enterprise is a fully compliant CCSDS Delay/Disruption Tolerant Network (DTN) router that has been used to conduct International Space Station payload operations for many years. Communications in space are characterized by their disrupted, wireless nature. This software, using the bundle protocol (BP), can maximize the efficient use of links to and among spacecraft. As part of NASA's efforts to deploy DTN in space, the HOSC developed a general purpose DTN router based on the SourceForge DTN2 version 6 reference code and reinvented a previously developed capability called the External Router.
Open Source

Global Precipitation Measurement (GPM) Spacecraft
Flight Software (FSW), Version 4.7.2   GSC-16669-1

The Global Precipitation Measurement (GPM) Spacecraft Flight Software (FSW) controls and coordinates all aspects of the spacecraft's operation in nominal and anomolous conditions. It distributes commands to, and collects data from, all spacecraft subsystems and the science instruments. The FSW controls high-gain antenna pointing to TDRSS satellites and manages communications with the ground controllers in real time to receive commands (during SSA contacts) and send housekeeping telemetry data during SSA and MA contacts. It sends science data using the Class-2 CCSDS File Delivery Protocol (CFDP). The GPM FSW monitors the health of most orbiter subsystems and takes corrective actions when necessary.
U.S. Government Purpose Release

GMSEC API Performance Testing Utility, Version 3.0   GSC-16168-1

This statistical performance testing tool is used to test and measure the GMSEC middleware systems by recreating test scenarios under various configurations. The benchmarks run simulations at increasing loads, measuring the performance in terms of message transmission delay. The results can be visually inspected in Microsoft Excel graphs or raw numerical data. The utility features the ability to compare performance of middleware-based systems against raw TCP socket-to-socket communications, providing a better perspective on the relative worth of GMSEC-compliant middleware systems.
U.S. Government Purpose Release

GNSS-Inferred Positioning System and Orbit Analysis Simulation Software (GIPSY-OASIS)   NPO-19636-1

GIPSY-OASIS is widely used for geophysical and global positioning system research.
U.S. Government Purpose Release

Goddard Enhanced Onboard Navigation System (GEONS)   GSC-14687-1

GEONS processes data from standard GPS receivers, communication equipment, and/or attitude sensors to produce accurate, absolute, relative onboard navigation solutions in real time. Navigation products from GEONS support additional autonomous functions, including onboard maneuver control, science viewing, and relative navigation for formation keeping.
U.S. Government Purpose Release

Goddard Mission Services Evolution Center (GMSEC) Application Programming Interface (API), Version 4.6   GSC-18523-1

The GMSEC architecture is a comprehensive flight and ground system architecture that spans the full mission life cycle. Software components use the GMSEC Architecture API to connect to a middleware software messaging bus that in turn is responsible for message routing and delivery. This software release contains enhancements to previous releases of the GMSEC API, including greater reliability and enhanced usability such as: Heartbeat Generator that allows a component to easily publish heartbeat messages; the ability for Field objects to be cloned; and extended log information for the Python3 binding.
Open Source

Goddard Mission Services Evolution Center (GMSEC) Application Programming Interface (API), Version 4.8   GSC-18753-1

The open-source GMSEC API allows software components to connect to a middleware messaging bus, which in turn is responsible for message routing and delivery. The API and middleware combine to free the components from having to know where other components exist and what data they need. The API combined with the GMSEC message standards allows a component to be GMSEC-compliant and help it achieve plug-and-play capability. Using standard messages for functionality lets standardized components be easily exchanged without affecting other GMSEC components. The API standardizes the interface to the middleware for the GMSEC component and normalizes the middleware behavior. The API supports multiple middleware, platforms, and languages. The API interface to the middleware ensures similar behavior from a large selection of commercial off-the-shelf middleware. The GMSEC API also provides access to all the standard middleware messaging capabilities, including publish/subscribe and request/reply. This software release contains enhancements to previous releases of the GMSEC API, including greater reliability and enhanced usability. For example, this release includes Ruby script language binding, support for Python 3.8.5, and support for Apache Artemis. Numerous bug fixes are also included with this release.
Open Source

Goddard Mission Services Evolution Center (GMSEC) Application Programming Interface (API), Version 4.9   GSC-18763-1

The GMSEC API is a software interface to a ground system middleware messaging bus and enforces the use of standard defined messages; the middleware (not part of GMSEC API) is responsible for message routing and delivery.
U.S. Government Purpose Release

Goddard Mission Services Evolution Center (GMSEC) Core, Version 4.0   GSC-17570-1

The GMSEC architecture is a comprehensive flight and ground system architecture that spans the full mission life cycle. Software components use the GMSEC Architecture API to connect to a middleware software messaging bus that in turn is responsible for message routing and delivery. The API and middleware combine to free the components from having to know where other components exist and what data they need. The API combined with the GMSEC message standards allow a component to be GMSEC-compliant and help it achieve plug-and-play capability. Using standard messages for functionality helps the GMSEC environment achieve the goal of application interchangeability, where standardized components can be exchanged easily without affecting other GMSEC components.
Open Source

Ground Hardware Management Tool Web Application   KSC-13923

The Ground Systems Development and Operations (GSDO) Program requires a Web-based application to effectively manage and coordinate the various components of ground support equipment (GSE) used at Kennedy Space Center (KSC) throughout the spacecraft and launch vehicle processing and integration flow, as well as for launch pad operations. This integrated GSE tracking and management tool tracks and manages GSE data used in support of KSC\GSDO operations planning and launch campaigns.
U.S. Release Only

High-Speed Software Implementation of Delay-Tolerant Networking (DTN)   LEW-19897-1

This software prototype called High-Speed DTN (or HDTN) takes advantage of modern hardware platforms to offer substantial improvement on latency and throughput with respect to DTN implementations that exist today. Specifically, our implementation maintains compatibility with existing implementations of DTN that conform to IETF RFC 5050, while simultaneously defining a new data format that is better suited to higher-rate operation in many cases. It defines and adopts a massively parallel, pipelined, and message-oriented architecture, which allows the system to scale gracefully as the resources available to the system increase. HDTN's architecture additionally supports hooks for replacing various elements of the processing pipeline with specialized hardware accelerators, which can be used to offer improved size, weight, and power (SWaP) characteristics at the cost of increased development, complexity, and cost.
Open Source

Input Device Framework (IDF)   MSC-25810-1

This framework is for mapping physical input devices (joysticks, gaming controllers, custom control panels, etc.) to application-specific virtual controller interfaces.
Open Source

Inspire Connect Explore (ICE)   KSC-13772

The ICE application is an inspirational tool utilized by the Education and External Relations organization to increase STEM participation. In addition to static content such as biographies and career information, the Web site allows dynamic (approved) content where students may post questions to specific employees about their degree experience and career advancement. This new application was developed utilizing ASP.NET, HTML, and SQL Server 2008 technologies. Access is controlled through role-based security at the application level. Employees are provided automated log-in capability after which they may create and edit their inspirational biographies and career information or respond to questions posted by the public.
U.S. Release Only

Integrated Test and Operation System (ITOS), Version 9.0   GSC-17915-1

ITOS is a satellite telemetry and command system. It has been used on more than 30 NASA projects, from CubeSats to Great Observatories. It is appropriate for use during the entire mission lifecycle, from development in the labs to on-orbit operations. ITOS is also a very capable closed-loop, scripted tool that can simulate an entire observatory or a particular subsystem.
U.S. Government Purpose Release

Interoperable Remote Component (IRC)　　　　　　　　　　　　　GSC-14308-1

IRC provides robust interactive and distributed control/monitoring of remote instruments. The IRC architecture combines the processing capabilities of Java with the power of XML to express hierarchical data in a human-readable, platform-independent format. For additional information, please visit: http://opensource.gsfc.nasa.gov/projects/IRC/index.php

Open Source

Java Astrodynamics Toolkit (JAT)　　　　　　　　　　　　　　　GSC-14912-1

JAT is a collection of Java components that aid flight dynamics engineers in performing space mission design; trajectory optimization; and spacecraft navigation, attitude-determination, and control systems analysis. Current capabilities include orbit propagation, orbit determination, maneuver planning, spacecraft attitude simulation, and 3D orbit and attitude visualization.

Open Source

Maestro Science Activity Planner for Mars　　　　　　　　　　　NPO-45871-1

The Maestro Science Activity Planner (Maestro) provides an intuitive interface to the Mars Exploration Rovers Mission, combining cutting-edge visualization with sophisticated planning and simulation capabilities.

U.S. Government Purpose Release

Maneuver Trade Space　　　　　　　　　　　　　　　　　　　　GSC-17683-1

The Maneuver Trade Space tool is used to assist in the operational decision making of the propulsive needs vs the time frame for a satellite maneuvering to avoid conjunctions with orbital debris and/or other satellites.

General Public Release

Mission Display (MDX) System　　　　　　　　　　　　　　　　　NPO-35238-1

The MDX System can be used to visualize a wide variety of raster scan data, including IFSAR images and DEM. The technology enables the user to view very large data sets (greater than 2 gigabytes per image) and offers several ways to combine information from different data sets into a single display window.

U.S. Government Purpose Release

Monte Carlo Pc Calculation from TCA (in equinoctial elements)　　GSC-18072-1

Calculates the probability of collision (Pc) between two conjuncting satellites using a Monte Carlo technique, executing the draws from the propagated states and covariances at the time of closest approach (TCA) between the two satellites.

Open Source

MSLICE Sequencing　　　　　　　　　　　　　　　　　　　　　NPO-47292-1

Developed for the NASA Mars Science Laboratory (MSL) mission, MSLICE Sequencing is a graphical tool for writing sequences and integrating them into RML files, as well as producing SCMF files for uplink. When operated in a testbed environment, it also supports uplinking these SCMF files to the testbed via Chill.

U.S. Government Purpose Release

Multipath TCP (MPTCP) Tools, Analytics, and Configurations　　　LEW-19620-1

This collection of tools, scripts, and configurations allows the use of Multipath Transmission Control Protocol (TCP) across multiple point-to-point interfaces such as those commonly used for satellite and optical links.

