

Shading with Painterly Filtered Layers: A Technique to Obtain Painterly Portrait Animations

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(a) Rendering with only diffuse rendering. (b) Rendering with diffuse and specular reflection.

(c) Three examples of our painterly portraits.

Figure 1: Examples of results from our method. Diffuse rendering in (a) is obtained using a Barycentric shader that interpolates three texture images. The illumination parameter is a lump sum of all illumination coming from lights and ambient occlusion. (b) shows an image obtained by adding subtle specular reflection effects. Our painterly portraits such as the ones in (c) are obtained by filtering all layers separately

ABSTRACT

In this manuscript, we describe a process that can be used to create still and/or animated portrait paintings to be shown in Expressive Art Exhibit. Our process consists of two stages: (1) Creation of control textures for a Barycentric shader by using color information gathered from photographs to provide realistic looking skin rendering; (2) Filtering and compositing the layers of images that are obtained by control textures, which correspond to effects such as diffuse, specular and ambient. To demonstrate proof-of-concept, we have created a few rigid body animations of painterly portraits under different lighting conditions.

CCS CONCEPTS

• **Computing methodologies** → **Non-photorealistic rendering**;

KEYWORDS

Painterly Portraits, Painterly Rendering, Expressive Depiction

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1 INTRODUCTION

Traditional portrait artists were masters of interpreting color values just by observing subjects with their eyes. They were able to obtain more effective impressions of skin than current high quality 3D rendered skins that are meticulously modeled and rendered including all extraneous physical details such as pores, veins and blemishes [Lawrence-Lightfoot and Davis 1997]. Therefore, there is a need for the development of simple processes for 3D rendering that can allow to obtain a wide variety of portrait painting styles.

Our conjecture in this paper is that painters create portraits by carefully observing a few illumination effects caused by the bidirectional scattering distribution function (BSDF) properties of skin [Bartell et al. 1981]. This observation is not really that difficult in practice. For instance, since specular reflection is view dependent, the only thing a painter should do is to move their heads slightly for separating specular effects from diffuse visually. Similar, approximate dark and bright color values of view independent illumination can easily be observed by moving light positions. This is specially important for skin since the values of shadows colors are not very low because of scattering.

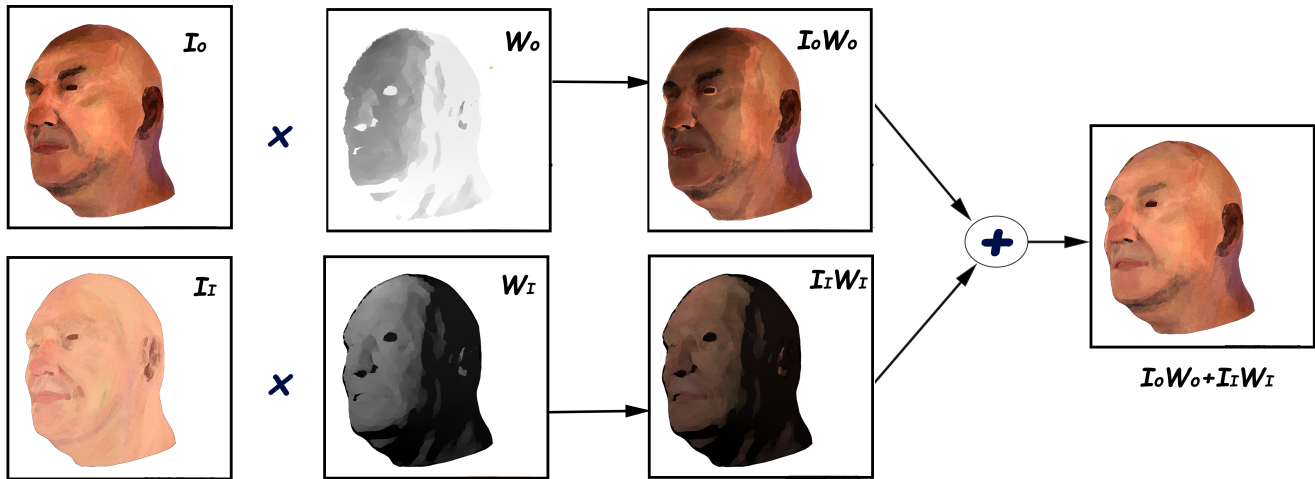


Figure 2: Barycentric mixing of the filtered layers to obtain painterly portraits. Note that we even filter illumination data W_1 . In this particular case, $W_0 = 1 - W_1$ to enforce Barycentric property.

Once they separate these effects, the painters transform each of these effects separately by using their own mental filter. Existing NPR methods based on filtering photographs such as [Haeberli 1990; Hertzmann et al. 2001; Zhao and Zhu 2011] obtain impressive results with the same principle of color and shape transformation. However, those methods treat the whole scene as a single layer. On the other hand, painters obtain results by compositing (or painting) each transformed effect layer by layer. Although it is hard to automatically separate effects in photographs, the effect separation already exist in 3D rendering. Therefore, it is straightforward to obtain similar process in for 3D rendering.

2 METHODOLOGY

In this work, we present a process for creating portrait paintings from 3D facial models using layer by layer filtering and compositing. Our process start with a data collection stage which allows to obtain an estimation of dark (ambient) and bright (ambient + fully illuminated) colors and color of specular highlight in every point of the skin. Using this data along with a proxy geometry that represent the face of the subject, for any given light and view position it is possible to obtain photographic image of any effect we are interesting in (See Figures 1a and 1b). Once we filtered each effect separately, we can easily obtain a composite image that corresponds to a portrait painting as shown in Figures 1c.

Our main contribution in this paper is filtering effect layers and combining the filtered layers using a Barycentric operation (See [Akleman et al. 2016] for details). Figure 2 shows an example of Barycentric mixing of filtered images. The advantage of this approach is that we can use any painterly filter to obtain results such as Haeberli’s paint-by-number filters [Haeberli 1990] or Zhao’s statistical filters [Zhao and Zhu 2011].

An important issue is that these painterly filters have to be applied to rendered layers not to textures. Filters applied to rendered layers creates imperfect boundaries as we see in real paintings. An

advantage of this approach over filtering images is that each layer can be filtered independently. For instance, dark colors can be filtered different than light colors. These choices are essential to obtain results similar to painters’ work.

This process can be implemented in post-production during compositing to obtain better control over results. However, current compositing software do not really provide the kind of the control that is needed for implementation of the Barycentric operations. For instance, we need W_0 automatically computed from W_1 . Otherwise, the whole operation becomes very time intensive for users. Therefore, we implemented this process in shader level. During the rendering we simply apply a sequence of photoshop filters. To generate the painterly effects, we have used Photodunot, a Photoshop image compositing plug-in. One disadvantage of our approach, if we do not like the results, we need to re-render again. It, therefore, can be good idea to apply compositing using shading languages.

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