

Integrating Drawing Tools with Behavioral Modeling in Digital Painting

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ABSTRACT

Our goal is to integrate traditional artistic media that demand hand dexterity (such as drawing) with intelligent systems techniques that may both constrain and nourish this dexterity. To this end we are experimenting with special brush tools that on top of traditional drawing provide possibilities that involve information processing and behavioral modeling. In this work, we are introducing a behavioral model as a color processing feature of our brush. More precisely, we use a regulation mechanism, that has been shown elsewhere to solve a typical problem in artificial ant societies, to distribute color on the drawing canvas. Our drawing tool, called “AntBrush”, manages to create controlled color variety during drawing by regulating its own quantity of color through picking and depositing color on the canvas. Different color effects are possible by controlling the brush’s parameters on line.

Keywords

Digital painting, behavioral modeling, color cooking, ant algorithms.

1. INTRODUCTION : THE OBJECTIVES

Usual computer painting tools define sets of customizable pens/brushes that the user may employ to draw or paint on an area. Such pens/brushes include simulated ink pens, pencils, chalks, watercolours, oil pastels, etc. Most of these tools also provide advanced image processing possibilities, such as special effects, image filtering, texture control, lighting techniques etc. As a result, these tools are addressed to a more graphic design oriented audience that does not necessarily master usual non-digital drawing or painting techniques, but may combine the provided possibilities to achieve highly rich and complex images. On the contrary, users with fine arts background and training may

encounter some difficulties with the highly technical aspect of brush customization. For example, such a difficulty arises whenever an artist has to define a color in terms of its three components (red, green, blue, or hue, saturation, brightness). While this is unnatural more generally, this procedure is even more painstaking for a trained painter, because he is used to incrementally and interactively blending existing colors on its palette in order to create new ones, rather than exactly specifying the ingredients of the desired color. Our goal is to devise and develop digital painting techniques and/or tools, which exploit and enhance natural painting and drawing dexterity.

One such feature that we are currently studying is the introduction of some behavioral autonomy to the drawing/painting tool. Our approach thus regards a brush/pen as a drawing tool possessing a limited degree of autonomy, so that it does not exactly follow the motion of the artist’s hand (i.e., the artist’s “command”), but rather it improvises a little either the path followed or the color used or both.

A preliminary attempt has been presented [3], where a special information processing brush has been implemented to allow freer work with colors during digital painting. In the present work, we are introducing a behavioral model as a color processing feature of our brush. More precisely, we use a regulation mechanism, that has been shown elsewhere to solve a typical problem in artificial ant societies [1] to distribute color on the drawing canvas. The same mechanism has been used to create color images in a semi-autonomous distributed way by a population of artificial painter ants working on the canvas [2]. Our drawing tool, called “AntBrush”, manages to create controlled color variety during drawing by regulating its own quantity of color through picking and depositing color on the canvas. Different color effects are possible by controlling the brush’s parameters on line (fading, degradation etc.).

2. ON COLOR PROCESSING

Trained painters are accustomed to incrementally and interactively blending colors on their palette in order to create a color set that they will later use with their brushes. Once the palette is ready, painters use the created colors and may obtain large numbers of color variations or achieve controlled tonal gradation effects in a natural way by just painting. This is because in most natural media colors on the brush/pen generally blend with colors on the canvas underneath the tool.

The first implementation of this idea is the information processing brush presented in [3] that reproduces in the digital medium an ancient tone sweetening technique. This brush blends the color of the first position touched on the canvas with the colors of the subsequent positions visited, and this in a way that implements fading. It therefore allows natural elaboration and blending of adjacent color tones and may under certain circumstances liberate color expression.

Our demo painting system also includes a digital color palette that allows the artist to define, pick or blend his/her own set of colors, as well as experimenting with colors and brushes on the palette, rather than on the canvas. This way, and beside color storage, the palette serves the role of experimental canvas and, to better facilitate this, it offers possibilities such as automatic color variants generation. All the above possibilities, as well as the ant brush presented in this paper, are integrated with a usual set of natural brushes (of ink, oil or pastel type), thus allowing freer expression and experimentation.

3. FROM PROCESSING TO MODELING

The next step to color processing is to allow the brush to “decide” on a color online by interacting with the canvas. A set of brush parameters controlled by the artist will define its “decision rule”, or else its behavioral model. This way, when the brush touches the canvas, it will not simply lay down a predefined color, but rather it may use an arbitrarily complex model to decide on a color. It will do this in relation with the actual color already on the canvas, as well as its, equally arbitrarily defined, internal memory.