Open Source

NASA Operational Simulator for Small Satellites (NOS3)　　　　　GSC-17737-1

NOS3 is an open-source software only test bed for small satellites. It is a collection of Linux executables and libraries. Current simulations are based on commercial off the shelf (COTS) hardware that is being used on the STF-1 CubeSat. It is intended to easily interface with flight software developed using the NASA Core Flight System (cFS).
Open Source

NOSS: NDAS One-Stop Shop　　　　　SSC-00529

NOSS is a Web-based central configuration interface for the NASA Data Acquisition System (NDAS), or it can be used additionally as a front end for other types of data acquisition systems. NOSS is accessed using a Web browser and allows for concurrent multi-user access. After configuration is complete, a user can export an XML that can be used in the configuration of a data acquisition system.
U.S. Government Purpose Release

Open Mission Control Technologies (Open MCT)　　　　　ARC-15256-1D

Open MCT is an open-source and Web-based mission control framework for visualization of data on desktop and mobile devices. Open MCT is designed for analysis, visualization, operation, and support of spacecraft missions. It provides an extensible plugin system allowing it to be integrated with existing ground systems and adapted to support multiple missions, as well as non-space applications.
Open Source

Oversight　　　　　GSC-18591-1

A Splunk Application solution for aggregated hardware and software asset inventory. The application identifies all hosts on the network, reports on host compliance status, and tracks for gaps in monitoring tools.
Open Source

Portable C/C++ STRS Operating Environment Library and Reference Implementation　　　LEW-19644-1

A portable software library which implements the fundamental components of the Space Telecommunications Radio System (STRS) operating environment as described in the latest revision of NASA standard 4009 (NASA-STD-4009A). This software library is intended to reduce the development cost associated with implementing an STRS operating environment by providing a C/C++ standards-compliant reference implementation of the basic functions described in the architecture document.
U.S. and Foreign Release

Python Ground Station for a Core Flight System
with CCSDS Electronic Data Sheets Support　　　　　LEW-20210-1

This software package consists of a Python-based graphical user interface (GUI) which serves as a generic telemetry and telecommand system for any mission that uses Core Flight System (cFS) with CCSDS Electronic Data Sheets (EDS) support. The GUI utilizes python bindings to automatically read all of the information contained in the mission's EDS Library and Core Flight Executive (cFE) Mission Library. This allows the software to send any command or decode any telemetry message defined in the EDS files. Utility scripts are also included for terminal operation and telemetry data processing.
Open Source

ROBUS-2 Fault-Tolerant Broadcast Communication System for Modular Avionics　　　LAR-17264-1

ROBUS-2 is a time-division, multiple-access broadcast communication system that uses a time-indexed communication schedule for medium-access control. The technology provides guaranteed fault-tolerant services that include: message broadcast (Byzantine Agreement), dynamic communication schedule update, time reference (clock synchronization), and distributed diagnosis (group membership).
Open Source

Operations

Satellite State Estimate Covariance Realism Evaluation
GSC-18655-1

This software tool ingests position residuals between predicted and as-flown ephemerides, as well as associated covariances, and performs a number of statistical tests to determine whether the predicted covariance is a realistic description of actual state errors.
Open Source

SCaN Optical Link Assessment Tool, Version 2
LEW-19313-1

A calculation procedure has been designed and implemented in software that enables the specification and design of a space-based optical communications system. The resulting optical link budget essentially accounts for the communication power flow through the entire optical communications channel from the transmitter to the receiver and yields design specifications for the optical system necessary to assure reliable data transmission with desired operational metrics such as data rate, link margin, etc. The link assessment tool takes into account all of the sources of deleterious noise that enters into the communications process such as electronically generated noise in the optical detector and stray optical irradiance from external sources. The link budget has the capability of being interfaced with the orbital element calculations of the Satellite Tool Kit (STK) to allow the dynamic description and evolution of optical link operation from any space-borne satellite within the solar system to and from Earth. The current version implements PPM and DPSK modulation types that can use PIN, APD, or nanowire optical detectors in the presence of atmospheric turbulence. Coded and un-coded link power margins are provided.
U.S. Release Only

Single Covariance Maximum Pc
GSC-17900-1

The Single Covariance Maximum Pc Offline Tool estimates the upper bound for probability of collision (Pc) when only one object's covariance information is available. The tool uses a method proposed by Frisbee that incorporates the miss vector and the known covariance to shape the two-dimensional conjuction plane ellipse and bound the maximum Pc.
Open Source

Space Telecommunications Radio System (STRS) Compliance Tools
LEW-18562-1

These tools are used to help verify software compliance to the NASA-developed Space Telecommunications Radio System (STRS) architecture. The goal of STRS is to support waveform application portability and upgradability and reduce the cost and risks of using software-defined radios for NASA. ComplianceTool.sh is a Bourne shell script that tests an STRS application for the appropriate method signatures. The output is a Web page containing the results. The command and compliance application, WFCCN, is ported, compiled, and linked with an STRS infrastructure to verify static compliance such that all required STRS infrastructure-provided methods are implemented, as well as the named constants, typedefs, and structs. WFCCN may also be executed for dynamic compliance testing.
U.S. Release Only

Stol-Mode
ARC-18520-1

An Emacs major mode for Spacecraft Test and Operations Language (STOL), written to be used with Integrated Test and Operations System (ITOS).
Open Source

STRS Flight Computer Interface (FCI) App for Core Flight System
LEW-19643-1

This software implements an application that executes within the NASA core Flight System (cFS) that provides required STRS operating environment components using cFS and the corresponding Operating System Abstraction Layer (OSAL). This software utilizes the portable C/C++ STRS OE implementation described in a separate software package titled "Portable C/C++ STRS Operating Environment Library" as the basis for the fundamental STRS API calls. The combination of this interface application with the underlying library provide a complete STRS operating environment within the NASA Core Flight System.
U.S. Release Only

Thermal Insulation System Analysis Tool (TISTool)   KSC-13561

The Thermal Insulation System Analysis Tool has been updated with more test data from the Cryogenics Test Laboratory and has been converted to Fortran 95 to allow for easier distribution.

U.S. Release Only

Timeline Builder Assistant (TBA)   LAR-18726-1

TBA is intended to support initial surface operations planning by quickly building mission timelines with the "building blocks" method. The result produces a possible approach to completing all mission requirements and is intended for basic feasibility analysis. To build a new timeline, the user is prompted to enter the name of each building block and the number of times it is to be used. The program builds an extravehicular activity (EVA) timeline to complete science and exploration objectives while complying with current human space-flight limits on the number of hours of EVA allowed per day and week. At completion, the program displays the timeline, number of days to complete all requirements, number of rest days, and number of sites visited. The database keeps a record of activities and building blocks used in all surface missions and is easily searchable by the user or the program.

U.S. Release Only

Propulsion

Propellants, Cryogenics, Engine and Motor
Performance Analysis

A close-up view of the first-stage engines as the United Launch Alliance Atlas V 541 rocket, carrying the National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite-T (GOES-T), lifts off from Space Launch Complex 41 at Cape Canaveral Space Force Station in Florida. GOES-T is the third satellite in the GOES-R series that will continue to help meteorologists observe and predict weather events that affect public safety.

Featured Software

Chemical Equilibrium Applications (CEA)   **LEW-17687-1**

The CEA program calculates chemical equilibrium product concentrations from any set of reactants and determines thermodynamic and transport properties for the product mixture. Built-in applications account for theoretical rocket performance, Chapman-Jouguet detonation parameters, shock-tube parameters, and combustion properties.
U.S. Release Only

Chemical Equilibrium with Applications in MATLAB (CEAM)   **MFS-33320-1**

This software is an adaptation of the Fortran-based Gordon-McBride Chemical Equilibrium with Application computer program developed 50 years ago. It incorporates modern programming techniques and data management and adds unique user features.
U.S. Release Only

ROCETS: Rocket Engine Transient Simulation Software   **MFS-31858-1**

ROCETS software consists of a library of rocket engine component software modules for combustion chambers, nozzles, turbines, pumps, valves, lines, etc. The tool can be used to analyze both steady-state and transient performance under various operating conditions in a variety of environments.
U.S. Release Only

ACD Aerodynamic Design of Multistage Axial-Flow Compressors   LEW-17448-1

ACD is an analysis code used for the aerodynamic design of multistage axial-flow compressors. The technology provides velocity diagrams on the streamlines at the blade-row edges. Blade elements are defined by centerline curve and thickness distribution, and blade-element inlet and outlet angles are established through empirical incidence and deviation-angle adjustments to the velocity diagrams. Blade elements can be stacked to provide the full blade design.
U.S. Release Only

ACOD Multistage Axial-Flow Compressor Off-design   LEW-17449-1

A companion tool to Glenn Research Center's ACD software, ACOD is streamline analysis code for predicting the off-design performance of multistage axial-flow compressors. Flow, blading, and loss are modeled similarly to ACD.
U.S. Release Only

Advanced Ducted Propfan Analysis Code (ADPAC)   LEW-16768-1

Developed by the Allison Engine Company under contracts with Glenn Research Center, ADPAC solves tightly coupled internal/external flows through future-concept short-duct turbofan engines.
U.S. Release Only

APNASA, Average-Passage Multistage Turbomachinery Flow Field Analysis Code   LEW-16855-1

APNASA simulates the three-dimensional viscous flowfield through an entire compressor or turbine consisting of multiple rows of blades in a single computational job. A grid is generated which encompasses all blade rows. The code marches forward in time on the flowfield solution within all the blade rows. During the process, the code periodically calculates the time-average glow in each of the blade rows and information required to model interaction effects between each row and its neighbors. When the solution converges to a user-specified tolerance, the simulation is realized, and the user obtains a time-average description of the flow in each blade row. Since information on blade row interactions is passed from row-to-row throughout the solution process, the simulation includes the time-average effects of neighboring blade rows on one another.
U.S. Release Only

Axial-Flow Turbine Off-Design (AXOD) Performance   LEW-16323-1

AXOD computes the flow and efficiency of multistage axial-flow turbines as functions of speed and pressure ratio. The technology uses a span-line analysis with simple radial equilibrium. The loss model includes blade-row inlet losses, blade-row losses, and stage-test losses. Coefficients are selected to match the known design-point performance, and the internal model provides the off-design performance.
U.S. Release Only

BLAYER   LEW-16851-4

BLAYER is a Fortran program used for calculating compressible laminar and turbulent boundary layers in arbitrary pressure gradients.
U.S. Release Only

Broadband Fan Noise Prediction System (BFaNS)   LEW-17307-1

BFaNS computes the broadband noise generated by a turbofan engine's fan stage. Noise sources can include turbulence impingement and boundary-layer turbulence convection.
U.S. Release Only

Centrifugal Off-Design Performance (CCODP) Compressor   LEW-17450-1

CCODP is a one-dimensional off-design performance prediction code used for centrifugal compressors. Correlations account for the following types of loss: inlet guide vane, impeller incidence, shock, skin friction, blade loading, trailing edge, clearance, vaneless and vaned diffuser friction, recirculation, and disk friction.
U.S. Release Only

Chemical Equilibrium Applications (CEA)   LEW-17687-1

The CEA program calculates chemical equilibrium product concentrations from any set of reactants and determines thermodynamic and transport properties for the product mixture. Built-in applications account for theoretical rocket performance, Chapman-Jouguet detonation parameters, shock-tube parameters, and combustion properties.
U.S. and Foreign Release

Chemical Equilibrium with Applications in MATLAB (CEAM)   MFS-33320-1

This software is an adaptation of the Fortran-based Gordon-McBride Chemical Equilibrium with Application computer program developed 50 years ago. It incorporates modern programming techniques and data management and adds unique user features.
U.S. and Foreign Release

CMPSTK Multi-Stage Axial-Flow Compressor Off-Design   LEW-17451-1

Developed for studying variable geometry effects at the conceptual design level, CMPSTK is a combination of the STGSTK and CMPGEN computer codes. STGSTK predicts multistage axial-flow compressor off-design performance using mean-line stage stacking, and CMPGEN estimates design-speed flow range and efficiency ratios.
U.S. Release Only

Commercial Modular Aero-Propulsion System Simulation (C-MAPSS)   LEW-18315-1

Written in a combination of MATLAB and Simulink, C-MAPSS provides a realistic simulation of a large commercial turbofan engine. The technology includes a number of graphical user-interface screens that allow point-and-click operation.
U.S. Government Purpose Release

Commercial Modular Aero-Propulsion System Simulation (C-MAPSS), Version 2   LEW-18315-2

Version 2 of C-MAPSS provides a transient simulation of a large commercial turbofan engine with a realistic engine control system. Written in a combination of MATLAB and Simulink, the software supports easy access to health, control, and engine parameters through a graphical user interface. Retaining the convenience and user-friendliness of the original, Version 2 includes three actuators (as compared to one) and offers an improved controller, as well as added actuator and sensor dynamics.
U.S. Government Purpose Release

Commercial Modular Aero-Propulsion System Simulation 40k (C-MAPSS40k)   LEW-18624-1

Developed in the MATLAB/Simulink environment, C-MAPSS40k is a high-fidelity transient simulation of a generic commercial turbofan engine with a 40,000-pound thrust. The nonlinear physics-based component-level model operates up to Mach 0.8 over a wide ambient temperature range and executes faster than real time. The model can be run from the command line or by using a graphical user interface.
U.S. Government Purpose Release

