

Parametric type design in the era of variable and color fonts

June 2024

Abstract

While Donald Knuth's ideas in METAFONT and subsequently in METAPOST are often seen as legacy techniques from the pre-graphical user interface (GUI) era of type design, recent trends like variable fonts suggest a resurgence of certain principles. This paper explores a modern type design process built on parametric design principles, specifically using METAPOST. The author created two variable fonts with this method and released them under a free, open-source license. The paper details the methodology, workflow, and insights gained from this process.

Keywords— Parametric design, Variable fonts, Opentype, Color fonts, METAFONT, METAPOST, Educational type design, Open source

1 Introduction

Parametric type design uses algorithms to create customized and complex typography. It involves defining parameters such as stem width, serif, and other letterform components, which can be adjusted to generate a wide range of variations within a single font. Parametric type design approach was pioneered by Donald Knuth with his METAFONT [1], technology in the early 1980s. However, this approach has not gained widespread acceptance in mainstream type design due to the perceived need for close collaboration between designers and programmers to define the design mathematically. The idea of style variations, parametrically derived from master designs resurfaced in the form of variable fonts in 2016 [2] [3].

2 Methodology

The author explored the modernization of metafont based type design. Instead of using METAFONT, METAPOST [4], a successor of METAFONT that can generate SVG outputs, is used. The author prepared mathematical descriptions of all the glyphs for Malayalam and Latin script, parameterizing various design details. The SVG images produced were compiled to create a Unified Font Object(UFO)¹ type source and used modern font build tooling. A variable [3], color [5] typeface is produced as a result and published as free and opensource typeface. This typeface has 4 design axes, encompassing width, weight, slant and softness. One of the subfamilies simulates wide nib calligraphy pen. A variable color font was also derived from the base design, using the colrv1 [5] technology introduced in opentype in 2020. Developing a variable color font is considered a sophisticated technological feat, even with the limited number of GUI-based type design editors available today. The author continued the exploration and an educational color font featuring arrows indicating the writing direction for educational purposes, and a dotted font designed for learning writing by tracing were also produced. Thanks to the abstractions provided by METAPOST and

¹<https://unifiedfontobject.org/versions/ufo3/>



Figure 1: A glyph in the variable color font produced by METAPOST

the virtues of parametric design, this approach reduced overall production time, facilitating inexpensive experimentation and rapid iterations.

The design of this typeface, which is inspired by early title designs of Malayalam movie posters, required non-trivial stroke modulations. METAFONT based type design favors (but not limits) pen based approach where the stroke modulation is limited to the path of a pen stroke. However, outline based typed design is very popular in digital type design because it can provide the flexibility of creating any arbitrary shapes. METAFONT can be used to define the outline points directly, however, skeleton based design still has some advantages regarding the shape consistency especially when working the complex scripts like Malayalam. To achieve the stroke modulation as demanded by design, an approach of applying multiple pens defined from shapes like razor nib, elliptical shapes with varying angle of rotations were used. This concept was introduced in MetaType1 [6] [7] for creating PostScript Type 1 fonts. Here, we are not producing any postscript fonts, but the utility library as part of MetaType include many macros to produce accurate pen envelopes suitable for typefaces. The curves in METAPOST is implemented using Hobby Curves [8]. Optimizing these curves with the curve harmonization techniques were required for aesthetic reasons. Linus Romer's implementation of Curvature combs and harmonization [9] of METAPOST was used for the purpose.

3 Type design workflow

A design and development workflow fine tuned for this kind of type design was also required. It is important to see the results of a METAPOST instantly for fast feedback loops. The author integrated METAPOST based type design to popular Visual Studio Code so that the designer can work on METAPOST code and live preview the results with all design utilities like design grid, point coordinates, anchors

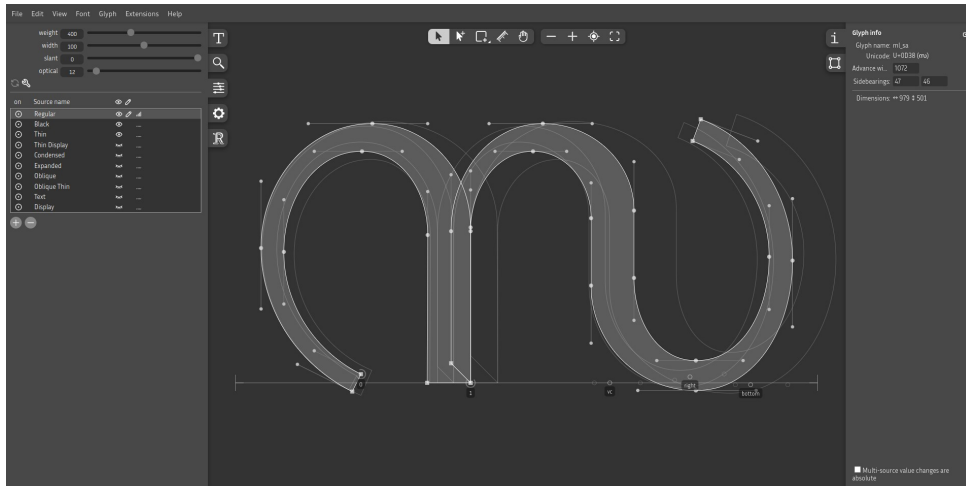


Figure 2: A glyph from a variable font produced by METAFPOST based workflow. Font opened and visualized in Fontra editor. Typeface designed by the author.

and so on. The author has also prepared an online sandbox for METAFPOST so that quick and cheap experiments are possible, and also sharing and collaboration on design concepts are feasible.

