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Improving the Estimation of a Font Face Attributes According to User Preferences

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Abstract: Every day in our life we can discover a lot of optimization problems. By exploring them more deeply we can reveal their fundamentals and think about their solution.

The problem of the most attractive font face for the writer is such a problem. The optimization function of this problem is unknown. Beside other methods also interactive evolutionary computation could be used to solve such type of optimization problems. If we utilize interactive evolutionary computation to find solution we encounter the user fatigue problem. To eliminate this disadvantage we need to accelerate the convergence of the evolutionary computation part.

In this article we propose an algorithm that tries to find a candidate solution to the most attractive font face based on input data. We assume that user likes his handwriting properties which is a subject of research for graphology. These handwriting properties will project into properties or attributes of the font face. The algorithm tries to connect Schwartz's culture model with observations and theoretical knowledge from graphology. It maps the computer font attributes to Schwartz's culture model using the revealed knowledge from graphology about handwriting. We modified our existing algorithm proposal and we included a learning phase of fuzzy membership function to match a case when user preferences are different from the theory found in graphology. The algorithm is a theoretical proposal to the user fatigue problem in interactive evolutionary computation.

1 Introduction

We encounter many optimization problems for which we do not know their optimization function. In such cases one need to find such methods that can replace explicit expression of optimization function with other resources. Sometimes we can include human user attributes as user can determine the optimal value according to his criteria. The interactive evolutionary computation [3, 5, 6, 7, 15, 16] has its broad application potential in computer graphics, tuning the hearing aid system, music, various industry applications, speech and image processing, data mining, art, therapy, robotics and control, architecture, design, virtual reality, but also in other fields of human activities [24, 25, 26]. The main problem by using interactive evolutionary computation is the human user fatigue problem. There exists some proposals of human user fatigue reduction (accelerating convergence of evolution by Wang [27] and also some general approach methods reviewed by Pei [17]. We chose the human values theory by Schwartz and connected it with fuzzy set theory and improved the previous version of the algorithm

We describe the problem of the most attractive font face for the writer which we deal with in our research in various stages [8, 9, 10, 11]. We describe in short the theory of human values, then we describe the algorithm that incorporates the theory of human values and fuzzy sets. We also describe the modification of the algorithm in order to include the learning ability in some important steps of the algorithm.

2 The Problem of the Most Attractive Font Face

We have dealt with the problem of the most attractive font face in our past research and also in recent, where we discuss the question of accelerating the convergence of the interactive evolutionary computation in order to reduce the human user fatigue.

We have one type of font which face is described with a finite set of parameters. The domain of each of the parameters can be either a finite set of values or interval. The task is to set the values for these parameters. By applying values of these parameters to a given font the user should get a font face that is the most attractive for him.

To describe the font face we used the Metafont language [13]. The font parameters are equations and we can change just one parameter value in one place and by applying this change we can obtain consistent change in the whole font face of the Computer Modern font.

The configuration file of the font contains 62 parameters. We have experimentally chosen 25 parameters that have the largest impact on the final font face look (or 21 parameters, if we consider that the parameters are the same for upper case and lower case characters).

So we have the configuration file of the font which has a parameter vector $\vec{p}$ with dimension of 62. Each of the vector components is a value of one parameter and is equal to 0 if the parameter is one from the set of our chosen parameters. The modification vector $\triangle\vec{p}$ is also a vector of dimension 62 and his components are values of parameters

Table 1: The table of chosen font parameters and their values. Parameters time, P_1 – P_{13} are integers, P_{14} – P_{17} are real, P_{18} – P_{21} are boolean.

P_i	**lower limit**	**upper limit**	P_i	**lower limit**	**upper limit**
P_1	0	100	P_{12}	0	100
P_2	0	100	P_{13}	0	100
P_3	0	100	P_{14}	0	0,5
P_4	0	80	P_{15}	0	1,5
P_5	1	10	P_{16}	0	1,0
P_6	0	80	P_{17}	0	0,7
P_7	0	60	P_{18}	False	True
P_8	0	60	P_{19}	False	True
P_9	0	100	P_{20}	False	True
P_{10}	0	30	P_{21}	False	True
P_{11}	0	100	time	0	indiv.

that we use for the font modification. These components equal 0 that we did not chose. The new vector $\vec{y}$ of all parameter values we obtain if we perform vector addition of $\vec{p}$ and $\triangle\vec{p}$:

$$\vec{y} = \triangle\vec{p} + \vec{p} \quad (1)$$

3 From Theoretical Problem to Application

According to the definition of the optimization problem [12] there should exist optimization function f. This function should assign a real number to each of the vectors $\vec{y}$. We can state that "the most attractive font face" could have different look for different users. We can also observe the expression of the optimization function f is missing.

