Estimating and Predicting Average Likability on Computer-Generated Artwork Variants

Jabier Martinez
SnT, Univ. of Luxembourg & Univ. Pierre & Marie Curie
Luxembourg
jabier.martinez@uni.lu

Gabriele Rossi
Art painter
Paris, France
moonsnail@ymail.com

Tewfik Ziadi
LiP6, Univ. Pierre & Marie Curie
Paris, France
tewfik.ziadi@lip6.fr

Tegawendé F. Bissyandé
SnT, University of Luxembourg
Luxembourg
tegawende.bissyande@uni.lu

Jacques Klein
SnT, University of Luxembourg
Luxembourg
jacques.klein@uni.lu

Yves le Traon
SnT, University of Luxembourg
Luxembourg
yves.letraon@uni.lu

ABSTRACT

Computer assisted human creativity encodes human design decisions in algorithms allowing machines to produce artwork variants. Based on this automated production, one can leverage collective understanding of beauty to rank computer-generated artworks according to their average likability. We present the use of Software Product Line techniques for computer-generated art systems as a case study on leveraging the feedback of human perception within the boundaries of a variability model. Since it is not feasible to get feedback for all variants because of a combinatorial explosion of possible configurations, we propose an approach that is developed in two phases: 1) the creation of a data set using an interactive genetic algorithm and 2) the application of a data mining technique on this dataset to create a ranking enriched with confidence metrics.

CCS Concepts

•**Applied computing** → *Media arts;* •**Computing methodologies** → *Genetic algorithms;* •**Software and its engineering** → *Software product lines;*

Keywords

Interactive genetic algorithms; computer-generated art; software product lines; user feedback; data mining

1. INTRODUCTION

Computer-generated art involves the use of a computer assisted autonomous system to create an artwork or a set of artwork variants. Because of the combinatorial explosion of possible artwork variants, not all of them will actually be created. Besides, a number of them may not reach the desired aesthetic quality. Based on human feedback, we present an approach towards estimating and predicting likability on computer-generated artwork variants through the creation of a ranking of all the possible configurations. The ranking has the objective to serve as input for the artists to understand people perception of their style, to inspire and refine it, and eventually help them in the decision making process to select the variants that have more guarantees of collective acceptance.

Since the approach will rely on human assessments of likability, the challenges are:

- Given the combinatorial explosion of configurations and the limited resources, how can one identify and select the optimal subset of artwork variants that are relevant for human assessment?

As we only consider a subset of artwork variants for human assessment, most of the variants have not yet been assessed. In addition, likability scores are subjective as different persons could assess the same variant differently.

- Given a subset of assessed artwork variants, how can one infer the likability scores of the non assessed variants? How can one aggregate likability scores to calculate predictions for the already assessed variants?

The approach contains two phases at which we first use an interactive genetic algorithm for the initial dataset creation and then a tailored data mining interpolation technique to infer the ranking by reasoning on the dataset. We apply and validate the approach on a Software Product Line (SPL) based computer-generated art system dealing with landscape paintings. Thus, we aim to empirically study whether we can predict the likability of artwork variants built by assembling perceivable components. Figure 1 outlines our approach.

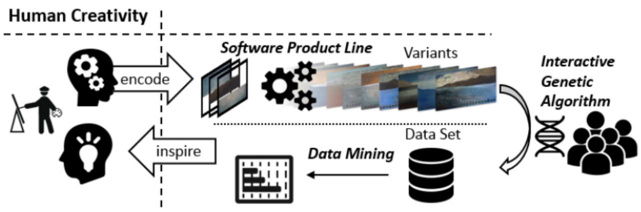

Figure 1: Steps and techniques of the approach

GECCO '15 July 11-15, 2015, Madrid, Spain

ACM ISBN 978-1-4503-3488-4/15/07.
DOI: http://dx.doi.org/10.1145/2739482.2764681

2. RANKING ARTWORK VARIANTS

The approach is developed in two phases: 1) the creation of a dataset using an interactive genetic algorithm and 2) the application of a data mining technique on this dataset to create a ranking enriched with confidence metrics

Phase 1: Evolution-based Dataset creation.

