An Artist Friendly Hair Shading System

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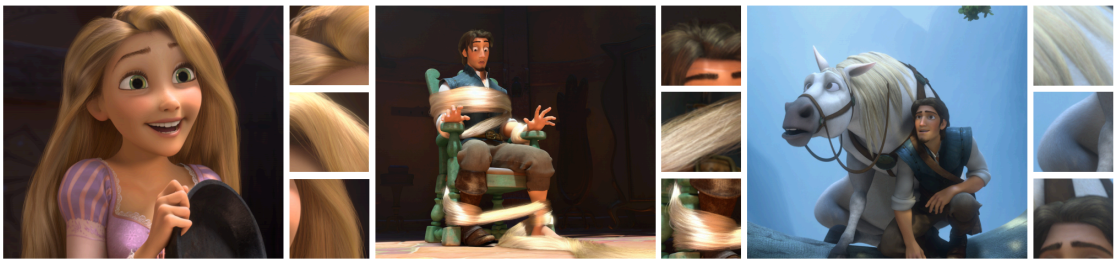
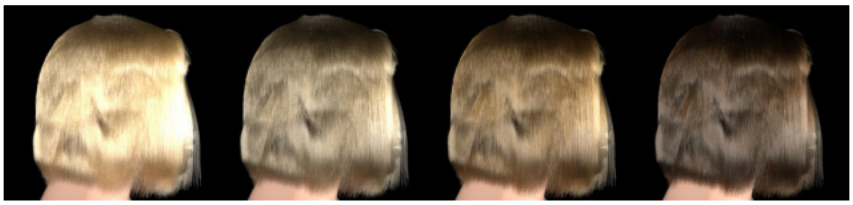


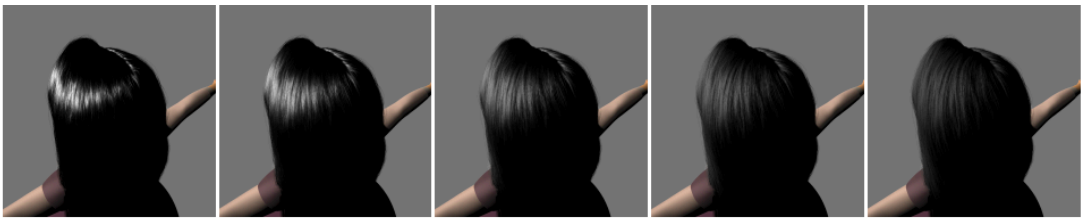
This paper addresses a challenging task, which is rendering hair in motion pictures. Although the task of rendering hair is well explored, this paper presents a shading system that offers artists a user friendly control system. Prior physically based shading models do not offer such intuitive controls and therefore they fail to satisfy the required controllability in a creative environment. Physically based shading models require accurate input and they introduce realistic results. However, as mentioned by the author: “good looking” does not necessarily mean it is scientifically accurate. Artists usually have specific comments and concerns about the final appearance of the rendered hair. Therefore, they need more controls for further adjustments, which physically based models cannot offer. This work is an art directable shading model and all end users are involved in the design process.

There are some features that make physically based models fail to satisfy controllability. First, the physical properties of materials such as index of refraction and absorption coefficients have unintuitive effects and it’s hard for artists to guess the shader parameter values in order to obtain the best desirable appearance. For example, the final hair color is determined by absorption coefficient values yet there is no direct relation between absorption coefficients and the hair color.



(0.03, 0.07, 0.15) (0.15, 0.2, 0.3) (0.2, 0.3, 0.5) (0.3, 0.6, 1.2)

Second, changing one physical property will affect other features of the final appearance. Because physically based scattering functions integrate to a value less than or equal to one, any change to one of the subcomponents of the scattering function will lead to changes in the other subcomponents. For example, increasing the light width will reduce the intensity.



The presented approach depends on deriving a scattering function from the physically based scattering function that is defined on a different domain of parameters. There are five steps to achieve the desired scattering function. The first is Examination: to examine the physically based scattering function over the domain of some parameters. The second is Decomposition: to decompose the scattering function into scattering sub-functions. Defining artist friendly controls from each sub-function is the third step. Reproduction, the fourth step, is to approximate the qualitative behavior of decomposed scattering sub-functions. Finally, Recombining: to combine the approximated scattering sub-functions.

The main part that differentiates this approach from prior ones is the decomposition step where in this study a team of artists is asked to identify appearance properties that they want to control. They provide four components, which are the primary light, secondary light, glints, and the rim light. Then, qualities like color, intensity, etc. for each decomposed component are defined.

A conducted evaluation showed that the new shading model enables artists to achieve the desired hair appearance more easily. The new shader has been integrated into the production pipeline at the Walt Disney Animation Studios and is being used in the production of the animated film Tangled.

Reference

Sadeghi, Iman, et al. "An artist friendly hair shading system." *ACM Transactions on Graphics (TOG)*. Vol. 29. No. 4. ACM, 2010.