

Realistic Image Making with Mandelbrot Set

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Abstract

Fractal images enjoy a great deal of abstraction and are very wonderful and out of expectation for observers. These mathematical paintings are clear exposures of complexity, all-scale features and self similarity which are presented simultaneously and provide unique views. On the other hand, fractals are representations of the nature behaviors and rise from nature. Therefore, it must be possible to use these fractal properties and images in the creation of natural and realistic phenomena and landscapes. In this article, I am going to briefly explain the way of creating an absolutely realistic painting, as real as nature landscapes, called *Sea at the sunset* only by means of Mandelbrot set.

Process of Creating a Realistic Painting with Mandelbrot Set

To create a realistic illustration, it is not absolutely essential to obtain a fractal exactly similar to our subject, instead we should try to exploit the properties of the nature that are presented in that fractal and apply them in our image making process. So, we ought to produce an image according to properties like self similarity, complexity, chaos which the last years` artists were disappointed with in creation of their artworks. The Mandelbrot set has no similarity to any imaginable natural phenomenon, but contains a great deal of nature traits; therefore this fractal can be used to create a perfectly realistic painting including many nature qualities. There will be no difference by which program or software we do the processes of our image making. We only use Mandelbrot fractal with some magnifications and sometimes color transparencies. Therefore, never do we use any distortion, erasing or any image processing software like Adobe Photoshop. Here, I have used Ultra Fractal software [1] to create my piece and started with this basic formula:

Initial Condition: $z = 0$

Loop: $z = z * z + \text{\#pixel}$

Bailout Criterion: $|z| < 2$

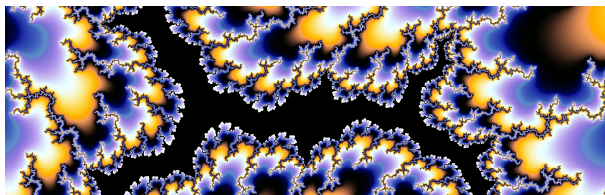


Figure 1: A close-up view of the Mandelbrot set, zoomed in by a factor of 5.8×10^7 relative to the bounding box of the entire fractal.

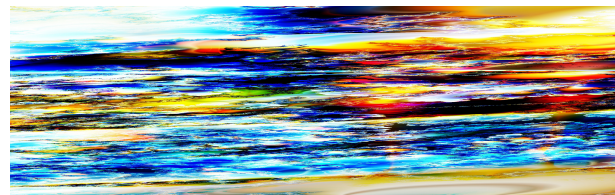


Figure 2: Our painting with 11 separated layers of Mandelbrot set.

We use our Mandelbrot set to create our painting and zoom in a piece of its outer border until we attain an image which can be seen in Figure 1. Afterwards, we change our point of view to the image by

changing angle of the image from horizon to make it flat and provide ten other different layers of this image, each of which has only a little difference in zoom and transparency from the previous ones. The result of over punching these ten layers on the first layer is observed in Figure 2.

Now we arrive at the phase that we should control the dispersion of the painting's colors. Accordingly, we can change and regularize the colors near what we want by putting nine other layers of Mandelbrot set with more blue, red, yellow and white colors on previous ones. It should be mentioned that in most stages of the color control process I have not changed the color of Mandelbrot fractal, but I zoomed in the suitable color I needed. After adding another layer that present the sun in the painting (by changing the amount of z in Initial Condition to 1 and in the Loop to #pixel), we obtain the complete landscape (Figure 3). What you can watch is the magic of fractals. However, our painting now consists of 21 layers of complex and disordered views of Mandelbrot fractal, but by managing the convolutions of different layers and controlling the dispersion of colors in the whole image, we have obtained an evidently ordered painting representing a blue sea at a reddish and yellowish sunset.

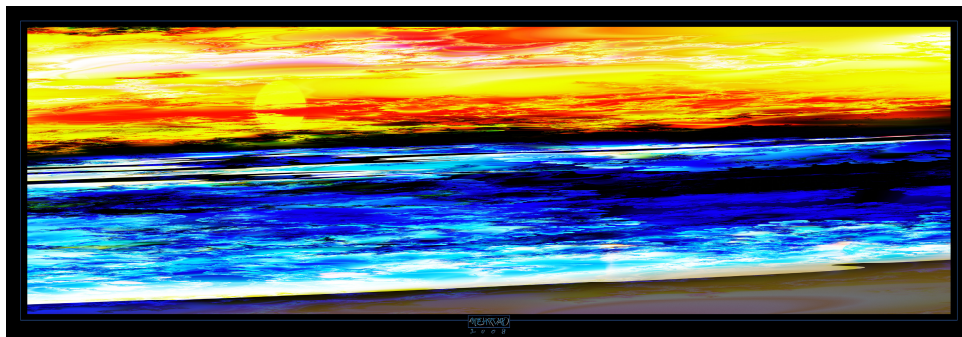


Figure 3: Completed “Sea at the sunset” with 21 layers (2008; © Mehrdad Garousi).

Now we have a 21 layer landscape in which every part of the canvas is covered with detail, just like a real landscape, which faces to more and more complexities. If we have a look at the space between two waves, we will observe other more irregular waves that sequentially continue towards the infinity and clouds of the painting similar to real clouds in the sky which do not have any clear border with sky. Now, we have a perfect and exclusive sunset painting which would not be created on any canvas or in any photograph. Its creation is dependent on computer assistance and on exploiting advanced fractal mathematics and geometry. To have a better look at the images I invite you to watch the color version of the paper on the CD-ROM.

Conclusion

Not all fractals provide an artistic and aesthetic image, but they present us several properties and behaviors of the nature, however rarely do some of their raw abstract formats have eye catcher beauties, too. It is the creative artist that, by enjoying and applying these properties, should create an artistic and aesthetic work of art. I hope fractal image making goes further than limited borders of abstract images and some professional painters will be interested in realistic painting by using fractals. Mandelbrot says [2]: “For many years I had been hearing the comment that fractals make beautiful pictures, but are pretty useless. I was irritated because important applications always take some time to be revealed.”

References

- [1] Slijkerman, F., <http://www.ultrafractal.com/>.
- [2] Brockman, J., 2004, *A THEORY OF ROUGHNESS*: A Talk with Benoit Mandelbrot. Available at http://www.edge.org/3rd_culture/mandelbrot04/mandelbrot04_index.html (accessed 5 November 2008).