

Creating Abstract Digital Paintings with Painting Camera Technique

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Abstract

We present a simple and intuitive rendering technique to create abstract paintings. This technique allows the users to render a given animated scene with multiple cameras, using a method inspired by concepts used by cubist and futurist abstract painters. In our method, the number of cameras is unlimited and the camera parameters are continuous functions. We define the camera parameters as parametric functions that are described by images, which we call camera-control-images. The spatial distribution color in these camera-control-images determines the camera parameters such as position and orientation.

For the creation of abstract paintings, we have developed two artistic techniques. In the first technique, artists incrementally paint a complicated camera-control-image for a given 3D scene. The second technique is the opposite of the first. In this technique, for a given camera-control-image artists incrementally built a 3D scene to create an interesting abstract painting. The second technique is helpful when using existing images such as photographs and paintings.

1 Motivation

The 20th century has seen a large number of abstract art movements such as Cubism, Futurism, Surrealism, Dadaism, Cercle et Carré and Abstraction-Création, Suprematism and artists such as Picasso, Braque, Leger, De launey, Duchamp, Dali, Max Ernst, Kupka, Klee, Kandisky, Mondrian, Malevich, Marinetti, Boccioni, Russolo, Marey, Balla, Severini and Carra. The most important common theme among these art movements is that they view painting in a way similar to music: an abstract entity to be enjoyed by using one of our senses.

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In computer graphics, although there has been an increasing interest in artistic (or non-photorealistic) approaches, only a few abstract rendering approaches, such as Karl Simms' "Artificial Evaluation", have been developed to create abstract paintings.

We present a simple and intuitive abstract rendering approach for creating abstract paintings. Figure 1 shows an abstract painting created using our approach. Our abstract

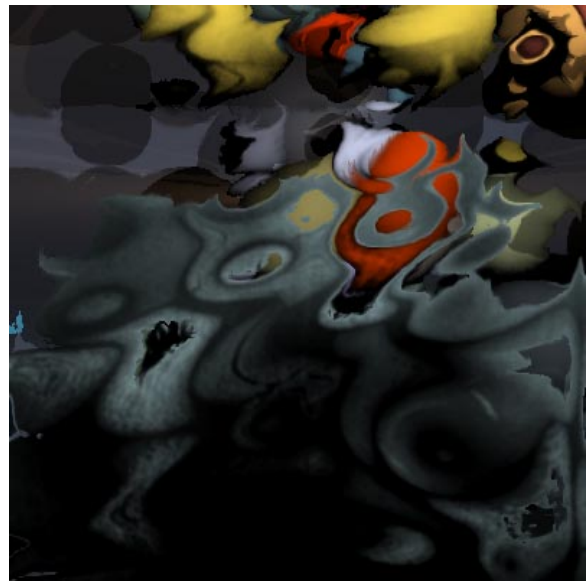


Figure 1. An abstract image created by painting camera technique.

rendering approach is inspired by the abstract art movements we mentioned above. We observed that several of these movements especially cubism and futurism can be best grasped by viewing abstract painters as high dimensional beings. These high dimensional painters can simultaneously view any animated 3D scene from every possible time, from all points of view, using any conceivable camera

type. Since these abstract painters have this supernatural ability, they can choose to paint at each point of the canvas what they see from any specific choice of time, point of view and camera. It is possible to represent this painting process as a parametric function from the canvas space to the space of camera parameters including position and time. We call this parametric function the *camera function*.

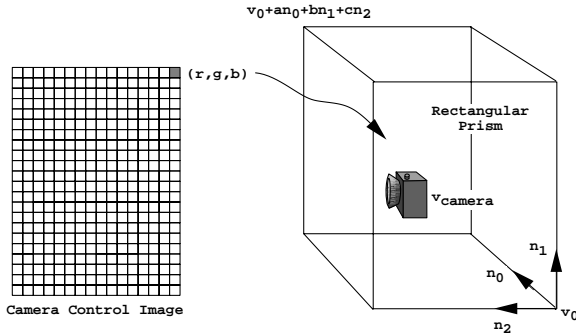


Figure 2. Rectangular prism that defines the camera position in 3D.

