Parametric Stylized Highlight for Character Animation Based on 3D Scene Data

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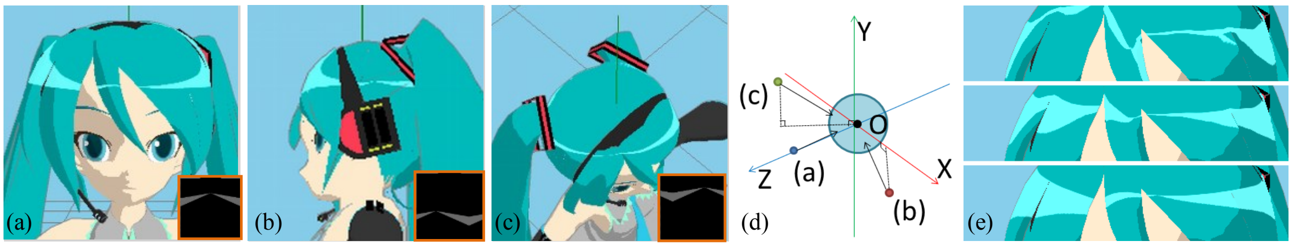

Figure 1. (*a*)-(*c*)*View-dependent highlights with the view points at* (*a,b,c*) *in* (*d*). (*e*) *A comparison of different normal blending parameters*.

1. Introduction

Cartoon shading has become one of the most widely used techniques for producing animated films using 3D models. However, its physically generated behavior is often insufficient for stylized highlighting of hair, which is symbolic and less physically correct. Texture mapping is effective for such stylizations; however, the approach is limited to static representation of highlights.

We propose a method to render and control stylized highlights. The proposed method effects desired changes to the shape and position of a highlight by modifying its control points as a function of light and view position, thereby providing artistic control over physically generated behavior. Another important feature of our method is pseudonormals, which simplify distracting highlights caused by original surface normal details. Figure 1 shows the results of our method.

Choi and Lee [2006] proposed a method to project an arbitrary highlight shape to a 3D model. Sloan et al. [2001] proposed Lit Sphere shading, which encodes an artistic shading style to a 2D sphere map as a function of screen space normals. However, they suffer from highly deformed highlights, which can be simplified using our method.

2. Proposed method

Here, we describe the overall process of our method. Initially, the user designs a highlight shape by specifying control points in 2D texture space.

I. Based on the designed control points, our system updates the positions according to light and view vectors.
II. The result of I is mapped to a guide sphere to render a cube environment map.
III. A stylized highlight is rendered on a 3D model using the environment map with a pseudonormal vector.

Our method is based on the dynamic construction of a highlight environment map. This process can be performed in real-time by relying on simple texture deforming and mapping procedures. The user can specify the center of the sphere O, which is typically set around the center of the hair model. The generated highlights are combined with a diffuse component that is rendered using cartoon shading.

View and light-dependent highlight behavior The shape of a highlight is represented by a polygon. The highlight positions are calculated to follow the view and/or light positions (Figure 1a, b, c). First, we calculate the relative view position v to O on the local coordinate of the input model. Then the view position are decomposed into a rotation angle θ_v from the front of the model and its y-axis component θ_{vy}. For the light vector, we also use the same decomposition to define θ_l and θ_{ly}.We then calculate the distance from the initial highlight position in the u and v directions (i.e., du and dv) as follows:

$$du = (\alpha_v \theta_{vy} + \alpha_l \theta_{ly})/2\pi, \qquad dv = (\beta_v \theta_v + \beta_l \theta_l)/\pi,$$

where the user-specified constants $\alpha_v, \alpha_l, \beta_v,$ and β_l are in the range of [0,1]. By varying the weight parameters, different highlight behaviors are continuously produced, such as a static position for the model $(\alpha_v, \alpha_l, \beta_v, \beta_l) = (0,0,0,0)$. If the highlight exceeds the texture to the right and left, we simply repeat the highlighting procedure to cover the opposite side of the texture in order to avoid unwanted seams. In the vertical direction, the movement domain can be limited by employing a threshold for dv.

Highlight simplification based on pseudonormals Our highlight simplification process is based on pseudonormals, which smoothen details of the original surface normals (Figure 1(e)). We define a pseudonormal N' at surface position p as a unit direction vector as $N' = p - O$, where the normal vector is simplified using sphere normals. Environment mapping is performed with the pseudonormal that is blended with the normal of the hair model at a ratio of γ:$(1 - \gamma)$, where γ is a constant in the range of [0,1]. This parameter permits interpolation between these two types of highlight behaviors.

Result For the images shown in figures 1a, b, and c, we set $(\alpha_v, \alpha_l, \beta_v, \beta_l, \gamma) = (1,0,1,0,1)$. The results confirm that the highlight follows the view. For the images shown in Figure 1e, we set γ = 0, 0.9, and 1, top to bottom, respectively. These images illustrate the method's creation of highlights.

[1]The 3D model is provided by Animasa. We modified it for simplicity. Hatsune Miku is copyrighted by Crypton Future Media, Inc. ©Crypton Future Media, Inc.

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