Comprehensive C++ Controller
for a Magnetically Supported Vertical Rotor, Version 1.0   LEW-17293-1

FATMaCC (Five-Axis, Three-Magnetic-Bearing Control Code), is a versatile code that possesses many desirable features that were not available in previous in-house controllers. Using a 1-GHz processor, the software controls a five-axis system in either a decentralized or a more elegant centralized (model control) mode at a loop time of 56 s. In addition, it levitates and controls (with only minor modification to the input-output wiring) a two-axis and/or a four-axis system.
U.S. Release Only

Compressible Flow Toolbox   LEW-17898-1

The Compressible Flow Toolbox is a set of algorithms that solve classical compressible equations for isentropic flow, fanno flow, Rayleigh flow, normal shock, oblique shock, and expansion. Implemented in the MATLAB programming language, the technology can be used in the analysis of one-dimensional steady flow with constant entropy, with friction, with heat transfer, or with supersonic Mach numbers.
U.S. Release Only

Computational Fluid Dynamics (CFD) Seal Analysis Code   LEW-16582-1

This technology is a computer program designed for the study of fluid dynamic forces.
U.S. Release Only

Computed Tomography Cylinder Unwrapper/Re-slicer Software (CT-CURS), Version 2   LEW-19031-1

CT-CURS is a dedicated unwrapping/re-slicing software tool for computing tomography data from cylindrical and partially cylindrical structures. The technology can be used as a complement to vendor software or can be utilized as a completely standalone visualization program.
U.S. Release Only

CORBASec   LEW-17214-1

This technology has been used for distributed aerospace propulsion simulations.
U.S. Release Only

Cryogen Storage Integrated Model (CryoSIM)   MFS-33071-1

CryoSIM provides input power and dry mass estimates for insulation and hardware used in in-space applications to maintain cryogens in storage. System heat load estimations and associated propellant loss masses can also be generated.
U.S. Government Purpose Release

CSPAN Axial-Flow Compressor Conceptual Design Code   LEW-16074-1

This span-line analysis technology uses isentropic simple radial equilibrium to determine a flow path.
U.S. Government Purpose Release

EADIN Communication Protocol   LEW-19264-1

This communication protocol allows microcontrollers to talk to each other in a structured fashion. As such, it is embodied in C++ code that runs on the microcontroller. The software is not mission certified and is being used for demonstration and testing purposes only.
Open Source

Generalized Fluid System Simulation Program (GFSSP), Version 701   MFS-33019-1

The Generalized Fluid System Simulation Program (GFSSP) is a general software tool that can perform complex fluid flow analysis in a wide variety of applications, including those related to chemical processing, gas processing, power plants, hydraulic control circuits, and various kinds of fluid distribution systems. The tool models liquid fuel phase changes that include compressibility and mixture thermodynamics and allows the user to apply and vary "what-if" effects of external influences.
U.S. Government Purpose Release

Generalized Fluid System Simulation Program (GFSSP), Version 701
(Educational Version)   MFS-32929-1

The Generalized Fluid System Simulation Program (GFSSP) is a general software tool that can perform complex fluid flow analysis in a wide variety of applications, including those related to chemical processing, gas processing, power plants, hydraulic control circuits, and various kinds of fluid distribution systems. Example problems can be used effectively as a teaching aid to students as part of their senior undergraduate or graduate coursework.
U.S. Release Only

ML_POGO Stability Analysis Software   MFS-33024-1

This technology models the coupled structural/propulsion (pogo) stability of a liquid-propellant rocket.
U.S. Release Only

Modular Aero-Propulsion System Simulation (MAPSS)   LEW-17674-1

MAPSS is a flexible turbofan engine simulation environment that provides easy access to health, control, and engine parameters through a graphical user interface. The technology can be used as a simulation environment for developing and testing advanced control algorithms, or it can run transient simulations or generate state-space linear models for creating a piecewise linear controller.
U.S. Release Only

Multidimensional, Multiphysics Computational
Heat Transfer Analysis Software (UNIC)   MFS-32554-1

The Multidemensional, Multiphysics Computational Heat Transfer Analysis Software (UNIC) solves transient, coupled, and simultaneous conjugate heat transfer solutions commonly encountered in rocket engine and launch vehicle component design and analysis.
U.S. Release Only

ROCETS: Rocket Engine Transient Simulation Software   MFS-31858-1

ROCETS software consists of a library of rocket engine component software modules for combustion chambers, nozzles, turbines, pumps, valves, lines, etc. The tool can be used to analyze both steady-state and transient performance under various operating conditions in a variety of environments.
U.S. Release Only

SNAP, Version 2.3   LEW-17816-1

SNAP is an N-body high-fidelity propagation program that can model the trajectories of the planets, the Sun, and virtually any natural satellite in the solar system.
U.S. Release Only

STAN5   LEW-13009-1

This computer program computes general two-dimensional turbulent boundary-layer flow using finite difference techniques. Without requiring any modifications to the program code, STAN 5 can handle a wide range of boundary-layer problems. The technology has been used extensively at Stanford University.
U.S. Release Only

SUPIN: Supersonic Inlet Design and Analysis Tool

LEW-20136-1

SUPIN performs design and analysis of axisymmetric pitot, three-dimensional pitot, axisymmetric-spike, two-dimensional, and streamline-traced inlets using an input data file consisting of input factors. SUPIN writes an output data file containing inlet performance metrics and geometric data. The inlet performance metrics calculated include the flow rates, total pressure recovery, and drag. SUPIN can create the surface grids for the inlets that may be used to visualize the inlet geometry and generate volume grids for computational fluid dynamics (CFD) simulations. SUPIN can also automatically generate three-dimensional, multi-block structured grids for CFD simulations.
U.S. Release Only

Three-Dimensional Nozzle Design Code

LEW-20180-1

This program uses the three-dimensional method of characteristics and streamline-tracing techniques to develop complex nozzle expansion surfaces. It is intended to facilitate integration of a high-speed vehicle aft-body with its propulsive flowpath.
Open Source

Toolbox for the Modeling and Analysis of Thermodynamic Systems (T-MATS)

LEW-19165-1

T-MATS is a Simulink toolbox intended for use in the modeling and simulation of thermodynamic systems and their controls. It contains generic thermodynamic and controls components that may be combined with a variable input iterative solver and optimization algorithm to create complex systems to meet the needs of a developer. Development of this tool was completed on behalf of the NASA Aviation Safety Program's Vehicle Systems Safety Technologies (VSST) project located at the Glenn Research Center.
Open Source

TURBAN Turbomachine Design Code

LEW-17454-1

TURBAN analysis is performed at the arithmetic mean diameter. The stage velocity diagrams are either all similar (therefore have the same work factor) or are determined from an input stage work split. All stages have the same stator exit angle. Stage-by-stage tailoring of the velocity diagrams is not allowed.
U.S. Release Only

V072 Rotor Wake/Stator Interaction Noise Prediction

LEW-17065-1

The V072 computer code predicts noise from rotor wake/stator interactions. The technology can perform compressor rotor wake prediction only, rotor/stator or fan/FEGV interaction only, fan/core stator interaction only, and both fan/FEGV and fan/core stator interactions.
U.S. Release Only

WOBBLE

LEW-17325-1

This technology computes the tone noise associated with propellers and predicts axial and circumferential directivity. The acoustic model is exact and accounts for all unsteady sources.
U.S. Release Only

Structures and Mechanisms

Deployables, Structural Loading Analysis and Design

A team at NASA's Kennedy Space Center in Florida test a 3D printer inside a vacuum chamber at the Granular Mechanics and Regolith Operations (GMRO) lab inside the spaceport's Swamp Works, as part of the Relevant Environment Additive Construction Technology (REACT) project. Testing REACT derives from NASA's 2020 Announcement of Collaboration Opportunity, with AI SpaceFactory – an architectural and construction technology company and winner of NASA's 3D Printed Habitat Challenge – collaborating with Kennedy teams to build 3D-printed test structures using a composite made from polymers and a regolith simulant in a vacuum chamber that mimics environmental conditions on the Moon.

Featured Software

VLOADS: Launch Vehicle Loads Analysis for Preliminary Design, Version 1.4 **MFS-27332-1**

The VLOADS program calculates launch vehicles' in-flight structural loads for preliminary design. The program may also be used to calculate structural loads for upper stages and planetary transfer vehicles. Launch vehicle information and input data such as aerodynamic coefficients, mass properties, propellants, engine thrusts, and performance data are compiled and analyzed by VLOADS to produce distributed shear loads, bending moments, axial forces, and vehicle line loads as a function of X-station along the vehicle's length. Translational accelerations and interface loads, if the launch vehicle has boosters or wings, are also computed.
General Public Release

Half-Cycle Crack Growth **DRC-010-044**

This NASA-developed software program predicts the operational flight life of critical aero-structural components. The tool offers a reliable method for calculating theoretical fatigue crack growths that could lead to catastrophic structural component failures. The program builds upon and integrates Armstrong Flight Research Center's proven half-cycle and closed-form aging theories and is especially accurate because it considers every half-cycle of loading spectra for specific structural components. The program works by reading test data files and determining maximum and minimum loads of each half-cycle of random loading spectra in order to calculate theoretical crack growth. The innovation is an improvement on traditional prediction software (and in particular on visual inspections) because it considers mini-amplitude stress loading and half-cycles based on the duty cycle of a particular component or structure.
General Public Release

Object-Oriented Optimization Tool, Version 2.0 **DRC-014-024**

This multidisciplinary design analysis and optimization solution automates optimization tasks early in the design process according to a range of user-defined parameters, including factors such as cost, safety, and environmental impact. The tool provides a framework that enables several engineers to use multiple programs to globally optimize a model. This tool quickly streamlines optimization and design tasks by integrating disparate software packages – NASTRAN, ZAERO, Cart3D, FUN3D, MOMAT, etc. – in a cross-platform network environment. Designers can convert design variables to structural parameters and generate objective functions using either the built-in pre/post-processor or their own analyzer.
General Public Release

Beyond Low-Earth Orbit (LEO) Architecture Sizing Tool (BLAST)　　MSC-25505-1

A user-friendly, configurable spacecraft sizing tool, BLAST provides a shareable, re-creatable and rigorous end-to-end multi-element architecture framework that has been used to generate mass data for in-space, beyond low-Earth orbit (LEO) transportation vehicles and architectures. Offering a novel approach to modeling, BLAST couples extensive MER research with the ability to assess mission changes instantaneously by analyzing sensitivity sweeps of several parameters at once.

U.S. Government Purpose Release

CCGEOM　　LEW-17450-1A

CCGEOM is a Fortran computer code developed to facilitate the rapid generation of flow passage and blading for various turbomachinery components.

U.S. Release Only

Data Transfer Between Dissimilar Meshes (DTBDM), Version 2.0　　LAR-16371-1

Designed to automate an otherwise labor-intensive process, DTBDM puts the aerodynamic loads output of a computational fluid dynamics (CFD) package into the structural model of an aircraft to allow for deflection calculations.

U.S. Release Only

Femera　　LAR-19531-1

An open-source finite element Mini-App, developed under LaRC's High Performance Computing Incubator (HPCI), that updates the element-by-element (EBE) matrix-free method for modern HPC architectures. This Mini-App isolates EBE iteration kernels, with tests for correctness and performance, for use across a wide range of problem sizes and HPC architectures.

