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A Case Study from the Point of View of Aesthetics: A Dialogue Between an Artist and a Computer Scientist

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Abstract

Computational Aesthetics draws from both a long history of artistic expression and the possibilities that computational methods can provide. As such, its success depends on a dialogue between the arts world and computer science. Based on the experience we gained through an art-computer science joint project on non-repetitive patterns we attempt to document our personal dialogue, to analyze the experiences we gained from our collaboration, and to extract insights we gained with respect to computational aesthetics.

Categories and Subject Descriptors (according to ACM CCS): I.3.0 [Computer Graphics]: General

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1. Introduction

Collaborations between artists and scientists have become a focus of work (e. g., [Dou73, Wil03, BMNM05]) to both empower artists to explore more and new ways of expression as well as to enable scientists to better visualize and communicate their findings. This sentiment and the consideration of its importance are not new; however, active art-science collaborations are still a rarity. This is despite the fact that discussions often occur among scientists about finding artists who are interested in working with them, among artists about finding the right scientist to help them realize their visions, and within industry (e. g., animation or gaming) about the importance of both art and science for creating the best results. What then are the issues? In our research lab we have been actively exploring this question through encouraging and supporting many types of art-science collaborations. These include visiting resident artists, interdisciplinary art-science courses, and professional collaborations.

In this paper we discuss the experiences that the two primary authors, Arlene Stamp (artist) and Tobias Isenberg (computer scientist), have gained through recent collaborations in generating non-repetitive patterns and through a project in non-photorealistic rendering. This paper addresses both issues of aesthetics as encountered in the produced artwork, and interaction as well as collaboration between art and science in general. As such, it presents and discusses views on the issue from both perspectives and examines the different possibilities of joint work in such contexts: artist-driven, scientist-driven, and balanced collaboration. Arlene and Tobias present their thoughts in the form of a dialogue between the two of them to express exactly what they each think, using the language that each has learned to use within their respective disciplines. If there is a disconnect between the two voices, then that in itself becomes interesting and revealing. The different voices are shown in Sections 3–5 by using the Roman font for Arlene's voice and *a slanted font for Tobias' comments.*

The paper is organized as follows. First we introduce the project we are referring to in this paper, an interactive art project to create non-repetitive patterns, in Section 2. In Section 3 we start our dialogue and talk about what role aesthetics plays in coming up with a concept and defining the project. In Section 4 we address the aesthetic issues in realizing an interface, and in Section 5 we discuss how we each evaluate the aesthetics of the result and the decisions that led to it. Finally, in Section 6 we summarize our dialogue and in Section 7 we attempt to draw some conclusions from it.

2. A Non-Repetitive Pattern Art Project

Repeating patterns have been produced for centuries [LS07] using modular units which are then repeated in a variety of

different ways. For example, Grünbaum and Shephard list various ways of tiling a plane [GS86]—nearly all of which involve repetition. Exceptions such as Penrose tiling [Pen74] and Conway's Game of Life [Gar70] are non-periodic patterns, the type of patterns we address. Recent art projects that algorithmically produce patterns include, for example, "RandScape" by Smith [Smi03] based on random data or the "randomSeeds" project by Isley and Smith [IS05]. Our project avoids the use of algorithms that use randomness, in favour of exploring patterns created by deterministic cellular automata, based on a set of rules that are controlled interactively by the users/viewers.

