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Analysis of hair shine using hair rendering and subjective evaluation

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Hair shine (lustre/gloss) is a very desirable attribute to consumers within the cosmetic industry. It is also an important characteristic within Computer Graphics (CG) based imagery, providing an improved perception of realism.

Synthesising realistic CG human hair is a difficult task, primarily because of the number and geometry of hair fibres, but also because of the duality of hair. Its appearance depends not only on each fibre (local properties) but also on the hair considered as a volume (global properties). The local properties of an individual hair fibre define the way that it is illuminated so for example when the hair is considered as a volume, global properties such as translucency and shadows become especially pertinent to creating a convincing appearance. Hair rendering deals with all of these effects. Over the last 10 years, major progress has been made in the area of physically-based hair rendering, which involves the construction of analytical models to represent the light scattering within hair fibres. Goniophotometric measurements of fibres have now been used to quantify scattering inside a single fibre (single scattering) and scattering events inside a group of multiple fibres or a strand (multiple scattering)[1, 2], so we are able to validate and modify these models.

Using these single and multiple scattering models, a framework was developed to analyse hair shine using CG images and subjective evaluation. In an initial study, CG images of hair were constructed with different lighting conditions, hair geometry, colour, scattering effects and various other factors. These images were then presented to a panel in order to evaluate them subjectively on the basis of realism to create an index of realism for each of the scattering models based on the various environmental factors[3, 4].

This study also explored a novel method to represent random orientation or arrangement of fibres within a hair strand. The randomness, termed “entropy”, helps to determine the overall effect caused by minor changes of orientation on hair shine by simulating their effect using computer graphics techniques. This helps to understand the effect even at small entropy values of disoriented hair on the stability of subjective hair shine testing and its robustness to change.

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