Open Source

Half-Cycle Crack Growth　　DRC-010-044

This NASA-developed software program predicts the operational flight life of critical aero-structural components. The tool offers a reliable method for calculating theoretical fatigue crack growths that could lead to catastrophic structural component failures. The program builds upon and integrates Armstrong Flight Research Center's proven half-cycle and closed-form aging theories and is especially accurate because it considers every half-cycle of loading spectra for specific structural components. The program works by reading test data files and determining maximum and minimum loads of each half-cycle of random loading spectra in order to calculate theoretical crack growth. The innovation is an improvement on traditional prediction software (and in particular on visual inspections) because it considers mini-amplitude stress loading and half-cycles based on the duty cycle of a particular component or structure.

General Public Release

HCDstruct　　LAR-18313-1

This MATLAB routine generates a scalable finite element model suitable for hybrid wing-body (HWB) structural analysis and optimization. HWB geometry structure is based on a vehicle sketch-pad (VSP) surface model of an aircraft and a FLOPS-compatible parameterization of the center body and wing structure. Optimization and weight calculation are based on a Nastran finite element analysis of the primary structural components.

U.S. Release Only

Monocoque Tank Analysis Spreadsheet System (MonTASS), Version 2.0　　MFS-31223-1

The Monocoque Tank Analysis Spreadsheet System (MonTASS) computer program enables rapid analysis and preliminary design of structural domes and truncated sections of cones. MonTASS performs both design and analysis functions and can be used to analyze nonpressurized conical structures.

U.S. Release Only

Structures and Mechanisms

Object-Oriented Optimization Tool, Version 2.0 — DRC-014-024

This multidisciplinary design analysis and optimization solution automates optimization tasks early in the design process according to a range of user-defined parameters, including factors such as cost, safety, and environmental impact. The tool provides a framework that enables several engineers to use multiple programs to globally optimize a model. This tool quickly streamlines optimization and design tasks by integrating disparate software packages – NASTRAN, ZAERO, Cart3D, FUN3D, MOMAT, etc. – in a cross-platform network environment. Designers can convert design variables to structural parameters and generate objective functions using either the built-in pre/post-processor or their own analyzer.
General Public Release

RANSTEP: Reduced Order Analysis Using a Nonlinear STiffness Evaluation Procedure — LAR-17262-1

A new implementation of reduced order finite-element-based analysis for solving geometrically nonlinear random vibration problems of complex structures has been developed. The implementation is given the acronym RANSTEP for Reduced Order Analysis using a Nonlinear STiffness Evaluation Procedure. The nonlinear stiffness evaluation procedure allows computation of otherwise inaccessible modal nonlinear stiffness terms from commercial finite element programs. Some operations are performed outside the commercial codes and utilize in-house-developed Fortran codes. Additionally, Direct Matrix Abstraction Program (DMAP) alters and Python scripts are used to facilitate implementations written about MSC. NASTRAN and ABAQUS, respectively. Two solutions procedures of different fidelity and computational cost are offered in each implementation. They are equivalent linearization and time numerical simulation. Aerospace uses include aircraft and spacecraft structural analysis.
U.S. Release Only

ScIFEN Solver Mini-App (HPCI) — LAR-19417-1

This technology is a stripped-down version of a previously released code (ScIFEN) that creates an open-source mini-app for LaRC's High-Performance Computing Incubator (HPCI). The app isolates the linear solver that ScIFEN uses and loads an example system from file as a test case. It represents roughly 1% of the total source code.
Open Source

Software Platform for Post-Processing Waveform-Based NDE, Version 2.0 — LEW-18460-1

This software platform is for post-processing Waveform-based NDE.
U.S. Release Only

Stochastic Reduced Order Models with Python (SROMPy) — LAR-19359-1

The SROMPy software package is a code written in Python to help solve uncertainty quantification and propagation problems. Stochastic Reduced Order Models (SROMs) are low-dimensional, discrete representations of a given random vector being modeled that facilitate efficient stochastic calculations. SROMs can be viewed as a smart Monte Carlo method. Using the concept for uncertainty propagation is similarly straightforward, but can significantly reduce computation time.
Open Source

Structure Deformation Calculation Program based on Ko Displacement Transfer Functions — DRC-013-035

A computer program that will calculate slopes, deflections, and cross-sectional twist angles if applicable at strain-sensing stations on any structures based on the Ko Displacement Transfer Functions. The program uses measured surface bending strains obtained at strain-sensing stations and structure geometrical properties as its inputs. The program will output time history slopes, deflections, maximum deflections, and cross-sectional twist angles if applicable, and depth factors if calculated. The calculated deflections of a structure can be studied and analyzed for monitoring the health of a structure to prevent catastrophic events.
General Public Release

Tool for Generation of MAC/GMC Representative Unit Cell for CMC/PMC Analysis LEW-19522-1

This is a GUI-based tool that generates a number of different user-defined repeating unit cells (RUCs) interactively that can be used in conjunction with MAC GMC and HF GMC, composite micromechanics-based analysis tools. In addition, the code has provisions for generation of a MAC/GMC-compatible input text file that can be merged with any MAC/GMC input file tailored to analyze composite materials. Although the primary intention was to address the three different constituents and phases that are usually present in CMCs (fibers, matrix, and interphase), the software can be easily modified to address two-phase polymer matrix composite (PMC) materials where an interphase is absent.
U.S. Release Only

VLOADS: Launch Vehicle Loads Analysis for Preliminary Design, Version 1.4 MFS-27332-1

The VLOADS program calculates launch vehicles' in-flight structural loads for preliminary design. The program may also be used to calculate structural loads for upper stages and planetary transfer vehicles. Launch vehicle information and input data such as aerodynamic coefficients, mass properties, propellants, engine thrusts, and performance data are compiled and analyzed by VLOADS to produce distributed shear loads, bending moments, axial forces, and vehicle line loads as a function of X-station along the vehicle's length. Translational accelerations and interface loads, if the launch vehicle has boosters or wings, are also computed.
U.S. Release Only

System Testing

Acoustics, Shock, Vibration, Thermal Vacuum, Leak and Pressure Testing, Test Criteria, Test Management and Planning, Aerodynamic Testing
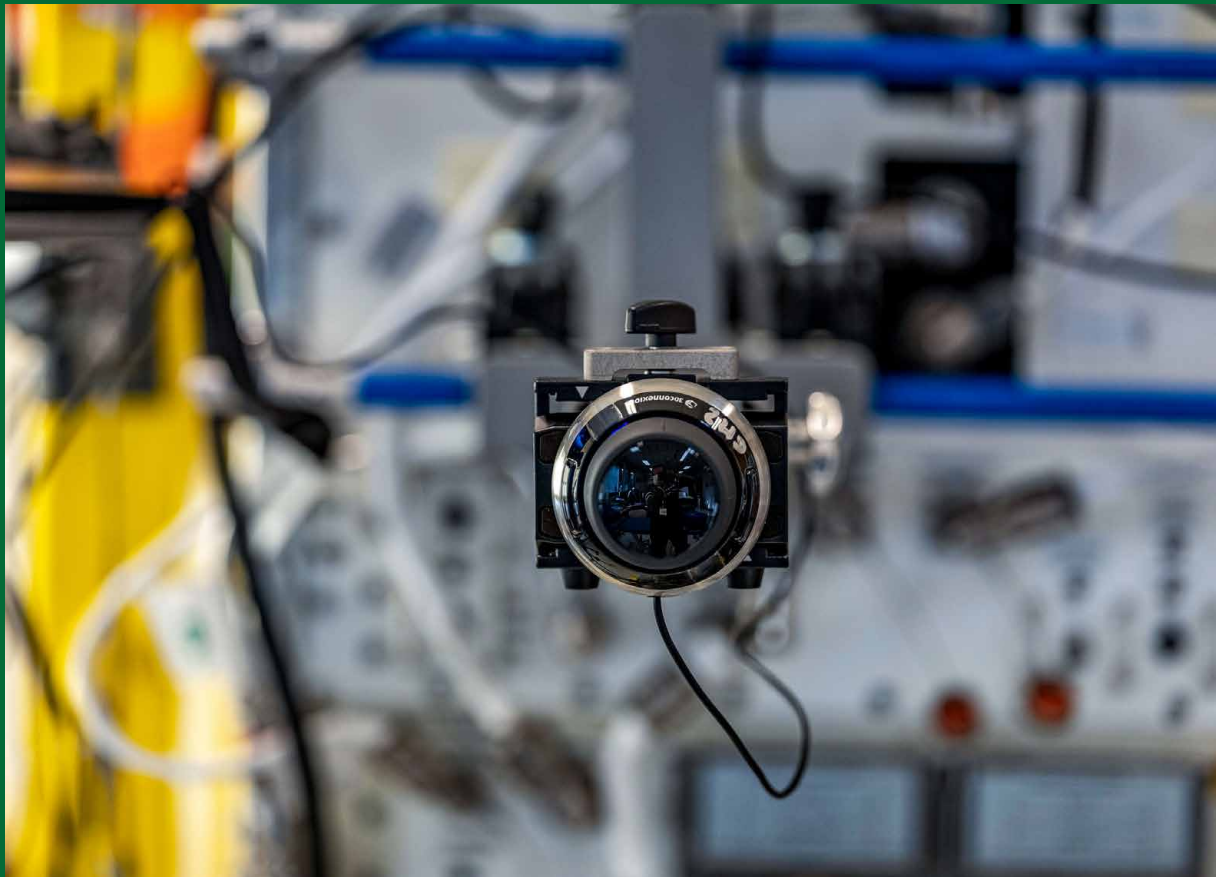
A preflight macro shot of the SIGMA-7 interface for the Pilote experiment. In order to test the ergonomics of a multisensory interface for controlling robotic arms and spacecraft, it is necessary to perform the trials in microgravity. Performing the test on Earth would lead to a design of a work station using terrestrial ergonomic principles that do not correspond to conditions experienced on a spacecraft in orbit. The Pilote investigation tests the effectiveness of novel control schemes for the remote operation of robotic arms and space vehicles, using virtual reality and a new class of user-machine interfaces based on haptics.

