American Dream Cycle (Payload)

Robert Spahr, M.F.A
Department of Cinema & Photography, Southern Illinois University, Carbondale, Illinois, U.S.A
www.robertspahr.com
e-mail: rspahr@siu.edu

1. Abstract

A live art performance will be presented by running computer code which will download in real time source images and text from the Internet. This code will then use the source material to generate the performance score, and to process new images based on genetic algorithms.

The work will explore the inconsistencies and cognitive dissonance of the information presented to the American people by the mainstream media on the Internet. The computer code will generate the real-time digital image juxtapositions and transformations of the downloaded source material. The performance creates a residue of digital art which will be archived to the web in real time.

My creative research of the past six years has focused on the development of automated computer code that creates art from source material downloaded from the Internet. I have recently begun research and development of art created by genetic algorithms inspired by Darwinian biological models. The process is analogous to natural selection, mutation and reproduction, with the basic idea of creating a population of candidate images that evolve under a selective pressure favoring the better solutions. Parent images are combined to produce offspring images, which then enter the population, are evaluated and may themselves produce offspring. As the process continues more successful solutions are found, ultimately producing a final work of art. Genetic algorithms search vast data structures for optimized aesthetic solutions. Much like a beautiful universe with no maker, I am investigating design solutions that are not created, but instead discovered.

2. Computational Art: Explorations in Genetic Algorithms

Genetic algorithms embody a simple but profound idea, that through simple change, great complexity can develop. And through natural selection optimized solutions will survive and are then more likely to reproduce. Evolution does not develop with a goal in mind, but instead through generations certain traits are passed from parents to offspring, and along with mutation, random change is introduced. Artists have traditionally produced art and design for a specific goal. To create evolutionary art using genetic algorithms turns traditional artisitc creation upside down. Using a genetic algorithm all possible solutions exist in a conceptual matrix of potential combinations. To navigate that conceptual space is basically a search through data.

To develop the rules of fitness and determine which offspring is healthy and survives is an exercise in aethetics. To create art and design using a Darwinian biological model is a revolutionary act. It calls into question our cultural biases and assumptions about creativity, genius, authorship, and originality.

2.1 Objectives

Building upon my current work writing computer code that creates art [1], I have begun investigating the potential of genetic algorithms and their search through design solutions. The logic of genetic algorithms can be described in pseudo code that looks something like this:

EV-OPT:

Generate an initial population of M individuals.

Do until a stopping criterion is met:

Select a member of the current population to be a parent.

Use the selected parent to produce an offspring which is similar to but generally not a precise copy of the parent.

Select a member of the population to die.

End Do

Return the individual with the highest global objective fitness. [2]

The aesthetic challenge for me as an artist using genetic algorithms ha been developing the fitness function, which in biology might be health, as well as a slight survival advantage due to the introduction of a mutation. Evolution is basically an endless repetition of reproduction, with each generation containing minor errors or change through mutation. The mutation can be the slight random change of a gene value. Although the mutation is random, the change over generations is not random, but based on the fitness function. How does one make a computer evaluate the fitness of an image? How do images reproduce? When does the genetic algorithm stop if evolution has no design goal? These were some of the questions I explored when I developed the code for this project, as I looked for an appropriate answer for me as an artist.

The exciting potential of genetic algorithms has been my ability to tweak fitness and mutation criteria, and run the program, with an image result that searches a vast possibility of outcomes, for that one relevant result that matches my criteria. Another objective of this work, has been to investigate what it means to create images and be a designer in a world created without a maker. The following two quotations from *The Blind Watchmaker : Why the Evidence of Evolution Reveals a Universe Without Design,* by author Richard Dawkins raises some of the aesthetic issues I am investigating.

> Natural selection is the blind watchmaker, blind because it does not see ahead, does not plan consequences, has no purpose in view. Yet the living

> results of natural selection overwhelmingly impress us with the appearance of design as if by a master watchmaker, impress us with the illusion of design and planning. [3]
>
> Evolution has no long-term goal. There is no long-distance target, no final perfection to serve as a criterion for selection, although human vanity cherishes the absurd notion that our species is the final goal of evolution. [4]

In a country where the majority of the population reject evolution [5], I want to investigate good design without the illusion of a long-term goal. To not create design, but to search for it.

2.2 Background and context

I completed my graduate studies in New York City, at Parson's School of Design, in 1991. After which I began my creative career making process oriented sculptures, which later developed into performance art, and experimental theater. Simultaneously I began my technical education during the Dot Com era, working as a web designer and producer at various start-up companies. Beginning in 2003, after having used the GNU/Linux Operating System [6] since 1998, I had developed enough programming skills to begin writing computer code that created art. Borrowing the computer hacker term "Cruft" I applied it to my current series of images. I create these CRUFT images by writing 'recipes' (also known as an algorithm). An automated system follows the instructions, first harvesting selected source material from the Internet, and then processing that information into a CRUFT, generating images 24 hours a day, 7 days a week.

I have now begun researching the potential of genetic algorithms as a method to process images and create the score to a performance. Computational art, and specifically genetic algorithms are a fertile area for exploration. There are primarily two methods for creating a fitness function, the first being an interactive mode [7], where a person selects from the offspring, images that are deemed aesthetically pleasing. This creates a 'fitness function bottleneck' slowing down the creation of generations of offspring, as well as introducing different individuals bias. The alternative that I am exploring is an automated fitness function that is an age-based replacement, and/or rank-based selection [8], that is completely dependent on computer instructions, avoiding the need of an individual to be involved in the evolutionary process once the script has begun. I find it fascinating to imagine a design space, where all potential solutions exist. Richard Dawkins explains this in *The Blind Watchmaker : Why the Evidence of Evolution Reveals a Universe Without Design,* as he describes an evolutionary computer program he created that makes small biomorphic creature like designs.