In a subsequent version of our painting system, we plan to follow an analogous approach for the path followed by the brush tool. The artist’s hand motion command will constrain rather than define the actual path followed by the brush on the canvas, so that the artist may think of the brush as a “dog following his/her hand, but improvising around its master’s steps”. A combination of such a behavioral model with a color processing model is expected to yield spectacular effects.

In the long term, such semi-autonomous drawing tools may provide the basis on which true intelligent digital painting tools may be built, to be used either for artistic creation or for educational or other applied purposes. For example, an intelligent brush might provide automatic correction in an educational system used by drawing students.

4. THE ANT BRUSH

The ant brush model is inspired from the model of an ant that gathers food samples and brings them back to a home base. Since there are generally many fairly big food sources in the ants’ environment, the solution to the problem of food gathering is to allow the ants to deposit and pick up chunks of another substance (“crumbs”). Crumbs therefore serve as a communication means between agents and resemble the pheromones used by real ants. In [1] we studied previous models of the problem and analyzed a solution that bypasses the problems presented by previous models, by using a mechanism of internal crumb regulation. This model has been transcribed to a brush ant model by replacing the variable “crumbs” with a variable “color”. The same mechanism has been used to create color images in a semi-autonomous

distributed way by a population of artificial painter ants working on the canvas [2].

There are three modes of the color processing model of the ant brush.

1. Unconstrained mode

<i>Action</i>	<i>Implementation</i>
Deposit color	Add to the color of the current canvas position a fixed quantity of color, up to saturation of one or more color components (R,G,B)
Pickup color	Subtract from the color of the current canvas position a fixed quantity of color, up to exhaustion of one or more color components (R,G,B)

2. Linear (bounded) mode

<i>Action</i>	<i>Implementation</i>
Deposit color	Add to the color of the current canvas position a fixed quantity of color, up to saturation of one or more color components (R,G,B) or up to exhaustion of one or more components of the brush color
Pickup color	Subtract from the color of the current canvas position a fixed quantity of color, up to exhaustion of one or more color components (R,G,B or up to saturation of one or more components of the brush color

3. Proportional (self-regulated) mode

<i>Action</i>	<i>Implementation</i>
Deposit color	Add to the color of the current canvas position a fixed proportion of the brush color, up to saturation of one or more color components (R,G,B) or up to exhaustion of one or more components of the brush color
Pickup color	Subtract from the color of the current canvas position a fixed proportion of the brush color, up to exhaustion of one or more color components (R,G,B or up to saturation of one or more components of the brush color

The logic of the brush behavior is one of the following :

1. Fixed behavior color Always pickup or always deposit color

2. Alternate behavior on start Alternate between always pickup and always deposit behavior every time the brush restarts drawing on the canvas. This behavior draws a stroke by picking color, the next stroke by depositing color and so on.
3. Alternate always Alternate between pickup and deposit behavior continuously while drawing on subsequent positions.
4. Automatic behavior Pickup or deposit color depending on the relation between the brush color and the canvas color. More precisely try to equalize the two by picking color when the canvas is more saturated than the brush or depositing color in the opposite case.
5. Targeted behavior Pickup or deposit color depending on the relation between the canvas color and a target color.

More precisely try to bring the canvas color close to the target color by picking color when the canvas is more saturated than the target or depositing color in the opposite case.

Furthermore, color processing may be of one of the following types :

1. RGB Pickup or deposit all three color components
2. R only Pickup or deposit only red color
3. G only Pickup or deposit only green color
4. B only Pickup or deposit only blue color

Lastly, the brush may be of arbitrary shape. The user may edit the shape with the aid of a mask (see Figure 1).