Featured Software

System Identification Programs for AirCraft (SIDPAC)   **LAR-16100-1**

Written in MATLAB, SIDPAC is a collection of over 300 programs that perform a wide variety of tasks related to system identification applied to aircraft. SIDPAC includes tools for experiment design, data analysis, kinematic consistency checking, static and dynamic modeling, simulation, numerical integration and differentiation, smoothing, filtering, finite Fourier transformation, statistical modeling and evaluation, optimization, parameter estimation, model accuracy quantification, model validation, and more.
U.S. and Foreign Release

LEWICE 3.2.3 Ice Accretion Software   **LEW-18573-1**

LEWICE contains an analytical ice accretion model that evaluates the freezing process thermodynamics that occur when super-cooled droplets impinge on a body. Both atmospheric parameters (i.e., temperature, pressure, and velocity) and meteorological parameters (i.e., liquid water content, droplet diameter, and relative humidity) are used to determine the shape of the ice accretion.
U.S. Release Only

Centrifugal Compressor Design (CCD) Code   **LEW-17452-1**

This NASA-developed technology provides a rapid preliminary assessment of the design geometry and the design-point performance of centrifugal compressors. The analysis is based on a one-dimensional flow model with correlations for the following losses: inlet guide vane, rotor inlet shock, incidence, clearance, blade loading, skin friction, disk friction, recirculation, vaneless diffuser skin friction, and vaned diffuser. With input performance, the code can operate in design mode; with input geometry, the code can operate in analysis mode.
U.S. Release Only

System Testing

Acoustic Propagation and Emulation Toolset (APET) LAR-17761-1

The Acoustic Propagation and Emulation Toolset (APET) is a framework code uniting several acoustic methodologies for the propagation and measurement of source noise audibility at farfield observers, accounting for the effects of the atmosphere, weather, terrain, and spherical spreading. Currently, APET consists of a modified version of the Rotorcraft Noise Model (RNM, Version 7) coupled with the newly developed Spectral Attenuation Method (SAM) that contains the Ray Tracing Program (RTP) and two versions of a Greens Function Parabolic Equation (GFPE) code. A third component of APET is an audibility prediction scheme based on the work of Abrahamson, initially called ICHIN (I Can Hear It Now) and further developed by Wyle Labs as AUDIB.
U.S. Release Only

Advanced Acoustic Model, Version 2 (AAM2) LAR-19004-1

AAM is a computer program that calculates community noise from aircraft flight operations. It is a simulation model computing time histories of noise for arbitrary vehicle flight operations. The model can accommodate multiple noise sources (rotors, engines, airframe, etc.), each represented by a sphere of spectral data at a reference distance. Propagation to the ground accounts for spherical spreading, atmospheric absorption, ground impedance effects, and weather effects. Spectral levels and a variety of community noise metrics are computed and can be plotted on a flat ground or non-flat terrain.
U.S. Government Purpose Release

Advanced Subsonic and Supersonic Propeller Induced Noise (ASSPIN) Prediction Program LAR-17590-1

ASSPIN is a computer program that predicts the noise generated by propellers operating at subsonic, transonic, or supersonic helical tip speeds in either single-rotation or counter-rotation mode. The format of blade surface pressure data obtained from aerodynamic codes for ASSPIN input is generally not compatible with that required by ASSPIN. The ASP_Tools suite provides the capability to manipulate blade geometry and surface pressure data to produce proper ASSPIN input. In addition, the ability to parse ASSPIN output files and obtain specific output variables is provided.
U.S. Release Only

AirShow 1.1.1 LEW-17228-1

The AirShow software package enables 3D visualization of computational meshes and computed flow-field data associated with computational fluid dynamics (CFD). The program displays structured grid blocks and computational grid planes.
U.S. Release Only

Arbitrary Accuracy Nonlinear Euler Solver LEW-17465-1

This NASA-developed code is the first in the world to solve the nonlinear Euler equations to at least 15th-order accuracy in space and time in two dimensions. It is capable of even higher order accuracy if sufficient computer precision is available.
U.S. Release Only

Automated Camera Calibration Software (ACCS) NPO-41312-1

Using collected metrology data, the ACCS system significantly increases the efficiency of the entire camera calibration process, resulting in reduced costs and turnaround time. Even in extreme conditions, the tool performs calibrations with minimal user input.
U.S. Government Purpose Release

System Testing

CARES/LIFE
LEW-16018-1

This NASA software was developed to predict the reliability and life of structures made from advanced ceramics and other brittle materials (e.g., glass, graphite, and intermetallics).
U.S. Release Only

Centrifugal Compressor Design (CCD) Code
LEW-17452-1

This NASA-developed technology provides a rapid preliminary assessment of the design geometry and the design-point performance of centrifugal compressors. The analysis is based on a one-dimensional flow model with correlations for the following losses: inlet guide vane, rotor inlet shock, incidence, clearance, blade loading, skin friction, disk friction, recirculation, vaneless diffuser skin friction, and vaned diffuser. With input performance, the code can operate in design mode; with input geometry, the code can operate in analysis mode.
U.S. Release Only

Channel Emulator
LEW-19351-1

The Channel Emulator (CE) is a software-based network testing tool. Its primary functions include providing data framing services, acting as a flexible protocol gateway, and providing network emulation capabilities.
Open Source

Coupled Structural, Thermal, Acoustic, Electromagnetic (CSTEM) Analysis
LEW-17052-1

CSTEM is a UNIX executable for coupled structural, thermal, acoustic, and electromagnetic analysis and optimization.
U.S. Release Only

Defect Detection and Prevention (DDP)
NPO-20741-1

DDP evaluates criticality by generating a tree of failure modes and a tree of requirements and then evaluating the impact of each failure mode on each requirement.
U.S. Government Purpose Release

DDS.js: Design Patterns and Methods to Rapidly Develop Web and Mobile Applications Integrated with Systems Utilizing the Object Management Group's (OMG) Data Distribution Service (DDS)
KSC-13925

DDS.js gives Node.js application developers the ability to integrate with a DDS-enabled software system without having to write the extension software that would otherwise be required. It achieves this feature by processing the system's already existing (or otherwise necessary on a new system) IDL files and generating the appropriate C++ code based on the IDL file contents. In doing so, the solution includes a novel way of using C++ templates and advanced generic programming techniques to produce data transcoders between JavaScript and C++ that preserve all data characteristics as described in the system's IDL files with no need for application developers to expend work implementing or customizing this transcoding.
Open Source

Fan Broadband Noise Prediction Code
LEW-17279-1

This NASA-developed technology predicts the dipole and quadruple noise that results from the interaction of anisotropic homogeneous turbulence with a rotor or stator.
U.S. Release Only

Fast Scattering Code (FSC), Versions 3.1 and 3.2   LAR-17828-1

The Fast Scattering Code (FSC) is a computer program designed to predict the scattered acoustic field that results from the interaction between a known incident sound and arbitrary three-dimensional surfaces immersed in a potential background flow. The technology is based on the equations of time-harmonic, linearized acoustics and employs equivalent sources for solving an exterior Helmholtz equation boundary value problem (BVP). The incident sound can be generated by the FSC using a collection of simple point multipoles (monopoles and dipoles), or it can be provided by the user from other prediction codes. Predictions for high-frequency/large-scale combinations yield linear systems with millions of unknowns and memory requirements beyond the capabilities of most advanced computer systems to date. The computational engine of the FSC has been totally redesigned to alleviate the frequency limitations of the code by employing numerical algorithms that drastically reduce computer resource utilization and take advantage of multiprocessor platforms.

U.S. Release Only

Formal Interactive Verification Environment for the Plan Execution
Interchange Language (PLEXIL5)   LAR-19339-1

PLEXIL is an open-source synchronous language developed by NASA for commanding and monitoring autonomous systems. PLEXIL5 is a tool that implements the formal executable semantics of PLEXIL. PLEXIL5 includes a graphical interface that enables access to formal verification techniques such as model-checking, symbolic execution, theorem proving, and static analysis of plans. The graphical environment supports formula editing and visualization of counter examples, interactive simulation of plans at different granularity levels, and random initialization of external environment variables.

Open Source

GRAPE.107   LEW-16851-1

GRAPE is a two-dimensional elliptic grid generation code to be used with isolated airfoils. This modified version of the software (with application for turbomachinery blades) can generate grids for the RVCQ3D turbo-machinery analysis code.

U.S. Release Only

HemoDose Software, Version 2.0   MSC-26186-1

HemoDose estimates the absorbed dose of radiation in adults by using single or serial counts of granulocytes, lymphocytes, leukocytes, or platelets after exposure.

General Public Release

High-Speed Data Viewer   MFS-31700-1

The High-Speed Data Viewer computer software was developed for viewing high-frequency data recorded in the East and West Test Areas at Marshall Space Flight Center (MSFC).Features include: Amplitude vs. Time Plots with full zoom capabilities; Frequency Component Plot at specified time interval; Waterfall Plots/Frequency Intensity Plots display changing frequency components over a duration of time; print options for plots; export functions save plot data as text files for importing into other applications. This software allows the user to plot data in time domain and view frequency components in multiple ways.

U.S. Release Only

IceVal DatAssistant   LEW-18343-1

This NASA-developed technology provides an improved mechanism for managing the large volume of data generated and utilized in performing icing research.

U.S. Release Only

System Testing

Jet Noise Prediction Code (JeNo)   LEW-18199-1

JeNo is a Fortran 90 computer code that calculates the far-field sound spectral density produced by axisymmetric jets at user-specified observer locations and frequency ranges. The user must provide a structured computational grid and also input a mean flow solution from a Reynolds-Averaged Navier Stokes (RANS).
U.S. Release Only

Jet Noise Prediction Code (JeNo 2.5D)   LEW-18199-2

JeNo is a Fortran 90 computer code that evaluates the far-field turbulence-generated noise in non-axisymmetric jets. The propagation Green's function is calculated along a user-specified azimuthal angle (line of sight), but source volume integration is carried out in 3D. The user must provide a structured computational grid in a polar coordinate system and also input a mean flow solution from a Reynolds-averaged Navier Stokes (RANS).
U.S. Release Only

JPF-NAS: An Extension of Java Pathfinder Supporting
Model-Checking Distributed Systems   ARC-17301-1

JPF-NAS is implemented as a JPF extension that models interprocess communication mechanisms. It uses a form of partial-order reduction to explore all possible executions of a distributed Java application. JPF-NAS provides the functionality to check a given distributed application under test against possible network failures that can occur at the operating system or the hardware layer.
Open Source

LEWICE 3.2.3 Ice Accretion Software   LEW-18573-1

LEWICE contains an analytical ice accretion model that evaluates the freezing process thermodynamics that occur when super-cooled droplets impinge on a body. Both atmospheric parameters (i.e., temperature, pressure, and velocity) and meteorological parameters (i.e., liquid water content, droplet diameter, and relative humidity) are used to determine the shape of the ice accretion.
U.S. Release Only

LINFLUX: 3D Linearized Unsteady Aerodynamic Analysis   LEW-17346-1

LINFLUX is a three-dimensional, linearized, unsteady aerodynamic analysis (and code) that can be used to predict the aero-acoustic/aero-elastic responses of axial-flow turbo-machinery blade rows to aerodynamic/ structural excitations.
U.S. Release Only

MERIDLN   LEW-16369-1

MERIDLN is a Fortran program for calculating velocities/streamlines of axial-, radial-, or mixed-flow turbo-machinery or annular ducts on the hub-shroud mid-channel stream surface.
U.S. Release Only

MESA: MEssage-based System Analysis   ARC-18229-1

MESA is a framework that provides runtime verification of large distributed systems in a nonintrusive manner. It checks a trace of the system under test against properties of interest, and if a property is violated, it issues an error along with a counter example. A trace is a sequence of messages entailing information about a run of the system. MESA leverages RACE, which is a platform for instantiating and running highly concurrent and distributed systems, to provide connectivity to and retrieve information from the system under test. Using existing domain specific languages, TraceContrance and Daut, It allows for formal specification of properties in state machines and linear temporal logic formulas. MESA is written in Scala, and employs the actor programming model, as implemented in the Akka framework. Finally, using asynchronous communicating actors to capture properties of interest, it allows for decentralized monitoring of the system.
Open Source

Metrics Library for Prognostics Performance Evaluation ARC-17898-1

A suite of algorithms implemented in MATLAB for evaluating the performance of prognostics algorithms that predict the remaining useful life (RUL) of engineering systems. It includes alpha-lambda, beta metrics that compare the ground truth RUL against continuous predictions; these predictions can either be point-value or be a probability distribution that depicts the uncertainty regarding the prediction of RUL. The library can be used for a variety of applications and performs different types of evaluations depending upon how the ground truth and the predictions are available.
Open Source

MGBK Jet Noise Prediction Code LEW-17062-1

The physics-based MGBK code predicts subsonic and low-supersonic jet mixing noise and shock noise. Predictions are in the form of far-field sound pressure level (SPL) and frequency spectra on an arc or a sideline.
U.S. Release Only

Multiple Kernel Anomaly Detection (MKAD) Algorithm ARC-16462-1

In offline mode, MKAD performs automated anomaly detection on large heterogeneous data sets that contain both discrete symbols and continuous data streams.
Open Source