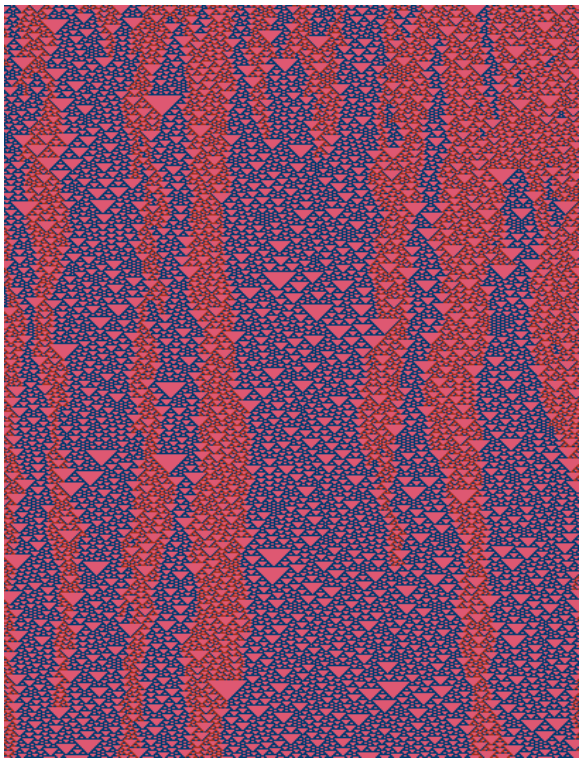

Figure 1: *Example of non-periodic pattern generated with "Growing Patterns."*

Figure 1 shows an example pattern generated with "Growing Patterns," the program we have developed. The pattern construction is based on a set of ten pattern-generating rules which cover all the possibilities for growing a three-colour pattern from a row of randomly arranged cells (Figure 2). Each of the ten rules determines the colour of the cell in the new row by looking at the three cells immediately above it in the preceding row; for example, the rule may determine that the new cell is to be red when the three cells immediately above it are red, blue and yellow. The program allows the user/viewer to determine the three colours and also to determine the ten rules of pattern generation. "Growing Patterns" is part of an online art website curated by Diana Sherlock at `http://www.artificial-life.net/`.

The issue of authorship should be raised at this point as it relates to the formulation of the entire art project. Since the opportunity for the project arose when Arlene was invited to produce an artwork for an on-line curatorial project on the basis of her past work as an artist, the assumption at the outset was that she was the author of the art project. On the other hand, as a person unable to realize her project concept by herself, Arlene needed the input and collaboration of someone conversant in the formulation of computer programs and interfaces. Through his role in helping to shape the interface (which became the face of the artwork), Tobias shared a considerable number of the aesthetic choices that led to the final project. However, the primary responsibility for the content or meaning of this project as an artwork rests with Arlene. Traditionally in the art world the person responsible for the content of an artwork is considered to be the "author" or artist. This issue will continue to arise in collaborative projects like this one and should be one of the first issues to be discussed by the participants.

3. The Aesthetics of the Concept or How to Define the Project

The concept for a specific computer-based art project is usually initiated either by the artist or by the computer scientist. In the general case it seems to be the artist who comes up with a project and the aesthetics for it and then gets help from a computer scientist for realizing it. In my specific domain, non-photorealistic rendering, the opposite case seems to be more common: the computer scientist decides on an artistic or illustrative technique to replicate and then gets input from artists. Unfortunately, this input often seems to be reduced to looking at example images; rarely are artists actively involved in the process. These two general approaches seem to lead to either artist-driven projects or scientist-driven projects, respectively. However, sometimes it also happens that an artist-initiated or computer scientist-initiated project can lead to a collaboration where both parties contribute about equally, but according to each ones' specific expertise. This case of joint work I think happened with the project Arlene and I are describing in this paper: a joint project to generate non-repetitive patterns as an interactive art piece.

I agree that in this case, a more collaborative development of a concept happened than has been my experience in working with computer scientists in the past. I have worked on both artist-driven projects and computer scientist-driven projects; but this was a situation where the computer scientist was involved at an earlier stage of the project—before I had any clear idea of the form that the interface might take.

When the invitation came from Diana Sherlock to produce a work for her art website, I saw it as an opportunity to try

out an on-line, interactive, pattern-generating program. I had set up a company, StudioStampa, in 2003 with my business partner Rina Greer, to market commercial applications for non-periodic patterns. I had been thinking about the possibility of making an on-line program available to customers so that we might make customer-determined patterns instead of the other way around. So I came to Tobias with an interest in trying to set up an interactive on-line program capable of generating all the possibilities for non-periodic pattern using three colours and a cellular automata approach to pattern generation. From the outset, we collaborated on how this could be set up.

As an artist, I do not think about aesthetics when I begin a project. I initiate a project because I want to see where a specific idea might lead. It is more of a scientific approach, I guess. But unlike the scientific approach, if the results of a concept are not interesting enough, I feel free to move the concept in a more promising direction. So in that sense, aesthetic judgment comes into play.