4 Derivatives

The educational typefaces with arrows and dots were first of this kind in Malayalam language. The author used the SVGs produced out of METAFPOST code to create a website to learn writing Malayalam. The SVG stroke paths are animatable to simulate a drawing animation. Along with Arrows, Dots variants and incorporating example words and pronunciation audio samples, this website has serious users now.

5 Conclusion

The author also designed another typeface with the same workflow, a typeface optimized for body text, which has stricter stroke modulation, optical fine tuning requirements. This typeface also has an optical size axis, which is first of its kind in Malayalam script.

The idea of typeface designers learning mathematics and programming was not well received in the time when METAFONT was introduced [10]. However, modern typefaces are sophisticated software systems, especially with latest introduction of variables color fonts. These typefaces are designed by the collaboration of engineers and designers. It is not unusual to see digital type designers who are good at programming. The author, who is also a designer and software engineer, would like to present the above explorations, results and learning.

References

- [1] D. E. Knuth, *TEX and METAFONT: New Directions in Typesetting*. USA: American Mathematical Society, 1979.
- [2] J. Hudson, “Introducing OpenType Variable Fonts — medium.com.” <https://medium.com/variable-fonts/https-medium-com-tiro-introducing-opentype-variable-fonts-12ba6cd2369>. [Accessed 08-06-2024].

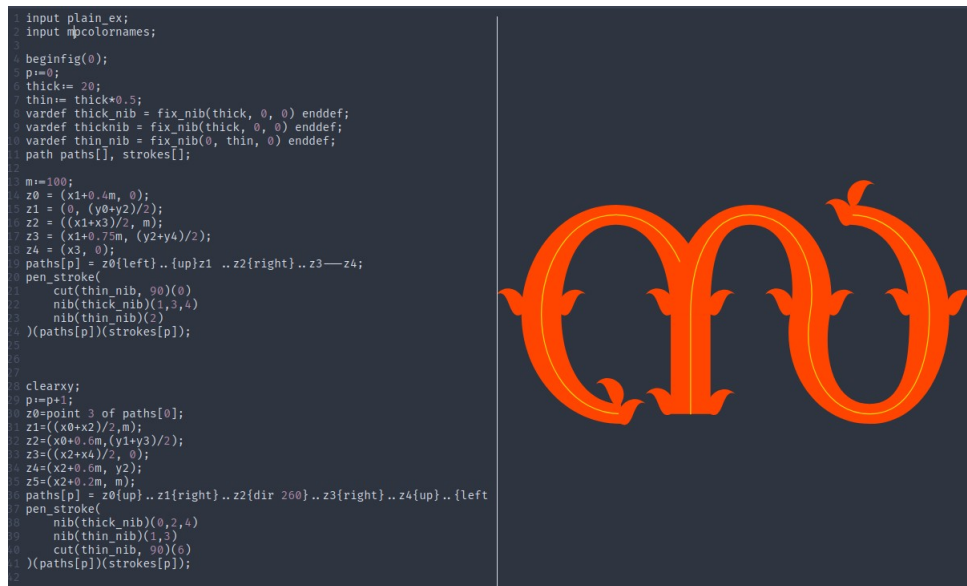


Figure 3: METAPOST code and live preview setup. Glyph designed by the author.

- [3] P. Constable, “OpenType Font Variations overview (OpenType 1.9.1) - Typography — learn.microsoft.com.” <https://learn.microsoft.com/en-us/typography/opentype/spec/otvaroverview>. [Accessed 08-06-2024].
- [4] J. D. Hobby, “A User’s Manual for Metapost. AT&T Bell Laboratories,” *Computing Science Technical Report*, vol. 162, 1994.
- [5] P. Constable, “COLR - Color Table (OpenType 1.9.1) - Typography — learn.microsoft.com.” <https://learn.microsoft.com/en-us/typography/opentype/spec/colr>. [Accessed 08-06-2024].
- [6] B. law Jackowski, J. M. Nowacki, and P. Strzelczyk, “Metatype1: A metapost-based engine for generating type 1 fonts,” *Proc. of EuroTEX*, pp. 111–119, 2001.
- [7] B. law Jackowski and J. M. Nowacki, “Latin modern: Enhancing computer modern with accents, accents, accents,” *TUGboat: Proceedings of the 2003 Annual Meeting*, vol. 24, 2003.
- [8] J. Hobby, “Smooth, easy to compute interpolating splines,” *Discrete and Computational Geometry*, vol. 1, pp. 123–140, 12 1986.
- [9] L. Romer, “Curvature combs and harmonized paths in metapost,” *TUGboat*, vol. 44, pp. 236–239, 01 2023.
- [10] D. E. Knuth, “Lessons learned from metafont,” *Visible Language*, vol. 19, no. 1, p. 35, 1985.