

**Applying Mathematical Algorithms in Image generation with an independent data set**

**Eliminating the copyright issue with Art generated from Artificial Intelligence by generating images strictly from one's own dataset**

A Thesis Prospectus  
In STS 4500  
Presented to  
The Faculty of the  
School of Engineering and Applied Science  
University of Virginia  
In Partial Fulfillment of the Requirements for the Degree  
Bachelor of Science in Computer Science

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November 5, 2023

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## Introduction

In animation and art, the process typically involves an analog approach of either using handdrawn assets or renderings from computer software to simulate or personify objects into moving works of media. However, the process is often laborious as it requires painstakingly animating each pixel or polygon to fit the mold of the director or artist's requirements. For this reason, there have been numerous advances in computer science and image creation software to streamline the process by assigning some of the more laborious tasks of art to computers- whether it be saving scenes for multiple frames in animation or allowing artists to use premade visual effects for prefabs. All of this work requires the use of complicated algorithms within a black box schematic, where the artists need not to know the technical details to do what they need to do for their visionary process. And while years of experience is expected to work in big companies such as Disney, the experience is focused strictly on one's artistic ability rather than one's technical ability. It is expected, however, that since many artists in the industry have taken at least a few introductory mathematics courses during their time in school, there exists potential for these creators to tap into a previously unforeseen part of their education to speed up the process of creating art. Algebra and calculus- though to many the bane of their primary and secondary education- are essential to creating the algorithms that allow us to see realistically-rendered oceans in *Interstellar*, among several hundreds of other groundbreaking rendition techniques in both film and the art industry.

We can see the effects of technological revolution in AI-generated art, where machine learning algorithms and neural networks are sophisticated enough to generate

art in a matter of seconds in multiple different formats. However, with this new advance in technology also comes moral questions that have previously not been brought up in the artistic integrity dilemma. According to the Aelaschool [1] and Danny Maiorca of Makeuseof.com [2], two important considerations when making AI art are the preservation of copyright - since AI models require the image inputs of artists to feed it data to create art on its own- and the elimination of individual expression from the advent of mass-production of art, where producing multiple clones of one artists's works devalue its creative value. Both of these questions lead many to question whether the use of AI promotes ethical or even creative behaviors, since the autonimizatin of something inheritely human will restrict the extent to which artists are allowed to call themselves as such due to the limitations of their boundaries. For these reasons, I will be making an AI model that generates images as it's being drawn by using mathematics and analog art. This project addresses two problems: for the technical side, this project will address the extent to which mathematics affects the development of images, and how and in which situations the two fields can meet together in creating distinct works of art, and for the societal side, it offers an alternative to AI generation by having the artist be in charge of both the technical and artistic sides of the creative process, not having to rely on the use of external software to make art on itself.

### **Image Generation Using Mathematical Principles**

Mathematics exists inside of everything that we can see, from biology in frogs to physics in buildings. Especially in art, the relationships inside of the different moments inside of a painting demonstrate the utilization of patterns. Perspective, shading, and anatomic studies all utilize properties of optics, symmetry and ratios to create something

that is tangible to the human eye. For this project, we will be creating a pseudo-AI implemented drawing software that creates basic visual effects as the user is drawing. Say, for example, a straight line is drawn from the bottom of the screen to the middle. The AI will be able to- given the trajectory of the stroke and the user-inputted specifications of width and color- generate curved lines that fork from the user-created brushstroke that mirror the line on the left and right sides. The scope of the project is a limited due to the timeframe consisting of a little over one college semester, so the software will take large inspiration from a pre-existing open-source drawing software and incorporate AI features alongside it. The drawing software will serve as a predictive software, since the goal will be to speed up production time by drawing alongside the original artists by adding visual effects the artist/user envisioned as the final product. Therefore, color features, brushstroke patterns, and several shapes will be a part of the project to give the user a basic degree of autonomy.

To incorporate the features, the AI will be coded with a few mathematical predictive algorithms. Going back to the brushstroke, the AI will be able to- in real time- take parametric notes of the cursor's position and create its own brushstrokes that mirror the pen stroke  $x$  or  $y$  units away from the point of origin. From there, a color gradient will change the tint of the mirrored strokes depending on the duration of the brushstroke. From this project, there exists a degree of freedom in how the author can customize the stylistic elements of their own artstyle, leading to many possibilities in how they envision their art being manufactured after laying down the foundational groundwork of their art. Though the algorithm is simple, it will serve as a rudimentary prototype for the idea that mathematics and art can be directly interacted with both on

their own and with each other. Overall, this is designed like a typical art creation software, with additional features to create additional visual flair as an add-on to bridge the gap between the artistic space and the mathematical space.