We have implemented and interactive evolutionary computation methods into our application that is trying to solve the problem of the most attractive font face [8]. The application run-time is iterative process where in each iteration 12 font samples (one generation) are presented to the user and user has to evaluate the proposed font samples. After a lot of iterations the user can get tired and we face the problem of the user fatigue. Here arises the challenge to improve the raw interactive evolutionary computation, e.g. to accelerate convergence or to create some smart way a convenient starting generation of font samples.

4 The Theory of Human Values

We chose the theory of human values from Schwartz [18] because the theory describes each human as an individual carrying each of these values ordered by some custom priority that makes every human unique.

4.1 The Common Features of Human Values

If we think about our values, we think what is important for us in our life. Everyone has or can have other values (e.g. achievement, security, benevolence) with other degree of importance. One value can be very important for one person but very unimportant for other. The theory of values [18, 20] is based on a concept of values, that is described by six main features that are implicitly included in papers of many theoretics:

1. Values are believes linked to affect.
2. Values refer to desirable goals that motivate action.
3. Values transcend specific actions and situations.
4. Values serve as standards or criteria.
5. Values are ordered by importance to each other.
6. The relative importance of multiple values guides the actions.

The above mentioned are features of all values. What distinguishes one value from another is the type of goal or motivation that the value expresses. The values theory defines ten broad values according to the motivation that underlies each of them. Presumably, these values encompass the range of motivationally distinct values recognized across cultures. According to the theory, these values are likely to be universal because they are grounded in one or more of three universal requirements of human existence with which they help to cope. These requirements are: needs of individuals as biological organisms, requisites of coordinated social interaction, and survival and welfare needs of groups [21].

Individuals cannot cope successfully with these requirements of human existence on their own. Rather, people must articulate appropriate goals to cope with them, communicate with others about them, and gain cooperation in their pursuit. Values are the socially desirable concepts used to represent these goals mentally and the vocabulary used to express them in social interaction. From an evolutionary point of view these goals and the values that express them have crucial survival significance [21].

4.2 Human Values

Each from the ten human values 1 expresses a wide set of goals. We also know them as a culture model. Values are based on universal needs and they refer to similar concepts of values. Furthermore the values are organized by motivational similarities and oppositions. They form four main groups:

- Openness to change
- Self-Transcendence
- Conservation
- Self-Enhancement

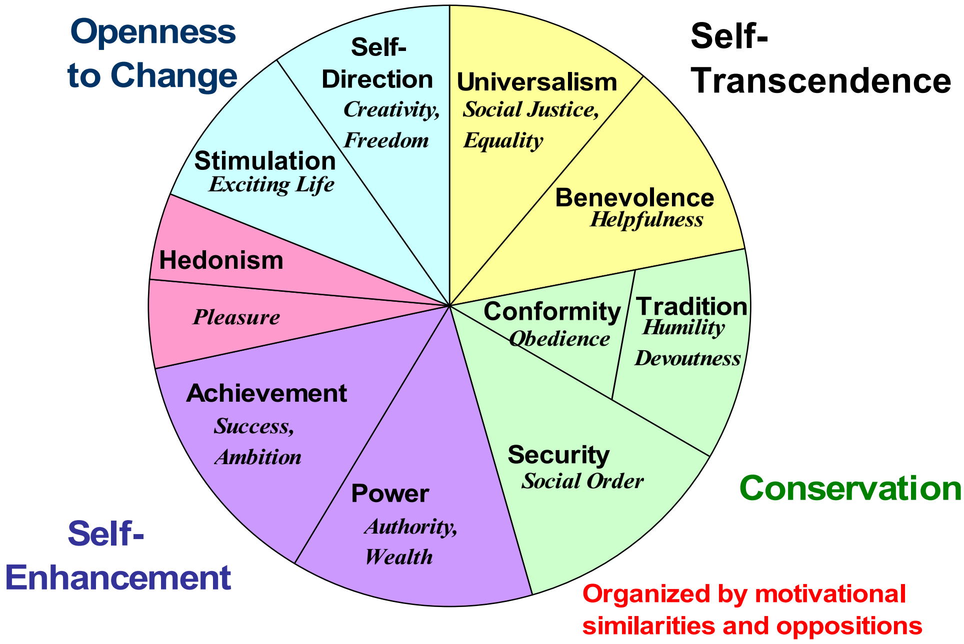

Figure 1: The Schwartz's culture model of basic human values, image borrowed from [21].

5 The Road from Human Values to Font Attributes

In order to assign each human value their characteristic font attribute values we need to search through resources of graphology and find a connection between human values and font attributes. We research the first level of the basic human values. In the literature we studied [1, 2, 4, 14, 22, 23] we are able to find the proposed human values in connection to font attributes, although we need to be correct and use word handwriting instead of font, but we assume that user likes his own handwriting which projects ones preferences also to the font attributes. If our assumption is true then we can apply the knowledge from graphology to our most attractive font face problem. Furthermore if these assumptions are correct we could accelerate the convergence of the evolutionary computation giving it a smart starting generation

We consider these basic font attributes: slant (S), pressure (thickness T), spaces between characters (SPC), proportional size of middle part of font (MS), proportional size of upper part of font (BS), proportional size of lower part of font (LS), character width (SP), the shape and width of loops (TS). We try to connect these attributes with our culture model and corresponding human values: self-direction (HSE), stimulation (HST), hedonism (HED), achievement (HAC), power (HPO), security (HBE), conformity (HCF), tradition (HTR), benevolence (HBN), universalism (HUN).