Computer graphics and, in particular, non-photorealistic rendering usually seems to work differently. Our work is guided by some example or a specific style to achieve, which is identified in the beginning, so the aesthetic choice is made at the start of the work. Then the question becomes how to achieve the specific goal most efficiently with the tools at our disposal. A project is completed successfully if the intended style is achieved by the produced software, if the software operates efficiently and hopefully interactively, and if the conceived technique producing the visual style is new and/or allows the creation of images/visualizations/illustrations that would not have been possible before.

As such, this way of working is also not the typical scientific process of coming up with a hypothesis and then testing whether it is true or not, but is more of an engineering approach. However, I think the technique of having interest in some subject and then experimenting with it is not necessarily either scientific or artistic but more what both have in common and where joint projects can start from.

One might say that the pre-determined goal of our project was the generation of a particular set of non-periodic patterns. But that was the easiest and least challenging aspect of our project because we did not have to consider aesthetically the patterns that the program produced. The aesthetic goals become more tied to the design of the interface and the aesthetic implications of all the choices involved there. For example, we considered the aesthetic implications of how the pattern renewed itself on the screen and how much of the screen it took up. We considered the aesthetic implications of whether or not the user should be able to download patterns they had created with our program and whether or not they should be able to be archived. We considered the aesthetic implications of whether or not to limit colour choice, and having decided to not limit colour choice in theory, we then had to make choices as to how to set up the colour selection system. We considered carefully how the viewer/user might experience the patterns at different levels of magnification—in art terms this is an important determining factor of the experience of the unique kind of space embedded in non-periodic patterns.

So the decisions surrounding the workings and look of the user/viewer interface become major determining characteristics of the artwork. The design of a program interface would seem to be an entirely fitting representation of the collaboration between an artist and a computer scientist.

4. The Aesthetics of the Interface

Interfaces for generating imagery with computer graphics approaches are usually driven by practical consideration in terms of having to test the program and having to create images for papers. In contrast to traditional methods without computer support, many possible parameters can be explicitly changed rather than being influenced by the choice of physical tool or medium and the interaction between them. This leads to interfaces that are typically not very intuitive, often very complex with many technical parameters. Even though this wealth of parameters allows control of the image production process, it is seldom clear to other people what individual parameters are doing so the software tool effectively becomes a black box, in particular to artists who want to use it.

I would characterize the look of the interface I was after as "transparent"—in direct contrast to the idea of an interface as a "black box." One of the goals of this project for me was to try to make as transparent as possible the way in which these non-periodic patterns are generated. It is still fairly difficult to figure out using the interface we came up with, how these patterns grow—especially since the essential nature of them is that they are unpredictable. At one level, the connection between the ten determining rules of the pattern and the look of the generated pattern remains almost totally obscure. But a careful exploration of the site does make it possible to uncover the relationship between the ten rules and the way the pattern grows line by line. Hopefully, the user/viewer will at least understand that these patterns generate themselves automatically from the set of ten rules, which they play a role in determining.

The concept of casting a specific artistic or illustrative technique into a piece of software, and by that, greatly reducing the freedom of expression for a person using this software, does not present too much of a problem for me personally because this freedom would most likely be too overwhelming for me. Nevertheless, I absolutely realize that this approach is not satisfying for an artist using such software as artists constantly look for new ways of expression and possibilities to experiment with their tools. Also, the way the parameters are presented in the interface leads to the software becoming unattractive for outsiders to use. This is something

we experienced in great detail in the pattern project, which led to the interface being redesigned several times. We tried to facilitate user interaction as much as possible in consideration of the fact that many of our anticipated users would be unfamiliar with pattern-generating programs.

The aesthetic choices made in connection with the interface are very important to me as an artist because the clues to the content of the artwork are embedded in the look and operation of the interface. The interface becomes the experience of the artwork and so Tobias and I worked and reworked the design of it to ensure that the viewer/user could experience as fully as possible the nature of these patterns. It needed to be as transparent and self-explanatory as possible. We wanted to convey the scope of variation of each pattern by allowing movement around and into the pattern and so introduced a number of options that would allow the participant to scroll through the pattern or zoom in and out. We also introduced an entire set of automatic pattern choices that would allow the user to experience a broad range of patterns possible with this program without having to try to generate the full scope of variation themselves by changing the rules of generation.(Figure 2).