Multiple Pure Tone (MPT) Noise Code LEW-17386-1

The MPT noise prediction procedure is based on uniform-rotor computational fluid dynamics (CFD) analysis of BPF tonal content in conjunction with engineering (statistical) correlation information of blade-to-blade non-uniformity effects.
U.S. Release Only

NASA Auralization Framework (NAF) LAR-18541-1

NAF is an open architecture for auralization components. It is structured as a set of common building blocks in the form of dynamically linked libraries and will serve as the basis for future auralization capabilities. Libraries for each of the following are provided as part of the framework: the core, Pathfinder, scene generator, synthesis, signal processing, and scheduling. Each library contains a usable but simple set of capabilities.
General Public Release

NASA Auralization Framework Advanced Plugin Libraries (NAF APL) LAR-19278-1

NAF is an open architecture for auralization components. It is structured as a set of common building blocks in the form of dynamically linked libraries. Each library contains a usable but simple set of capabilities. The NAF APL provides additional means for source noise synthesis, propagation effects, and interfaces to NASA's Aircraft Noise Prediction Program 2 (ANOPP2).
General Public Release

NDE Wave & Image Processor (NDEWIP), Version 3.0 LEW-18640-1

The NDE Wave & Image Processor software application has been created to provide a state-of-the-art, comprehensive, integrated science-based tool for the advanced visualization, processing, and analysis of NDE and health-monitoring waveform- and image-based data. With NDEWIP, the user has access to a complete post-processing capability in a single tool. Although the software has been developed for the NDE professional, the technology could be used for any other RF signal or image processing and analysis application.
U.S. Release Only

System Testing

NESSUS 6.2C
LEW-18229-1

The NESSUS 6.2c computer program is a set of separate but related modules for solving a wide range of component and system probabilistic and reliability problems, including finite element analysis, heat transfer analysis, geometry generation, and ceramic material property generation.
U.S. Release Only

Orbit Determination Toolbox (ODTBX) R2020a (v8.1)
GSC-18784-1

ODTBX is an advanced mission simulation and analysis tool used for concept exploration, proposal, early design phase, or rapid design center environments; the emphasis is on flexibility but it has enough fidelity to produce credible results. ODTBX R2020a v8.1 includes multiple feature additions, enhancements, and bug fixes from the prior release. The primary user interface and supporting functions are written in Matlab and Java.
Open Source

OXIMAP: A Model for the Oxidation of C/SiC Composite Structures
LEW-18212-1

The OXIMAP software has been used to analyze the oxidation behavior of carbon-fiber-reinforced composite structures.
U.S. Release Only

PathDroid
ARC-17293-1

PathDroid is an extension of the open-source Java Pathfinder (JPF) verification framework that supports checking binary Android applications for the absence of software defects such as unhandled exceptions and deadlocks. PathDroid lets users run applications on development platforms without the need for hardware-in-the-loop or availability of sources.
Open Source

Payloads and Components Real-Time Automated Test System (PACRATS)
MFS-31383-1

The PACRATS data acquisition program allows test engineers to acquire, display, store, and retrieve test data.
U.S. Release Only

PCSTAGE
LEW-16325-1

PCSTAGE is simple computational simulation of multi-stage turbo-machinery blade-to-blade flows on a surface of revolution.
U.S. Release Only

PMESH
LEW-18402-1

The PMESH grid-generation program produces three-dimensional blade-passage meshes for the computational fluid dynamics (CFD) modeling of advanced single- or counter-rotation turboprops and propfans.
U.S. Release Only

Propulsion Diagnostic Method Evaluation Strategy (ProDiMES), Version 1.0
LEW-18371-1

ProDiMES provides a standard benchmarking problem and a set of evaluation metrics to enable comparison of candidate aircraft engine gas-path diagnostic methods. The MATLAB-based tool enables users to develop and evaluate diagnostic methods independently.
General Public Release

Radial Turbine Off-Design (RTOD) Performance Code
LEW-14060-1

The RTOD code predicts the performance of a single-stage radial-inflow turbine (with either radial or swept rotor blades) as a function of pressure ratio, speed, and stator setting.
U.S. Release Only

RAT-EDA
LEW-18321-1

This NASA-developed technology is a MATLAB-language computer program for exploratory data analysis. Through the fast post-processing of measured time-series Raman spectral data, RAT-EDA reveals thermo-chemical properties and turbulent-chemistry interactions in combustion. The computer program deduces probability density functions of combustion temperatures using user-selected super-pixel regions for each major species (e.g., O2, N2, CH4, CO2, or $H_2$0).
U.S. Release Only

Rotor-Stator Interaction (RSI) Broadband Noise Prediction Code
LEW-18131-1

RSI is a Fortran computer code for calculating the spectrum of broadband noise produced by the interaction of fan-rotor wake turbulence with fan-exit guide vanes (i.e., the stator). Provided with incident-turbulence characteristics, the code computes the spectra of acoustic power upstream and downstream of the stator on a mode-by-mode basis at each frequency of interest. Target frequencies are arbitrary and need not be harmonics of a fan's blade-passing frequency.
U.S. Release Only

Rotorcraft Noise Model (RNM), Version 7
LAR-17753-1

The RNM simulation model calculates community noise, computing time histories of noise for arbitrary vehicle flight operations. The technology accommodates multiple noise sources (e.g., rotors and engines), each represented by a sphere of spectral data at a reference distance. Propagation to the ground accounts for spherical spreading, atmospheric absorption, ground impedance effects, and limited weather effects.
General Public Release

RTD Radial-Inflow Turbine Conceptual Design Code
LEW-17453-1

The RTD code executes a conceptual design for a single-stage radial-inflow turbine. A mean-line analysis is performed for the locations having constant radius over the blade span. Constant span-fraction sectors are used at the rotor exit. The analysis can account for stator end-wall clearance flow and swept rotor blades. The loss model includes stator and rotor passage losses, trailing-edge losses, vaneless space loss, disk-friction loss, and rotor-exit clearance loss.
U.S. Release Only

RVCQ3D.406
LEW-16851-2

RVCQ3D is a two-dimensional computational fluid dynamics (CFD) analysis code for turbo-machinery (e.g., compressors, turbines, and mixed-flow machines). The technology solves Navier-Stokes equations on a blade-to-blade surface of revolution using explicit finite-difference techniques. Three differencing schemes are available: central differences, AUSM+, and H-CUSP. Three turbulence models are also available: Baldwin-Lomax, Cebeci-Smith, and Wilcox 2006 K-Omega.
U.S. Release Only

SCISEAL
LEW-16330-1

This computer program has been used to study the fluid dynamic forces in SEALS.
U.S. Release Only

Seeker 1 Simulation
MSC-27108-1

The Seeker 1 Simulation is a Trick-based, high-fidelity, 6 DoF simulation that models a 3U CubeSat, including sensors and effectors, and a target spacecraft for inspection.
U.S. Release Only

System Testing

Single Board Computer System Monitoring Software for Radiation Testing   MSC-26984-1

This software package uses simple Python scripts to assess computer performance. This is specifically intended to be used on Single Board Computers for monitoring system parameters during radiation testing. This is hoped to provide a powerful, flexible framework that can be rapidly deployed on a variety of systems (Windows/Linux, Intel/ARM) and can serve as a common community benchmark for a radiation testing Single Board Computers.
Open Source

Smagglce UNIX, Version 2.0   LEW-17399-2

The Smagglce software toolkit can be used to create structured grids for single- or multi-element 2D iced airfoils in preparation for computational fluid dynamics (CFD) analysis. Software tools will measure ice shape characteristics, add artificial ice shapes, prepare an ice surface for gridding, perform domain decomposition, create and modify grids, analyze grid quality, and output grids for subsequent input into flow solvers.
U.S. Release Only

Smagglce Windows, Version 2.0   LEW-17399-1

The Smagglce software toolkit can be used to create structured grids for single- or multi-element 2D iced airfoils in preparation for computational fluid dynamics (CFD) analysis. Software tools will measure ice shape characteristics, add artificial ice shapes, prepare an ice surface for gridding, perform domain decomposition, create and modify grids, analyze grid quality, and output grids for subsequent input into flow solvers.
U.S. Release Only

Solar Array Verification and Analysis Tool (SAVANT)   LEW-17681-1

The powerful, yet easy-to-use SAVANT quick-engineering code calculates the expected radiation damage to solar cells in Earth orbit. The tool contains ten types of solar cells and four types of cover glass. Radiation damage calculations are based on the Displacement Damage Dose method developed at the Naval Research Laboratories.
U.S. Release Only

Sound Lab (SLAB), Version 5   ARC-14991-1

SLAB is a software-based, real-time, virtual acoustic-environment rendering system designed to study spatial hearing in environments such as concert halls, listening rooms, virtual reality, aviation spatial information displays, and video game sound effects.
Open Source

Space Science Investigations: Humans in Space (SSIHRP)   MSC-26212-1

An educational game, taking the user through how a microgravity environment affects the body in space. Through the use of this application, the user will become familiar with what happens to humans in space, how the effects are being mitigated, experiments that can be done in the classroom and at home to simulate the on-orbit effects, and numerous fun facts about the International Space Station.
General Public Release

SWIFT v.400   LEW-17635-2

SWIFT is a multi-block computational fluid dynamics (CFD) analysis code for turbo-machinery. The software, which solves Navier-Stokes equations using explicit finite-difference techniques, can be used for linear cascades, isolated blade rows, or multistage machines. Three differencing schemes are available: central differences, AUSM+, and H-CUSP. Three turbulence models are also available: Baldwin-Lomax, Cebeci-Smith, and Wilcox 2006 K-Omega.
U.S. Release Only

System Identification Programs for AirCraft (SIDPAC)   LAR-16100-1

Written in MATLAB, SIDPAC is a collection of over 300 programs that perform a wide variety of tasks related to system identification applied to aircraft. SIDPAC includes tools for experiment design, data analysis, kinematic consistency checking, static and dynamic modeling, simulation, numerical integration and differentiation, smoothing, filtering, finite Fourier transformation, statistical modeling and evaluation, optimization, parameter estimation, model accuracy quantification, model validation, and more.
U.S. and Foreign Release

Systematic Sensor Selection Strategy (S4) Software   LEW-18815-1

The Systematic Sensor Selection Strategy (S4) optimally selects a sensor suite from a larger pool of candidate sensors based on their performance in a diagnostic system. S4's user-defined fault-diagnostic approach considers conflicting objectives including cost, weight, and reliability.
U.S. Release Only

TCGRID v.400   LEW-17635-1

TCGRID is a three-dimensional grid-generation code for turbo-machinery blades. The software can generate single- or multi-block grids that are compatible with several computational fluid dynamics (CFD) analysis codes, including SWIFT and ADPAC.
U.S. Release Only

TD2 Axial Turbine Design and Performance Code   LEW-11029-1

TD2 performs a streamline analysis that can use meridional velocity gradients to control the radial distribution of work and flow for multistage, multishaft, cooled/uncooled axial-flow turbines. The effects of streamline slope and curvature are included in the radial equilibrium. Hub and tip radii are specified at inlet, at exit, and between each blade row, and velocity diagrams for each stage can be individually controlled. An internal loss correction determines blade-row total-pressure-loss coefficients along the streamlines.
U.S. Release Only

Tempest   LEW-17294-1

Tempest was created to provide Internet/Intranet connectivity to real-time embedded applications.
U.S. Release Only

Time-Accurate, Sectored, One-Dimensional Reactive Code
for Simulation, Prediction, and Control of Combustion Instabilities   LEW-17677-1

This sectored one-dimensional model utilizes a simplified computational fluid dynamics (CFD) algorithm to simulate combustion and acoustic processes (including instabilities) in combustors with complex shapes. Utilizing modest computational resources, the code produces realistic results and is well suited for controls development.
U.S. Release Only

Tone Fan Noise Design/Prediction System (TFaNS), Version 1.4   LEW-17063-1

TFaNS predicts tone noise emanating from a fan stage, including the effects of reflection and transmission by the rotor and stator and by the duct inlet and nozzle.
U.S. Release Only

Tone Fan Noise Design/Prediction System (TFaNS), Version 1.5   LEW-17063-2

TFaNS predicts tone noise emanating from a fan stage, including the effects of reflection and transmission by the rotor and stator and by the duct inlet and nozzle. Version 1.5 upgrades include: the SOURCE3D subprogram's ability to perform transmission-loss calculation for modes scattering into themselves; the inlet and aft radiation codes' use of infinite envelope elements in the far-field; and the AWAKEN subprogram's use of a new Acoustic Wake/Turbulence File format.
U.S. Release Only

System Testing

TSONIC

The TSONIC Fortran program calculates the transonic velocity on the blade-to-blade stream surface of a turbo-machine.