2 Previous Work

Artistic rendering, or as it is commonly known as non-photorealistic rendering, has been becoming an increasingly important subfield of computer graphics. Most non-photorealistic rendering approaches try to formalize the effects of material such as pen and ink drawing [13, 11], watercolor [1], and digital engraving [8, 9, 10] or mimicking artistic effects such as impressionist [3, 7], fur, grass and trees [4].

Approaches to doing purely abstract painting have not been fully explored with only a few exceptions such as Karl Simms’ pioneering work on artificially evaluated images [12].

Our work can be classified between these two approaches. Our concept is based on the cubist paradigm of rendering scenes by using more than one distinct camera. Our approach differentiates from the cubist approach in that 1) we can use an unlimited number of cameras, and 2) the parameters of our cameras can be continuous.

3 Methodology

In order to implement such an abstract rendering approach in a simple and intuitive way, we describe camera functions by using sets of images, since painters are comfortable in dealing with images. These images are used as a control net for tensor product B-splines. We call the images

that are used for representing camera functions *camera-control-images*. In a camera-control-image, the values of red, green, and blue color channels provide information about camera parameters.

The number of camera-control-images to be used depends on the number of camera parameters. To simplify the painting camera process we have considered only the position of the camera. Based on this choice, we only need one camera-control-image to describe camera parameters (the position of a camera requires only 3 real numbers) as shown in Figure 2.

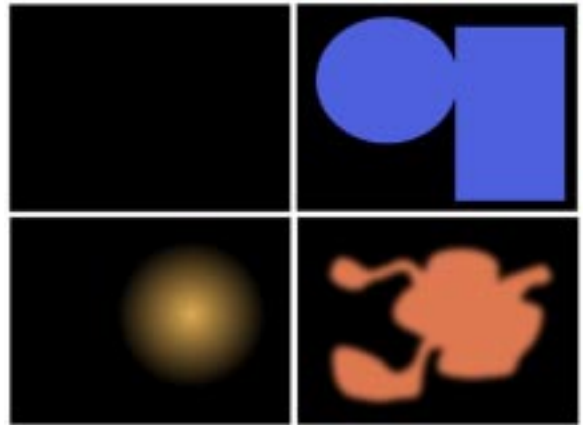


Figure 3. Examples of camera-control-images.

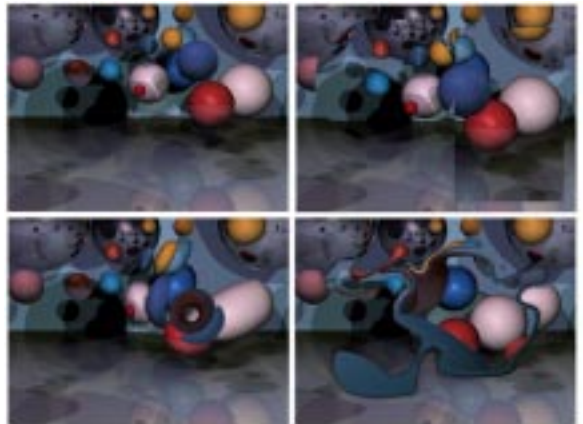


Figure 4. Abstract paintings created by using camera-control-images in Figures 3.

To render the abstract images, we use a simple ray-tracer. Again for the purpose of simplicity, the 3D scenes used in this paper include only texture mapped spheres and planes.

Figures 3 and 4 illustrate some effects that can be achieved by camera painting. The top-left black image in Figure 3 describes a constant camera position at v_0 . There-

fore, the corresponding top-left image in Figure 4 is a classical ray-traced image. The top-right image in Figure 3 shows how to add a new camera position by painting a solid blue color. Since blue moves the camera in the n_2 direction, the new camera is at the position of $v_0 + cn_2$. The effect can be clearly seen in the top-right image of Figure 4. Warping effects can be created by using a ramp map such as the one that is shown in the bottom-left image of Figure 3. This circular ramp image warps the objects around the center creating toroidal looking shapes as shown in the bottom-left image of Figure 4. The bottom-right image of Figure 3 shows the effect of low-pass filtering. A low-pass filter, by smoothing the edges, creates a boundary region that transitions from one camera position to the other. This smooth transition creates the interesting painted look shown in the bottom-right image of Figure 4.

For the creation of abstract paintings, we have developed two artistic techniques. In the first technique, artists incrementally paint a complicated camera-control-image for a given 3D scene. We used a paint program to create a series of images that document the steps involved in creating a set of abstract paintings for a given 3D scene. Each of these steps was run through the renderer in order to make decisions on how the painting should progress. The Figures 5, 6, 7 and 8 show two abstract paintings created by this method. We used the same 3D scene to create these images.