Each font in Metafont language has a different form of configuration (various equations), so does our chosen font according to table 1. In order to use this connection between human values and general font attributes we need to make another mapping between these general attributes and attributes of given font that is going to be modified. We can see in table 2 the occurrence of the font attributes by particular human values from Schwartz's culture model. This model was tested in an *European Social Survey* where respondents were had to answer the questions for particular human values giving each of the values some priority (from -1 which means it is against my value to 7 which means I agree).

6 The Improved Algorithm of Font Attribute Estimation

If we assume the mapping from table 2 we can propose an algorithm for estimating the font face attributes following way:

At the beginning we assume that fuzzy membership function μ_p^i of attribute i which has a domain in $< min_i, max_i >$ will be given by linear function f that $f(min_i) = 0$ a $f(max_i) = 1$. We initialize at the beginning a set of small feed forward neural networks which learn this linear fuzzy membership functions for every attribute (even the simplest neural network – perceptron can learn this 2-D linear function). Our network in comparison to the perceptron should have three layers: input, hidden and output layer with topology e.g. 1–5–1 in order to learn more complex functions. We also assume we obtain the basic human values j from the model for each user according to his preferred weighted priority w_j (e.g.: w_j is recommened by [21] from -1 which means it is against my values to 7 which means I agree). Then we begin with the algorithm itself:

1. For every font attribute i we select values j that influence the attribute and for every combination

Table 2: Mapping of human values and font attributes according resources from graphology and culture model. Legend: L - left, P - right, R - straight, S - small, M - middle, B - big; font attributes in first row: slant (**S**), pressure(thickness **T**), spaces between characters (**SPC**), proportional size of middle part of font (**MS**), proportional size of upper part of font (**BS**), proportional size of lower part of font (**LS**), character width (**SP**), the shape and width of loops (**TS**). The culture model legend: self-direction (HSE), stimulation (HST), hedonism (HED), achievement (HAC), power (HPO), security (HBE), conformity (HCF), tradition (HTR), benevolence (HBN), universalism (HUN).

	S	T	SPC	MS	BS	LS	SP	TS
HBE			B					
HBN			S				B	B
HED					S	B		S
HPO	P	B						
HCF				S				
HSE	L		B	B			S	
HST			S		S	S		
HTR					S			
HUN	R							
HAC		S		M	B			

attribute–value we create a fuzzy membership function μ_h^k from the mapping in table 2, e.g. for attribute slant where we have terms left, right, straight, we select values from the table: HSE, HPO, HUN. For pairs left-HSE (μ_h^1), right-HPO (μ_h^2) a straight-HUN (μ_h^3) we assign a fuzzy membership function μ_h^k by expressions e.g.:

$$\mu_h^1 = \frac{x+1}{16} \tag{2}$$

$$\mu_h^2 = \frac{x+1}{16} + \frac{1}{2} \tag{3}$$

$$\mu_h^3 = \frac{1}{2} \tag{4}$$

2. We use aggregation operator (weighted average) to calculate a value μ_p^i as an average from μ_h^k, we use the priority values as weights w_j, but we need to normalize them so that the sum will be: $\sum_w = 1$.

3. For every font attribute i we find an inverse image of an image of fuzzy membership function μ_p^i and we obtain value - an estimation of font attribute values of our modified font. These font attributes will determine the look of the fonts in starting sample.

4. Optionally in interactive evolutionary computation in each iteration we can introduce some form of learning for each of the fuzzy membership functions μ_p^i to express them also as non-linear functions. Between the iterations in the application we can teach our neural network that has learned linear functions μ_p^i. For the teaching we use those values of font attributes that has user evaluated as very good (they will have higher fuzzy membership function value). That way we could catch individual features of user that can lead to accelerated candidate space search of the problem of the most attractive font face.

7 Conclusion

We proposed a theoretical improved algorithm for font attributes estimation for our problem of the most attractive font face. We used only the first level human values from the Schwartz's culture model, but every value can be further expanded to more sub-values. This way we could obtain more complex model of the human user which could lead to more precise estimation of font attributes so that the convergence of the evolutionary computation can be accelerated and user fatigue can be reduced. As an improvement of the algorithm we introduced the neural network that can learn individual preferences between iterations that breaks the limit of expressing each fuzzy membership function with a linear formula or any other predefined formula. The next step will be to implement the algorithm and perform experiments on real data collection. Afterwards we will be able to verify the method and determine the validity of the proposed method.

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