The first phase of the approach aims at overcoming the challenge of selecting a relevant set of configurations to be presented to users for assessment. Indeed, to address the combinatorial explosion of possible configurations, we rely on an interactive genetic algorithm (IGA) which explores the possible configurations' space trying to reach optimal or suboptimal solutions [2]. In our case study, the fitness function for the IGA is based on values ranging from 1 (*strong dislike*) to 5 (*strong like*). When a user votes, the displayed painting vanishes and the next painting of the genetic algorithm population is displayed. When all paintings from the population have been assessed, a new population is generated based on the calculations of the genetic algorithm, and the exploration towards optimal paintings continues, until it is stopped manually at the end of the session.

Phase 2: Ranking computation.

In the second phase the algorithm for the ranking computation takes the dataset produced by the previous evolutionary phase as input, and assigns a ranking for all possible configurations, including those that are not in this dataset. We make the assumption that when two products are similar in the way they were assembled they will be appreciated similarly. First, we define a similarity measure for computing a *similarity distance* between two configurations. We then design a protocol for aggregating feedback from different users for a set of *similar* products. This protocol works by defining a *similarity radius* which will be relied on to compute the *weighted mean score* for each possible configuration. We further automatically investigate the suitability of different methods for defining the radius as well as for the approaches for computing the weighted mean. Finally, we create a ranking of all possible configurations with the hypothesis that the computed score of each configuration should equate the average likability. We also provide a *global confidence metric* for each of the ranked items based on the measurement of the neighbors similarity and density.

3. CASE STUDY AND RESULTS

In the last years, Gabriele Rossi has been drawing abstract representations of landscapes with quite a recognizable style. We encoded this style using variability management techniques that belongs to the Software Product Lines Engineering domain [1]. The total amount of possible configurations amounted to 59,200. We further implemented an automatic derivation process for any configuration to be able to create any computer-generated artwork variant.

a) Rank 102 - liked b) Rank 15,532 c) Rank 59,145 - disliked

Figure 2: Key paintings with high global confidence

The IGA was operative as part of an art festival were 1,620 likability scores were collected and added to the dataset. Afterwards, the ranking was computed. Figure 2 shows three key rank items: The configuration with the highest global confidence for configurations that are *liked* (i.e., likability greater or equal to 4) holds the position 102. The corresponding variant is presented in Figure 2a. Figure 2b shows the variant that was derived for the configuration with the highest global confidence. This configuration got *normal* likability and holds the rank 14,532. Similarly, we identify the configuration with the highest global confidence for configurations that are *disliked* (i.e., likability less or equal to 2). It holds the rank 59,145 and it is shown in Figure 2c.

4. EVALUATION

We performed a controlled assessment of the estimations using 10-fold cross validation in our case study's dataset. The prediction had a margin of error around 1. This suggest, for example, that if the likability is *like*, the margin of error is between *normal* and *strong like*. We consider this to be a good performance when attempting to capture collective understanding of beauty within the boundaries of our variability model. We repeated the case study with only one person each time. In the 10 separated individualized evaluations we conducted, we obtained 91% of accuracy in distinguishing between like and dislike. This suggests that the predictions in the extremes of the ranking were accurate in the case of individualized estimation. We also qualitatively evaluated the ranking from the artist's perspective. He claimed that the ranking was very interesting to understand his own style and people sensibility about the possible configurations. The rank has also led to him seeing novel well-ranked pieces which he likes.

5. CONCLUSIONS

Being able to apprehend, estimate and predict likability of computer-generated artwork variants can provide insights on the external appreciation of an artistic style. We presented an approach to rank computer-generated artwork variants according to its calculated average likability. We rely on interactive genetics algorithms to overcome the combinatorial explosion of possible artwork variants and we rely on a data mining approach to aggregate the obtained likability scores.

6. ACKNOWLEDGMENTS

Funded by FNR Luxembourg under the project MODEL C12/IS/3977071 and the AFR grant agreement 7898764. The work of Tewfik Ziadi was also supported by the University of Luxembourg as a visiting researcher. Special thanks to the Rebelarte artistic association.

7. REFERENCES

[1] P. C. Clements and L. Northrop. *Software Product Lines: Practices and Patterns*. SEI Series in Software Engineering. Addison-Wesley, August 2001.

[2] J. Romero and P. Machado, editors. *The Art of Artificial Evolution: A Handbook on Evolutionary Art and Music*. Natural Computing Series. Springer, 2008.