The second technique is the opposite of the first. In this technique, for a given camera-control-image we incrementally built a 3D scene to create an interesting abstract painting. The second technique is helpful when using existing images such as photographs and paintings. Existing images such as photographs and paintings that have a lot of texture and detail are especially useful for creating interesting abstract paintings. For such photographs, instead of changing the camera-control-image, it is better to change 3D scene. In order to control the resulting abstract image for a given photograph, we start with a simple 3D scene and update the scene until achieving a satisfactory result. The Figures 9, 10, 11 and 12 show abstract paintings created by this method by using different 3D scenes for the same camera-control-image.

4 Conclusion

We presented a simple and intuitive abstract rendering approach to create abstract paintings. This approach allows painters to create abstract paintings by using a set of images. Implementation of the camera painting is also simple. Any ray-tracer can easily be expanded to include the camera painting. Camera painting can even be implemented as an homework in an undergraduate graphics class.

We have developed two artistic techniques. By using

these techniques, it is extremely easy to create interesting abstract paintings. We have included several abstract paintings created by using these techniques.

References

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Figure 5. Camera Painting: an example of abstract paintings that are created by painting camera-control-images.

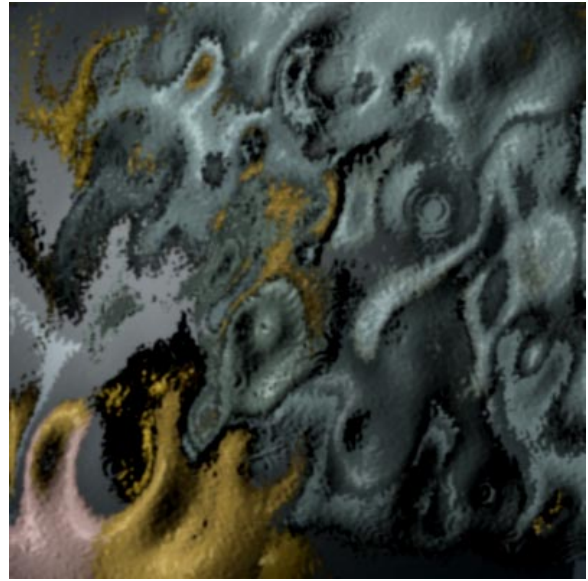


Figure 7. Waves: an example of abstract paintings that are created by painting camera-control-images.



Figure 6. Splash: an example of abstract paintings that are created by painting camera-control-images.

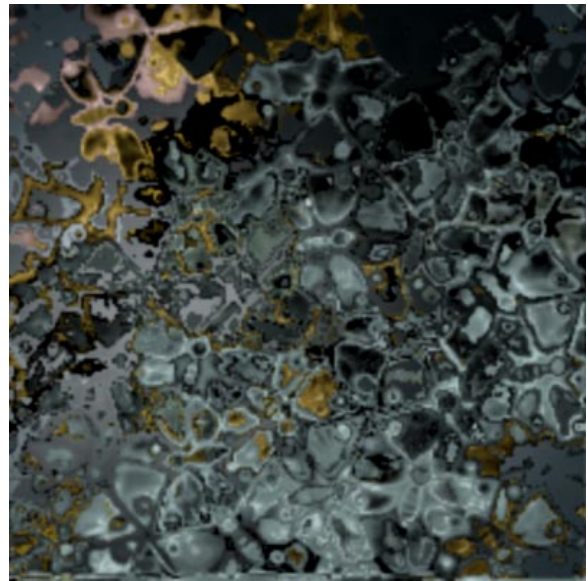


Figure 8. Butterflies: an example of abstract paintings that are created by painting camera-control-images.