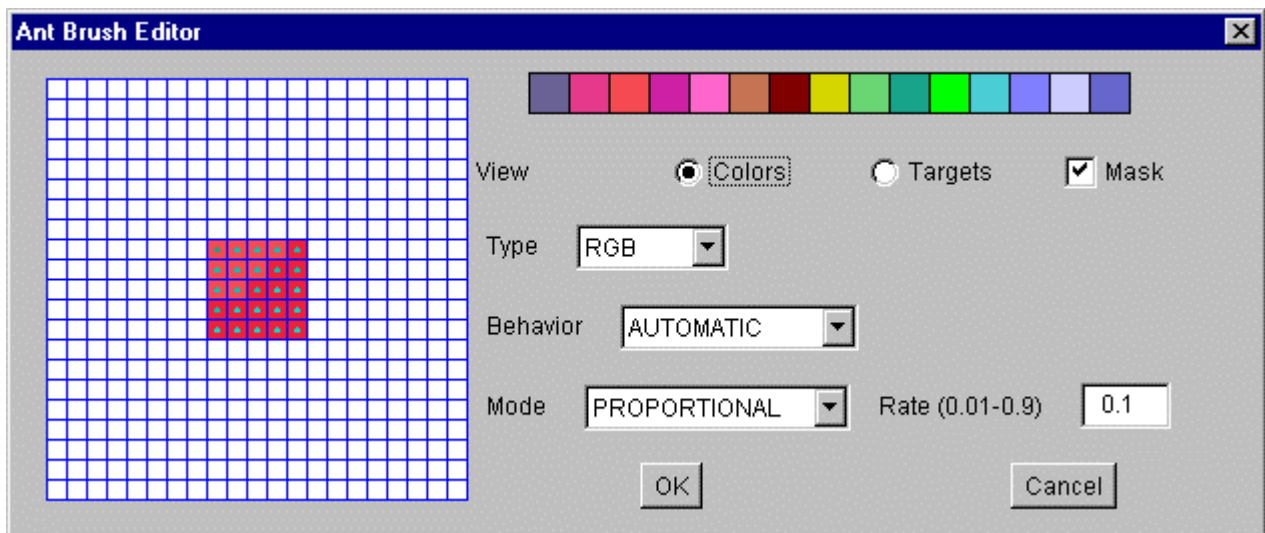


Figure 1. The editor of the ant brush (the color palette is visualized on the top right).

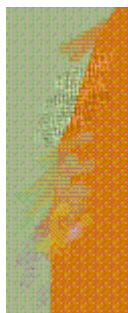


Figure 2. Effects obtained with the Ant Brush.

Operationally, the color processing mode allows for color superposition, steadily changing strokes, or smoothly changing strokes (unconstrained, linear or proportional mode, respectively). The behavioral logic enables a number of effects, such as fishbone strokes (“Alternate Always” behavior), smooth color distribution over an area (“Automatic” behavior) and smooth color blending with a different tone (“Targeted” behavior) (see Figure 2). Furthermore, the initial brush color may be either defined by the artist (for example, selected from the palette) or picked online on

the canvas the first time the brush touches it. In this way, repeated application of the automatic and targeted behaviors may yield effects such as sweetening of adjacent color tones.

Overall, the artist has less control than with usual brushes, but he/she usually can learn quickly to exploit the effects obtained with the different variants and parameter settings of the brush. For example, with some of the variants it is fairly easy to create foggy images, that would otherwise involve painstaking, meticulous work with usual brushes.

5. DISCUSSION

A study of the ant brush in action has revealed two issues that deserve to be pointed out.

First, effects such as the fishbone stroke, obtained with the “Alternate Always” behavior, create the impression of a texture although there is no such thing in our painting system. Beside the area of research that opens up in studying how texture-like effects and patterns might emerge from a behavioral model, this is an observation that might liberate the notion of texture as a tool. In

natural media, the texture preexists on the paper, canvas or other surface chosen and the artist tries to exploit or tame its properties. Usual texture definition in commercial painting software tools tries to reproduce such phenomena as much as possible. However, if texture is allowed to emerge as a side effect from the interaction of the tool with the canvas, then the artist might create images that appear to have more than one textures, overlapping, superposed or blended textures, or even non uniform and non canonical textures. The gain is expected to be even bigger, if we recall that this is all achieved by just drawing.

Secondly, the ant brush and behavioral brushes in general, have memory. This is a strong point, because, unlike traditional media, it might allow the whole history of the creation of a piece to influence its future evolution. A medium term objective of our work is to identify technical aspects of the painting process that may be directly or indirectly recorded in memory and exploited by a behavioral brush. For example, a brush constraining the quantity of a color that may be used on a painting could be exploited in an educational setting to force students to create minimal drawings.

These issues will constitute the subject of further study on behavioral painting. Other issues under current investigation include : additional behavioral models that may be used as brush models, the relation between behavioral model and corresponding

psychological effect for the artist or for the spectator (for example, models creating great color variation are less controllable and thus hostile for the artist, while they are generally more impressive for a spectator).

6. ACKNOWLEDGMENTS

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7. REFERENCES

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