Light Painting: Visualization with and through Light

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Abstract

Taking inspiration from Impressionist painters, this paper presents a project creating a light painting combining traditional oil technique with mathematical strategies and latest technology. As an artist with plein air and studio practice, I emphasize the importance of value relationships in defining lightness and darkness within a composition. In this paper, I describe a project transforming an oil painting into a model that can be 3D printed. The uniqueness of this result is that the forms and composition are only recognizable if the 3D print is held against light. In this work, I further explore the Impressionists' goal to depict the world in innovative ways.

Introduction: Light and Oil Paintings

I am an artist focusing on oil paintings and present my recent work including descriptions and photographs on my website: https://barbaralicht.com [4]. In many of my works, I deal intensively with light. In my solo exhibition 2018 in a gallery in Linz, Austria, I exhibited more than 30 oil paintings addressing mainly landscapes, but also portraits (German title: „Fenster in die Natur – Landschaftsmalerei 2.0“). Two pieces related to this solo exhibition are illustrated in Figure 1a and Figure 1b. Both paintings focus on building landscapes taking into account artistic considerations such as composition of light and dark, temperature (warm and cool colors) and contrasts. My aim was to create a second version of landscapes (2.0) in an oil painting in addition to the already existing first version, but not to copy a photograph.

(a) (b)

Figure 1: *Paintings, Barbara Lichtenegger: (a) Birch forest, 2015, oil on canvas, 60 x 80 cm, (b) Tree next to the water in Giverny, 2017, oil on canvas, 60 x 80 cm.*

Within this exhibition, I showed artworks I created in different environmental settings: (a) painting in my studio and/or (b) painting in front of the motif in the nature called *en plein air*. Combining both painting strategies indoors and outdoors was already practiced by different artists that are well known from the history of landscape painting, such as Claude Monet [3, 7].

Already the Impressionists painted in front of the motif aiming to preserve their concepts and "impressions" on canvas. Many of these artists preferred to paint outdoors when possible [3]. Engelmann [3, p. 8] highlighted their likely intentions: "To say that the artists who found their way into the history of art as the Impressionists wanted to depict their environment in a novel, subjective manner is a simplified and therefore imprecise description of their intentions, both accurate and false at the same time." Similar to artists of Impressionism such as Claude Monet [3, 7], it is also important for me to capture my own impression of the motif with the aid of oil and a major focus in my work is the light within the composition. I also attempt to arrange the brush strokes on the canvas to create an oil painting in a novel and simplified manner. On the one hand, when I work in front of the motif, the natural setting helps me to capture the true effects of light and color [6]. On the other hand, painting outdoors is not an easy task requiring (i) the ability to simplify, and (ii) flexibility. As a painter, I am always confronted with the fact that the light conditions are constantly changing depending on the time of the day [1] and varying nature's appearance—e.g., when suddenly the clouds are hiding the sun. Having only a limited time to sketch the motif, it is important to capture the key value relationships presented below in the composition.

Values—Capturing the Relative Lightness or Darkness

Mitchell Albala [1, p. 49] explains that "*Value* refers to the relative lightness or darkness of any given area within a drawing or painting. Value relationships are the primary means through which we achieve *differentiation*—the ability to distinguish one shape from another—in both in the real world and in the world of our canvases. The shapes and patterns made by value differences also help form the underlying framework of the composition."

(a) (b)

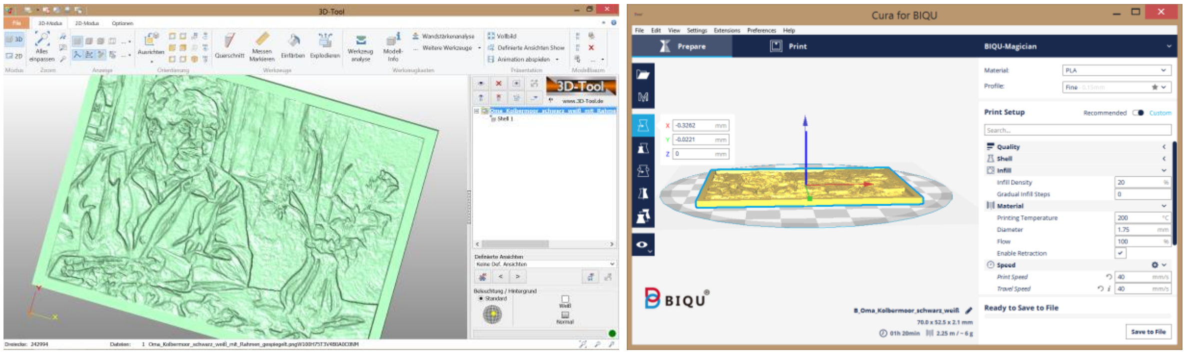
Figure 2: *Painting, Barbara Lichtenegger, grandmother, 2014, oil on canvas, 60 x 80 cm: (a) photograph of the original oil painting, (b) grayscale version highlighting different values and framed*.