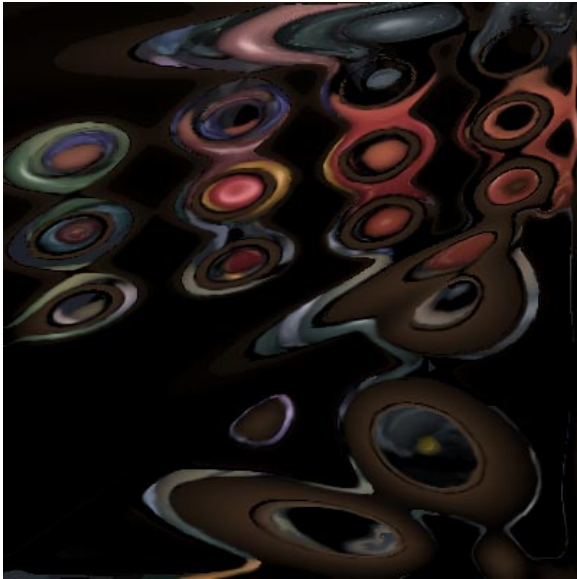


Figure 9. Ripples: an example of abstract paintings that are created by building 3D scenes.

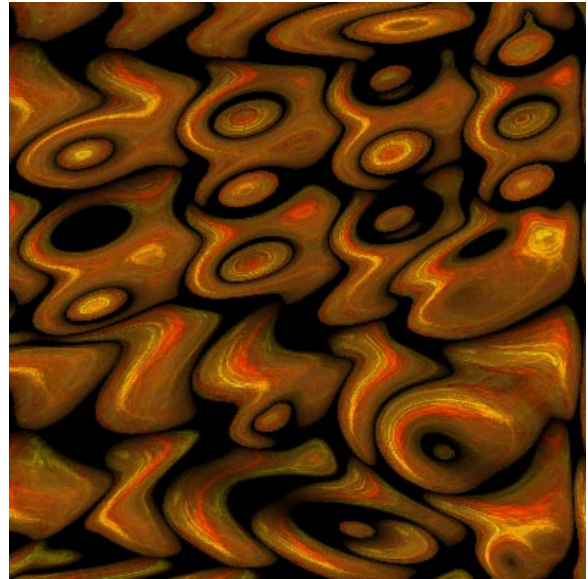


Figure 11. Ripples 3: an example of abstract paintings that are created by building 3D scenes.

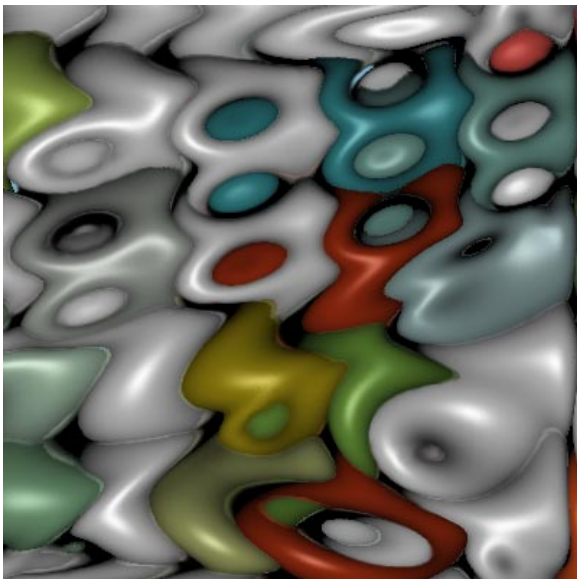


Figure 10. Ripples 2: an example of abstract paintings that are created by building 3D scenes.

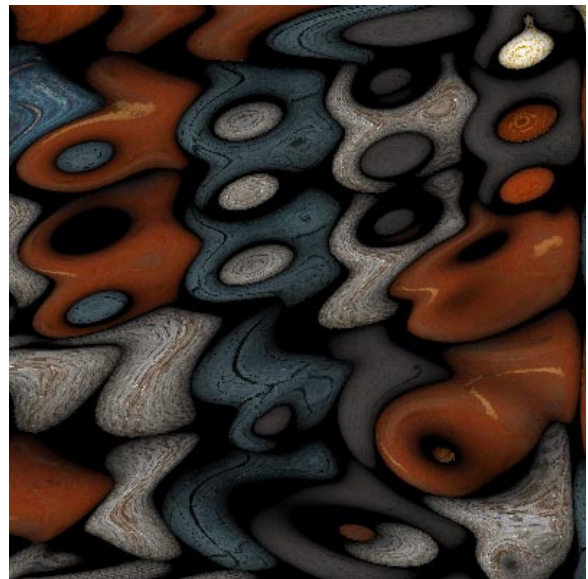


Figure 12. Ripples 4: an example of abstract paintings that are created by building 3D scenes.