### **Is there a way to incorporate the use of technology in art without taking away from its artistic merit?**

AI art has been the point of contention amongst computer scientists and artists since its inception. The main points of contention is that AI art promotes plagiarism by using artists' works as training data without their consent, leading to AI-generated publications to take on the impression that it was created by another party. Alternatively, said process takes away from the genuine nature of the artist by falsely advertising the artwork as the artist's own despite never contributing to it, leading to possibilities of defamation and the detraction of the artist's creative value. To paraphrase LMU magazine, the important aspect of AI is not to eliminate the use of AI, but to eliminate its possibility at destroying the credibility of others [3]. However, this issue is not necessarily one-sided. Proponents of AI art argue that the field allows artists to tap into an infinite well of creativity and opportunity, where artists with physical disabilities are able to create works of art and new styles, mediums or ideas can be generated from a pre-existing set of data. While many people see this field as a source of discovery, others see it as restrictive and restraining the creative liberty and expression of the field.

The research question of, "Is there a way to incorporate the use of technology in art without taking away from its artistic merit?" encompasses a few components: the act of preserving artistic merit and the preservation of technology. For the former, it is important to consider the impact of technology on preserving the freedom of creation as

it pertains to the roles and restrictions imposed on one party- be it directly or indirectly as a result of the act of using this technology in potentially mass quantities. For the latter, it is important to research this dynamic as permitting or restricting the usage of this technology could lead into the developments of AI to be put into question. In addition, it could prompt discussions as to allow AI inside of the creative arts as a whole, as privacy restrictions and claims of unethical usage of data could inhibit the development of the work of software developers and AI engineers. To research this, several different perspectives will be enquired, some from professional artists and others from AI engineers, along with roles from third-party spectators such as those in the machine learning or music industries whose involvement with AI- though not direct- have been put into question from their profession. Upon gathering the perspectives from each party about the issue, their replies will be gathered to form a comprehensive analysis on the issue, where a final stance can hopefully be constructed given. All of the evidence will be interpreted as separate perspectives and components in the larger picture of the STS problem, most of which will consist of either academic journals or public website journals from professionals or freelancers in the field.

## **Conclusion**

In conclusion, this research project tackles the issue of data copyright by creating art from itself instead of the work of others. The impacts it would bear on society would consist of promoting ethical use of AI in art, where mathematics and science would be used to promote one's individual expression rather than the expression of an unwilling party. By the end, the expected results would consist of a thorough deconstruction of

how each party would benefit or be hurt by the advancements of each field, and how the relationships between each other inhibit or further each other's growth. The results would also demonstrate the extent to which one is able to manipulate not the sovereignty of other people's creations, but rather their own understanding of the laws of the world to create something both of their own machination and from their own creative mechanisms.

## References:

- [1] Aela, E. (2023, April 1). *Artificial Intelligence: How AI is Changing Art*. Aelaschool.com. <https://aelaschool.com/en/art/artificial-intelligence-art-changes/>
- [2] Maiorca, D. (2023, September 11). *How Will AI Art Impact Creativity?* MUO. <https://www.makeuseof.com/how-ai-art-impact-creativity/>
- [3] Wakelee-Lynch, J. (2023, April 26). *AI's Impact on Artists*. LMU Magazine. <https://magazine.lmu.edu/articles/mimic-master/>
- [4] Wall, S. (2023, March 14). *What is AI art and how will it impact artists?* Www.cgspectrum.com. <https://www.cgspectrum.com/blog/what-is-ai-art-how-will-it-impact-artists>
- [5] Winn, Z. (2023, June 15). *If art is how we express our humanity, where does AI fit in?* MIT News | Massachusetts Institute of Technology. <https://news.mit.edu/2023/generative-ai-art-expression-0615>
- [6] published, J. F. (2023, October 2). *New AI tool could be a game-changer for 3D animation*. Creative Bloq. <https://www.creativebloq.com/news/anything-world-animate-anything-ai>
- [7] Tinoco, A. (2023, September 11). *Tim Burton Calls AI Replicating His Animation Style "Disturbing": "It's Like A Robot Taking Your Humanity."* Deadline. <https://deadline.com/2023/09/tim-burton-ai-replicating-animation-style-disturbing-1235543730/>
- [8] *AI music sending traditional industry into "panic," says new AI music platform CEO*. (2023, September 15). Cointelegraph. <https://cointelegraph.com/news/ai-music-sending-traditional-industry-into-panic-ai-music-platform-ceo>



- [9] Brittain, B., & Brittain, B. (2023, October 30). Judge pares down artists' AI copyright lawsuit against Midjourney, Stability AI. *Reuters*.  
<https://www.reuters.com/legal/litigation/judge-pares-down-artists-ai-copyright-lawsuit-against-midjourney-stability-ai-2023-10-30/>
- [10] *What the latest US court ruling means for AI-generated art's copyright status*. (2023, September 1). The Art Newspaper - International Art News and Events. <https://www.theartnewspaper.com/2023/09/02/artificial-intelligence-lawsuit-decision-us-copyright-law>