In addition to the two mentioned landscapes focusing on different light conditions, I present an oil painting illustrating a portrait of a female who is sitting at a table next to a flower vase (see Figure 2a). This work was also presented in the previously mentioned exhibition in 2018 in Linz, Austria. One of my artistic aims within this composition was focusing on the light setting of the motif. For example, half of the woman's face is light and the other half is dark. The flower vase on the left contrasts strongly with the darkness in the background. To highlight the light conditions by mixing various oil colors of different values, I additionally present this painting in grayscale and in a black frame. In Figure 2b, the areas numbered with 1, 2, 3 and 4 outline different areas of dark values of this painting. Comparing the grayscale version with the original painting, it becomes apparent that the forms are still recognizable and different colors related to black (1), green (2), blue (3) and brown (4) transform to the darkest parts in the composition. Macperson

[6] explained that proper values (lights, darks) are more important than colors in a painting and can be considered as key of the work.

Creating a Light Painting

Based on the previous discussed oil painting presented in Figure 2, I developed a project combining the traditional oil technique with latest technology. I consider the work as Mathematical Art because I apply both (i) knowledge based on my painting experience (e.g. composition, values—relationship between lightness and darkness) and (ii) mathematical knowledge (e.g. defining and adjusting a model in a coordinate system):



(a) (b)

Figure 3: *3D model showing the STL file of the woman's portrait in different perspectives.*

Figure 4: *Light painting—holding the 3D print against a light source so the woman and a vase appear.*

As discussed, although the portrait illustrated in Figure 2 was created with a multiple amount of colors, it can be easily transformed into a grayscale version. For instance, different colors are transformed to the darkest parts of the work and are expressed with the highest layers in the 3D model (see Figure 3). In contrast, the light parts are printed with thinnest layers allowing the light to shine through.

In other words, I created a translucent plane that is backlighted and varied its thickness. This technique was already used in the early 1800s aiming to create "lithophane" panels. Traditionally, they were made of thin, translucent porcelain, but recently there has been interest in using 3D printing to create similar effects [5, 8]. In this work, I used one of many online tools (see Lithophane [5]) to convert an image of the oil painting into a STL file. As in Figure 3b illustrated, this model was further adjusted in a coordinate system with the software BIQU [2] to control (i) material, (ii) speed, and (iii) printing duration. For this adjustment, mathematical skills can help for decisions to shorten the printing process without losing quality. By modifying the values, each layer has to be considered to realize a light painting of high quality in the end. In other words, different parameters can be adjusted using mathematical strategies to enhance the printing result.

Summary and Conclusions

In this paper, I present my artwork and explain concepts for plein air and/or studio practice emphasizing the importance of value relationships (relative lightness or darkness within a composition). The primary focus is on a project that transforms an oil painting into a 3D model including different layers. This project combines mathematical skills with artistic knowledge and can therefore considered as a real representation of Mathematical Art. With this described strategy, I created a further version of the original motif characterized as light painting. In addition to the real world (version 1) and the oil painting (version 2), I realized a third representation using mathematical considerations and supported by technology.

In this work, light contributes to the art piece in a natural and unique way, similar to experiences in plein air. The light parts are only visible because of the existence of light that shines through the material. The darkest parts are dark because of the missing light within these areas. In other words, these light paintings can integrate light more naturally than it would be possible with oil on canvas or other known techniques and non-transparent materials. Besides the presented result, I also conducted other experiments to transform oil paintings into a lithophane. I varied sizes, filaments, colors and number of layers attempting to enhance results. In the future, I want to continue creating light painting using the 3D printing technology. My goal is to follow the Impressionists' intention to depict the environment in novel approaches by applying mathematical strategies and latest technologies to become an innovative artist in the modern world.

References

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