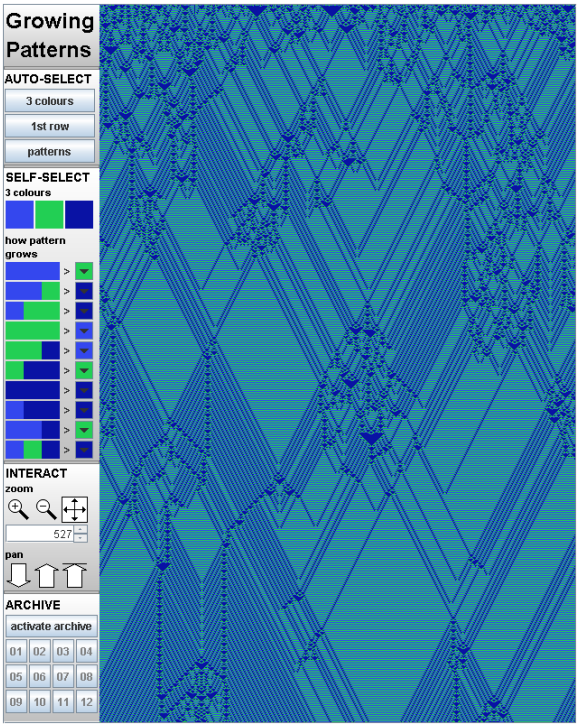

Figure 2: *The user interface of "Growing Patterns."*

These automatic ways of determining patterns and colours, I felt, were very important for people to be able to more comprehensibly explore the parameter space of the program, which turned out to be comparatively large. Without these options, people were restricted to iteratively changing the scheme of the previous pattern to get to a new one by changing one setting at a time. This way of interacting was, while necessary to explore some settings in more depth, sometimes counterintuitive as small iterative changes to the rules would, at times, introduce no change at all to the pattern, while at other times the pattern would change drastically. The automatic option offers the opportunity to let people explore very different sets of parameters without having to add much complexity to the program and its interface.

One problem for me as an artist without knowledge of programming languages is that I do not know how much work is involved in making a change that I might like to try. The fact that I need to hesitate before asking for a change is inhibiting for the development of the work and is not conducive to the best results. I feel that I could collaborate much more effectively with a computer scientist if I had some knowledge of programming languages. It is important to feel free within a working process to move backwards and forwards and to pursue any impulse that arises. Without this knowledge on my part, Tobias and I nevertheless achieved quite a good level of collaborative exchange on this project. It seems important that good dialogue take place between the participants so that the computer scientist understands the reasons why a change is being requested and can have input as to how some new goal might be achieved.

For such a dialogue it is essential to have at least a basic joint vocabulary that both collaborators are familiar with. In our specific case this was easier as Arlene had previously worked with other computer scientists on joint projects even though I had never worked as closely with an artist. Arlene's experience, in my opinion, also gave her a basic technical understanding that was very useful in the collaboration. Still I can understand her concern that the lack of knowledge of programming languages would prevent her from a more effective collaboration. In this case the computer scientists have to take the responsibility to suggest easy additions that allow new interesting features or other forms of expression, try their best to implement even computationally difficult features, or point out why these are not easily possible. In doing this they can make their own kind of aesthetic contributions to the project.

Certainly Tobias made many contributions to the development and placement of options in the interface. His understanding of the assumptions associated with interactive interfaces and the options possible were crucial to the transparency I was reaching for.

5. The Aesthetics of the Result and Output

For me as a person with a limited sense for artistic expression, I really enjoy being able to use and even author software that allows me to create imagery that would normally

be much beyond my capabilities. For example, being able to create beautiful line drawings from 3D models, convert photographs into painterly images, or experiment with how patterns evolve is what I think makes being a researcher in computer graphics very rewarding. I enjoyed the results Arlene and I achieved with the non-repetitive pattern project and experimented with the program a lot, but initially wished for more guidance in the form of the previously mentioned templates of "what looks good" (in terms of specific patterns and colour sets) from Arlene.