> There is a definite set of biomorphs, each permanently sitting in its own unique place in a mathematical space. It is permanently sitting there in the sense that, if only you knew its genetic formula, you could instantly find it; moreover, its neighbors in this special kind of space are the biomorphs that differ from it by only one gene. Now that I know the genetic formula of

> my insects, I can reproduce them at will, and I can tell the computer to 'evolve' towards them from any arbitrary starting point. When you first evolve a new creature by artificial selection in the computer model, it feels like a creative process. So it is, indeed. But what you are really doing is *finding* the creature, for it is , in a mathematical sense, already sitting in its open place in the genetic space of Biomorph Land. The reason it is a truly creative process is that finding any particular creature is extremely difficult, simply and purely because Biomorph Land is very very large, and the total number of creatures sitting there is all but infinite. It isn't feasible just to search aimlessly and at random. You have to adopt some more efficient – creative – searching procedure. [9]

My interest in genetic algorithms is in the conceptual basis of the search for a design solution, not in the computer science. I want to efficiently search the data structure of possible solutions, and find the appropriate design solution for that which I wish to express.

2.3 Methods/procedures/materials

I have written a framework of reusable modular code, that can be combined in various ways to then create many different algorithms. I have begun developing the algorithms by gluing together smaller scripts that perform simple tasks, such as one chunk of code that downloads a population of images from a selected source on the Internet, another bit of code will test the images for fitness, or divide the image population into two groups and select two images to reproduce and introduce mutation, and finally a script tests the fitness of the offspring. For the past six years I have been writing computer code to create art from source images downloaded from the Internet. Even though I am using computer code, the process is rather traditional, in the sense that I capture source material, and a new image is created based on the rules I have created in the code. The images and text are downloaded and transformed using shell script, perl, and imagemagick. The computer automates the process, and allows me to make thousands of images, doing so every hour of every day for years on end, but the aesthetics are the same as if I was creating the work manually in an image editor.

With code written using genetic algorithms, I am able to produce images created in an untraditional way, that challenge our assumptions about art. My goal is to create a process that is independent of the artist. I set the process in motion, and sit back and allow it to unfold and generate unimagined design solutions.

The computer code I have written creates the score and associated images in a piece I call 'American Dream Cycle (Payload).' For this piece, I am downloading daily program quotes from talk radio host, Rush Limbaugh [10], and these quotes become the textual source for the performance and images. I sort the downloaded text, removing duplicates and words common to the english language. Each remaining word is then passed to a web search engine. The image search results are then downloaded and used as the initial population of my genetic algorithm. One of the fitness functions I am using in this piece, is done by calculating the number of colors in an image, and those images with less color, are considered more fit, and

more likely to survive and produce offspring, compared to images with many colors. Reproduction is reduced to the creation of a composite image from two parents. It is similar to, but not identical to the parents. I also introduce mutation, by randomly altering contrast, which also manipulates the number of colors in the image. I then continue to parse the source text, and add selected words to the composite offspring images. This text becomes part of the residue artwork produced by this code which will be archived in real time to my website, as well as being the spoken word of the actual performance piece.

Fig. 1 Image detail of American Dream Cycle (Payload)

2.4 Conclusion

My exploration into genetic algorithms have only just begun, and the performance and residual artwork of 'American Dream Cycle (Payload)' is proof of it's potential for my own creative research. Figure 1 is an example of the composite images and text produced by my genetic algorithms in 'American Dream Cycle (Payload).' The implications of discovering design solutions, by manipulating simple fitness functions has great potential for me as an artist. I have created modular code that can now be tweaked to create very different design solutions. The creative act has been reduced to fitness functions and manipulating mutation, to then search an endless number of design possibilities, finding the one solution that matches the criteria for that which I wish to express.

3. References

1. http://www.robertspahr.com/work/

2. De Jong, Kenneth. 2006. *Evolutionary computation : a unified approach*. Cambridge Mass.: MIT Press. p. 19.
3. Dawkins, Richard. 1996. *The Blind Watchmaker : Why the Evidence of Evolution Reveals a Universe Without Design*. New York: Norton. p. 29.
4. Ibid., p 72
5. http://www.cbsnews.com/stories/2005/10/22/opinion/polls/main965223.shtml

6. http://www.gnu.org/

7. Romero, Juan. 2008. *The art of artificial evolution : a handbook on evolutionary art and music*. Berlin ;;New York: Springer. p. 55-56.

8. Eiben, Agoston. 2003. *Introduction to Evolutionary Computing*. New York: Springer.
p.65-66

9. Dawkins, Richard. 1996. *The Blind Watchmaker : Why the Evidence of Evolution Reveals a Universe Without Design*. New York: Norton. p. 93.

10. http://www.rushlimbaugh.com/

3.1 Additional References

Goldberg, David. 1989. *Genetic Algorithms in Search, Optimization, and Machine Learning*. Reading Mass.: Addison-Wesley Pub. Co.
Wolfram, Stephen. 2002. *A New Kind of Science*. Champaign IL: Wolfram Media.
Poli, Riccardo. 2008. *A field guide to genetic programming*. [S.l.]: lulu.com.
Miranda, Eduardo. 2007. *Evolutionary computer music*. London: Springer.