U.S. Release Only

WOPWOP

WOPWOP is used for helicopter main-rotor noise prediction. The user must input measured air loads.

U.S. Release Only

Vehicle Management ⌌⌍

Space • Air • Ground

Flight Software, Spacecraft Processes, Command
and Data Handling, Instrument Management

This image shows a close-up of the cockpit view of the eXternal Vision System that will be placed in the X-59 experimental supersonic aircraft. Instead of a front-facing window, the pilot will use these monitors for forward-facing visibility. *Lockheed Martin Photography by Garry Tice*

Featured Software

SpaceWire 2014   **GSC-17201-1**

SpaceWire is a spacecraft communication network based in part on the IEEE 1355 standard of communications. The 2014 version is an update to fix bugs, improve performance, and change the back-end user interface.
U.S. Release Only

Range Safety Algorithm Software Module for an Autonomous Flight Safety System   **GSC-15594-1**

This software library was developed to mitigate the public safety risks associated with the flight of expendable launch vehicles and other unmanned flight vehicles. The software encapsulates the various constructs and algorithms required to accomplish Time Space Position Information (TSPI) data management from multiple tracking sources. At its core, the technology evaluates various user-configurable rule sets that govern the qualification of TSPI data sources; provides a pre-launch autonomous hold-launch function; performs flight-monitoring/flight-termination functions; and provides end-of-mission safing.
General Public Release

Trade-Space Analysis Tool for Designing Constellations (TAT-C), Version 2.0   **GSC-18399-1**

This is a tool to design satellite constellations to a set of parameters, handle multiple spacecraft sharing a mission objective, facilitate distributed spacecraft missions, and explore the variables trade space for pre-defined science, cost and risk goals, and pre-defined metrics. It optimizes cost and performance across multiple instruments and platforms, vs. one at a time. TAT-C leverages the use of the Goddard Mission Analysis Tool (GMAT) to compute coverage and ancillary data, streamlining the computations by modeling orbits in a way that balances accuracy and performance.
U.S. Government Purpose Release

Advanced Spacecraft Integration & System Test Software (ASIST), Version 20.0   GSC-16783-1

Since the early 1990s, a government/contractor team has been developing a spacecraft ground system capable of being used for all phases of a spacecraft's life: box-level development and testing, satellite integration and test, and post-launch mission operations. This system uses a single, industry-standard protocol to ease integration with other products and employs COTS, GOTS, and public domain software to form one cohesive unit. It is composed of several parts. ASIST is the user interface, providing the user with the ability to view and analyze telemetry, send commands, and automate tests. The Front End Data System reads telemetry from spacecraft, distributing requested data packets to subscribing clients; additionally, it controls the forward (command) link to the spacecraft, formatting command packets and verifying that commands are transferred correctly. The Digital History Data Store (DHDS) archives the raw telemetry received from spacecraft and distributes historical telemetry data to clients.
U.S. Government Purpose Release

Automated Planning and Scheduling Environment (ASPEN)   NPO-41986-1

ASPEN automates space mission planning and other tasks that involve the reasoning of time, states, resources, and actions.
U.S. Government Purpose Release

Autonomous Landing Hazard-Avoidance Technology (ALHAT)
Scanning Lidar-Based Simulation for Mars Landing   NPO-21220-1

The ALHAT simulation tool provides an efficient software model and a set of algorithms in C++ code for performing scanning lidar-based hazard detection and avoidance.
U.S. Government Purpose Release

Constellation Visualization Tool (CVT)   GSC-17917-1

CVT is a touchscreen interactive software tool designed to model automated analyses of the Earth Observing System (EOS) Morning and Afternoon Constellations. Displays educate and inform users and the public about the missions NASA supports. Combining data presentation with user experience, user-selected stories are brought to life.
U.S. and Foreign Release

Core Flight Executive (cFE)   GSC-16232-1

The Core Flight Executive (cFE) provides software bus, time, event, executive, table, and file services, and it defines the application programming interface (API) for each set function. Applications subscribe to cFE services at runtime, making system modifications easy. Facilitating rapid prototyping, new applications can be compiled, linked, loaded, and started without requiring the entire system to be rebuilt.
Open Source

Core Flight System (cFS) 101 Training   MSC-26323-1

This is a training tool for learning to develop software with the NASA-developed Core Flight System (cFS) framework. No agreement is necessary through this catalog. Software is available at the open-source site.
Open Source

Core Flight System (cFS) CFDP Application, Version 2   GSC-16125-1

The CFDP application provides the capability to transmit and receive files to/from the ground. Tables are used to allow flexibility in specifying directory priorities and configurations.
Open Source

Core Flight System (cFS) CFDP (CF) Application, Version 3.0   GSC-18447-1

The CFDP (CF) application is one of the reusable applications that make up the Core Flight System (cFS). CFDP manages the transmitting and receiving of files to/from the ground.
Open Source

Vehicle Management (Space, Air, Ground)

Core Flight System (cFS) Checksum Application, Version 2 — GSC-15996-1

Checksum (CS) is one of the reusable applications that make up the Core Flight System (CFS). The technology performs memory integrity management by verifying the contents of critical flight memory regions. Unexpected changes in memory (i.e., due to an SEU) are reported to ground operators.
Open Source

Core Flight System (cFS) Command and Data Dictionary Tool (CCDDT) — MSC-26167-1

This software is used with the Core Flight System (cFS) framework. It is a configurable ground-based software tool for managing spacecraft command and telemetry data. It accepts multiple input formats and produces output files suitable for use by flight and display software tools. No agreement with NASA is needed. Please visit the following URL to download
the software: https://github.com/nasa/CCDD
Open Source

Core Flight System (cFS) Data Storage (DS) Application, Version 2 — GSC-16126-1

The DS application provides the ability to store data (i.e., messages) into files. Tables are used to provide the flexibility for specifying messages.
Open Source

Core Flight System (cFS) Data Storage (DS) Application, Version 2.5.2 — GSC-18448-1

The Data Storage (DS) application is one of the reusable applications that is used with the Core Flight System (cFS) framework. DS manages the storing of data on-board a spacecraft for later transmission to the ground.
Open Source

Core Flight System (cFS) Data Storage (DS) Application, Version 2.6.0 — GSC-18917-1

The Data Storage (DS) application is one of the reusable applications that is used with the Core Flight System (cFS) framework. DS manages the storing of data on-board a spacecraft for later transmission to the ground.
Open Source

Core Flight System (cFS) File Manager (FM) Application, Version 2 — GSC-16007-1

FM provides the user commands to perform the following operations: copy file, move file, rename file, delete file(s), close file, concatenate file, decompress file, delete directory contents, create directory, remove directory, obtain file information, obtain open file listing, and obtain directory listings.
Open Source

Core Flight System (cFS) File Manager (FM) Application, Version 2.5.3 — GSC-18475-1

The File Manager application (FM) is a Core Flight System (cFS) application that is a plug-in to the Core Flight Executive (cFE) component of the cFS. The FM application provides onboard file system management services by processing ground commands for copying, moving, and renaming files, decompressing files, creating directories, deleting files and directories, providing file and directory informational telemetry messages, and providing open file and directory listings.
Open Source

Core Flight System (CFS) File Manager (FM) Application, Version 2.6.0 — GSC-18918-1

The File Manager (FM) application is one of the reusable applications that make up the Core Flight System (cFS). FM provides the user interface to the on-board file system.
Open Source

Core Flight System (cFS) Framework GSC-18719-1

The core Flight System (cFS) is the first and only community-developed, reusable, platform-independent embedded software framework. cFS enables embedded software engineers to innovate and quickly transition from concept to implementation through a carefully designed layered architecture that isolates software applications from the operating system and hardware platform.
Open Source

Core Flight System (cFS) Health and Safety (HS) Application, Version 2 GSC-16151-1

The plug-and-play cFS Health and Safety application is compatible with the Core Flight Executive (cFE) and uses the Operating System Abstraction Layer (OSAL), both of which were developed by Goddard Space Flight Center in order to provide a reusable, platform-independent, mission-independent, layered architecture for hosting applications. The technology can be used for any government or commercial spacecraft. Please visit the following URL for additional information: http://sourceforge.net/projects/coreflightexec/files/cFE-6.1.1/
Open Source

Core Flight System (cFS) Health & Safety (HS) Application, Version 2.3.2 GSC-18476-1

The Health and Safety application (HS) is a Core Flight System (cFS) application that is a plug-in to the Core Flight Executive (cFE) component of the cFS. The HS application provides functionality for Application Monitoring, Event Monitoring, Hardware Watchdog Servicing, Execution Counter Reporting (optional), and CPU Aliveness Indication (via UART).
Open Source

Core Flight System (cFS) Health and Safety (HS) Application, Version 2.4.0 GSC-18920-1

The Health and Safety (HS)application is one of the reusable applications that make up the Core Flight System (cFS). HS monitors the health of the flight software system.
Open Source

Core Flight System (cFS) Housekeeping (HK) Application, Version 2 GSC-16127-1

The cFS Housekeeping application provides the ability to organize data from various packets into new packets in order to best utilize the telemetry bandwidth available for a mission.
Open Source

Core Flight System (cFS) Housekeeping (HK) Application, Version 2.4.2 GSC-18449-1

The Housekeeping (HK) application is one of the reusable applications that can be used with the Core Flight System (cFS) framework. HK provides the capability to take pieces of data from multiple messages and create a new message. This is very important for bandwidth-constrained missions.
Open Source

Core Flight System (cFS) Housekeeping (HK) Application, Version 2.5.0 GSC-18919-1

The Housekeeping (HK) application is one of the reusable applications that can be used with the Core Flight System (cFS) framework. HK provides the capability to take pieces of data from multiple messages and create a new message. This is very important for bandwidth constrained missions.
Open Source

Core Flight System (cFS) Limit Checker (LC) Application, Version 2 GSC-16010-1

The Limit Checker (LC) application is responsible for monitoring telemetry values.
Open Source

Core Flight System (cFS) Limit Checker (LC) Application version 2.2.0   GSC-18921-1

The Limit Checker application is one of the reusable applications that make up the Core Flight System (cFS). Limit Checker monitors telemetry data points in the flight system and compares the values against predefined or computed threshold limits. When a threshold condition is encountered, an event message is issued and a command script may be initiated to respond to the threshold violation.
Open Source

Core Flight System (cFS) Memory Dwell Application, Version 2   GSC-16012-1

The Memory Dwell application telemeters the contents of table-defined addresses at a table-defined dwell rate. Addresses can be processed using symbols if the target processor/operating system includes symbols.
Open Source