Tobias' expectation of more direction from me as to "what looks good" stems, I believe, from his more goal-oriented approach to programming. As an artist, I try to keep the output of a system I have set up as transparent and all-inclusive as possible. By transparent I mean that I try not to make aesthetic decisions that are hidden from the viewer and try to accept all outcomes of the system that has been set up without editing on the basis of aesthetics. We did have to make one hidden limiting decision with respect to colour choice, deciding to limit the hues available to ones that were visibly discernible on screen. But I consider this to be a practical decision, rather than an aesthetic one.

Other aesthetic decisions also had to be made in terms of the initial values of the program's parameters when it starts up as has to be done for most computer programs. For example, as the scheme Arlene chose for generating patterns also allows for repetitive patterns to show up very early on, we decided on a number of pattern production schemes that would generate a non-repetitive pattern, one of which would randomly be chosen when the program was started. These "cover image" patterns were chosen by both of us, by selecting schemes that produced patterns we liked as we were exploring the parameter space of the program. Initially I wanted to present these pre-defined choices to be directly accessible by people interacting with the program, but Arlene objected and wanted this feature removed. By only choosing from the default set when starting the program we can now demonstrate the possibilities of the program to our users/viewers without limiting them too much. They are still free to make their own choices in exploring the artwork.

Part of the content of this artwork from my point of view depends on the viewer/user being able to understand that they are able to access the full range of possibilities within the limited three-colour pattern generating system that we have set up. It is only then that they can begin to exercise their own aesthetic judgment and realize that this program allows them to create their own pattern. If the viewer/user thinks of the patterns as the artwork, then they are the artists. I was interested in setting up a system capable of generating non-periodic patterns by relatively simple and direct means which could then be explored by the viewer/user to gain insight into the nature of their recursive space.

6. Summary

In summary we list some of the important issues that arise in art-science collaborations. We acknowledge that art-science collaborations have a tendency to be both exhilarating and difficult. As in the above dialogue our intention is to bring these topics into open discussion rather than to prescribe or even suggest guidelines. We feel that many flavours of collaboration will enrich research and creation in the future and here merely summarize some important issues.

- The issue of lead: As mentioned at the beginning of the paper it is more common to have either an artist-led or a scientist-led collaboration than to have a fully balanced one. Difficult issues arise when the lead shifts during collaboration and it takes maturity and generosity to recognize and welcome these shifts.
- The issue of trust: There are many ways that issues of trust arise. These include the artist maintaining their own sense of trust in their artistic decisions and the scientist learning to develop that trust; or vice-versa, the artist developing a sufficient understanding of the technical issues to trust when things are not possible as opposed to merely difficult.
- The issue of vocabulary: It is quite possible for an artist and scientist to think they understand each other only to discover that, while they were using the same words, the meaning was different in their respective fields of discourse.
- The issue of authorship: Authorship is handled quite differently in the two different communities and can be a very sensitive issue.
- The issue of interaction as an aesthetic: This last point may be at the heart of the issue. What is an aesthetic interaction? How can this be developed without close collaboration between artists and scientists?

7. Conclusion

The collaboration between Arlene and Tobias, we feel, was a successful one. Even though Arlene as the artist had initiated the project, it turned out to be an example of a collaboration where both parties contributed equally to the aesthetics of the result, both in terms of the produced software and the interaction with it as well as in terms of the visuals produced. We have both learned about each other's approach to working on such an interactive piece. Arlene, for example, gained insight into the difficulties of implementing certain features she wanted to be added to the piece, and Tobias has now a better understanding of what aesthetic decisions artists do or do not like to make. Also, both of our experiences have helped tremendously with realizing the project and have determined aesthetic decisions throughout the process. Arlene's previous work with non-repetitive patterns has had a major influence on the look of the patterns that are being produced. Tobias' experience from non-photorealistic rendering in terms of creating imagery inspired by artwork has helped

to inform the realization of the interface and how to enable users of the program to explore the parameter space. Arlene, together with other artists, made sure that the interface we presented was also understandable to people who are not necessarily familiar initially with the pattern computation process. As such, the aesthetics of the piece were influenced by both of us as we had our dialogue throughout the entire work. We also feel that we have achieved a result that is more successful and is aesthetically better than if the work had been strictly artist-driven or strictly scientist-driven.

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