Core Flight System (cFS) Memory Dwell Application, Version 2.3.2   GSC-18450-1

The Memory Dwell application (MD) is a Core Flight System (cFS) application that is a plug-in to the Core Flight Executive (cFE) component of the cFS. The MD application monitors memory addresses accessed by the CPU.
Open Source

Core Flight System (cFS) Memory Dwell Application, Version 2.4.0   GSC-18922-1

The Memory Dwell (MD) application is one of the reusable applications that make up the Core Flight System (cFS). MD provides the capability of dwelling on an address or range of addresses on a flight system, which can be very useful tool when trying to diagnose a failure. If the operating system supports symbolic addressing, Memory Dwell supports specifying the memory address using a symbolic address.
Open Source

Core Flight System (cFS) Memory Manager Application, Version 2   GSC-16011-1

The Memory Manager application processes commands, generally from the ground, in order to dump the contents of a memory location, dump the contents of a range of memory locations, load a memory location with specified data, load a range of memory with specified data, or fill an area of memory with the specified fill pattern. Operations can be performed on non-volatile, volatile, and memory-mapped I/O.
Open Source

Core Flight System (cFS) Memory Manager Application, Version 2.4.2   GSC-18662-1

The Memory Manager (MM) application is one of the reusable applications that make up the Core Flight System (cFS). MM is responsible for the loading and dumping of flight system memory, which can be a very useful tool when trying to diagnose a failure. Memory manager provides the ability to load and dump memory via commands as well as from files. If the underlying operating system supports symbolic addressing, Memory Manager supports specifying the memory address using a symbolic address. MM version 2.4.2 provides fixes to bugs in the previous version of the app and compatibility with Core Flight Executive version 6.8.
Open Source

Core Flight System (cFS) Memory Manager Application, Version 2.5.0   GSC-18923-1

The Memory Manager (MM) application is one of the reusable applications that make up the Core Flight System (cFS). MM is responsible for the loading and dumping of flight system memory, which can be a very useful tool when trying to diagnose a failure. Memory manager provides the ability to load and dump memory via commands as well as from files. If the underlying operating system supports symbolic addressing, Memory Manager supports specifying the memory address using a symbolic address.
Open Source

Core Flight System (cFS) Scheduler Application, Version 2   GSC-16123-1

The Scheduler application uses a one-second major timeframe that is divided into a designer-determined collection of equally divided minor timeframes. The technology is configurable and table-driven to provide greater flexibility.
Open Source

Core Flight System (cFS) Software Bus Network (SBN) Application, Version 1.0   GSC-16917-1

The SBN serves as a plug-in to the Core Flight Executive framework to transfer messages across process/processor interfaces. The technology has three primary functions: to establish and maintain a connection to each peer over available process/processor interfaces; to distribute and maintain a subscription message database for each peer; and to distribute messages to peers that have subscribed to message identifiers.
Open Source

Core Flight System (cFS) Software Bus Network Client   GSC-18396-1

The Software Bus Network Client communicates with the core Flight System (cFS) Software Bus Network (SBN) application. Its main purpose it to facilitate two-way communication from the cFS Software Bus service to an external application (i.e., an application that is not a child task of cFS). It implements the SBN communication protocol. The Software Bus Network Client provides the external application with all of the relevant Software Bus functionality without a separate cFS core. This is implemented as a C library, and wrappers are provided so that existing cFS applications may use the library in place of the standard cFS Software Bus service.
Open Source

Core Flight System (cFS) Stored Command (SC) Application, Version 2   GSC-16009-1

The cFS SC application provides the ability to execute onboard absolute-time and relative-time command sequences. The technology offers a generic implementation that can be configured by a user to fit the needs of a specific mission.
Open Source

Core Flight System (cFS) Stored Command (SC) Application, Version 3.0   GSC-18702-1

The Stored Command (SC) application is one of the reusable applications that make up the Core Flight System (cFS). SC provides an onboard scripting feature. SC version 3.0 is a modification of the existing application but includes a breaking change that will prevent existing tables from being used with the new version of the application.
Open Source

Core Flight System (cFS) Stored Command (SC) Application, Version 3.1.0   GSC-18924-1

The Stored Command (SC) application is one of the reusable applications that make up the Core Flight System (cFS). SC provides an onboard scripting feature.
Open Source

Magnetosphere Multi-Scale (MMS) Spacecraft Flight Software   GSC-16471-1

This spacecraft flight software was developed to support unique multi-satellite MMS mission requirements. The technology interfaces to a sensor/actuator complement that includes a star sensor and digital sun sensor, accelerometer, and thruster hardware to implement the functionality for determining and controlling spacecraft attitude and orbit.
U.S. Government Purpose Release

Mesh Network Communication System   MFS-33391-1

This system provides a framework for the exchange of information between multiple network nodes to facilitate cooperation using a distributed mesh network communication architecture. A node is any entity, such as a vehicle, ground control station, etc., that is connected to the mesh network. Data exchanged could include telemetry from vehicle-based nodes, commands from ground control nodes, and science data. By exchanging pertinent data, multiple nodes can act together to perform a task without requiring direct control from a central control node. The system was generically designed so that it would be applicable to any node type and many different vehicle types including UAVs and satellites. The mesh network architecture allows the system to adapt to individual node failures because, by design, the system has no master controlling the operation of the entire network.
Open Source

MSLICE: Science Activity Planner for MSL   NPO-45908-1

MSLICE has been tasked to fulfill a challenging set of requirements. To meet these requirements, MSLICE delivers a rich feature set which includes: (1) a simple, intuitive, and powerful search capability; (2) visualization of the rover's traverse in a HiRISE image; and (3) visualization of data products and the ability to view mosaics.
U.S. Government Purpose Release

Ndarts   NPO-47703-1

Ndarts is designed as a general-purpose dynamics library that can be used for the modeling of robotic platforms, space vehicles, and molecular dynamics. All NASA space vehicles use such capabilities.
U.S. Government Purpose Release

OpenMDAO: The Next-Generation Multidisciplinary Design Analysis
and Optimization (MDAO) Open-Source Framework   LEW-18550-1

OpenMDAO provides the core software infrastructure to integrate multidisciplinary variable fidelity tools and enable design, analysis, and optimization of complex systems. OpenMDAO functionalities include component linking, data passing, driver interface, and lazy evaluation.
Open Source

Operating System Abstraction Layer (OSAL)   GSC-14921-1

The OSAL library isolates embedded application software from a Real-Time Operating System (RTOS). The technology provides a well-defined, generic interface to RTOS services; a generic interface to hardware services; and an implementation for several current RTO systems. By using the library, an embedded application can remain portable among multiple operating systems on multiple platforms. Please visit the following URL for additional information: http://opensource.gsfc.nasa.gov/projects/osal/
Open Source

Range Safety Algorithm Software Module for an Autonomous Flight Safety System   GSC-15594-1

This software library was developed to mitigate the public safety risks associated with the flight of expendable launch vehicles and other unmanned flight vehicles. The software encapsulates the various constructs and algorithms required to accomplish Time Space Position Information (TSPI) data management from multiple tracking sources. At its core, the technology evaluates various user-configurable rule sets that govern the qualification of TSPI data sources; provides a pre-launch autonomous hold-launch function; performs flight-monitoring/flight-termination functions; and provides end-of-mission safing.
General Public Release

ROAMS: Rover Analysis and Modeling Software   NPO-30722-1

ROAMS is a planetary rover simulation software package. The technology consists of mechanical models of a rover, instrument arms, actuators and sensors, power resources, terrain interactions, and onboard software.
U.S. Government Purpose Release

Rock Identification Toolkit (RockIT)　　　　　　　　　　　　　　　　NPO-41133-1

RockIT is an interactive tool used by mission scientists to identify and characterize rocks and rock distributions.
U.S. Government Purpose Release

Simulation of Cryogenic Tank with Temperature Stratification　　　　　　ARC-17900-1

This is a MATLAB-based simulation of temperature stratification effects for cryogenic fluids in a tank. It is a reduced dynamical model describing temperature stratification effects driven by natural convection in a liquid hydrogen cryogenic tank. It accounts for storage, loading, and unloading of the cryogenic fluid.
Open Source

SpaceWire 2014　　　　　　　　　　　　　　　　　　　　　　　GSC-17201-1

SpaceWire is a spacecraft communication network based in part on the IEEE 1355 standard of communications. SpaceWire 2014 is an update to fix bugs, improve performance, and change the back-end user interface for different embedded applications to the original SpaceWire Link and Switch.
General Public Release

Trade-Space Analysis Tool for Designing Constellations (TAT-C), Version 2.0　　GSC-18399-1

This is a tool to design satellite constellations to a set of parameters, handle multiple spacecraft sharing a mission objective, facilitate distributed spacecraft missions, and explore the variables trade space for pre-defined science, cost and risk goals, and pre-defined metrics. It optimizes cost and performance across multiple instruments and platforms, vs. one at a time. TAT-C leverages the use of the Goddard Mission Analysis Tool (GMAT) to compute coverage and ancillary data, streamlining the computations by modeling orbits in a way that balances accuracy and performance.
U.S. Government Purpose Release

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Download Ways to Deep Dive into Earth Data

Earth Global Reference Atmospheric Model

Create a model or picture of Earth's atmosphere using temperature, winds, and other data for any month on the calendar at any altitude and location.

MFS-32780-1

EarthKit

Leverage the internet to collaborate with other Earth science researchers using this software to share research, manage project workflows, and more.

NPO-49145-1

Landslide Hazard Assessment for Situational Awareness

Model landslide risk using regional risk maps, satellites-based rainfall estimates, and other data with proven analyses to identify areas of moderate and high landslide hazard.

GSC-17452-1

Lightning Forecasting Algorithm

This code supports lightning forecasts using meteorological data such as updraft speeds to generate functional estimates.

MFS-33225-1

GeoCam

Crowd-source, analyze, and share images and other geo-referenced data during a disaster response using low-cost consumer hardware, such as cellphones, and a web-based workflow.

ARC-16088-1A

Coastal Salinity and Temperature Web Application

This app provides daily and historic salinity and temperature data and oyster lease locations for the Gulf of Mexico, offering related trends and statistics.

SSC-00492

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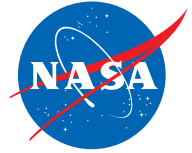
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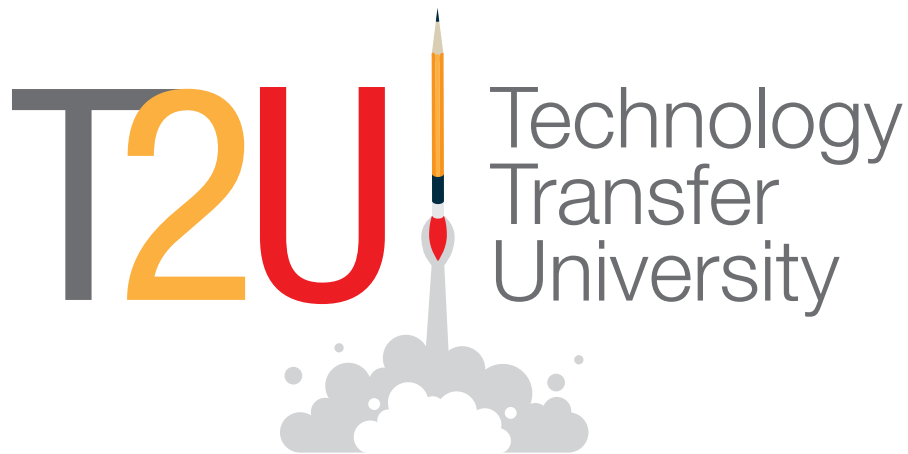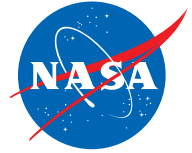
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