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Dissertation Title: Cartoon Hair Simulation

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Abstract:

The purpose of this project was to implement a real-time cartoon hair simulation pipeline for potential use in games and other interactive applications. The overall goal was for the hair to be appealing and to successfully emulate a cartoon artistic style.

The hair was composed of guide strands which were designed in a 3D modelling program and then used to generate a base mesh around each hair which could then have artistic stylisations applied. Depth dependent cartoon shading, back lighting and custom specular effects were implemented using an extended cartoon shader method where the x axis is indexed by light intensity and the y axis by a custom metric such as surface orientation or specular value. Surface hatching was applied using either viewport projection or surface projection. The hatching textures were generated in a custom program to ensure uniformly distributed strokes and tonal, border and depth coherency. The hair silhouettes were outlined using either an image-space method based on Sobel and a dilation pass or an object-space method which identified silhouette edges as line segments bordering front and back facing triangles. The object-space silhouettes were used to generate camera facing quadrilateral strips which could have custom stroke textures applied.

The final product was tested for performance and user acceptance. Real-time performance was found to be achievable on modest hardware using the default settings, and users in general found the hair appealing although scores for effectively emulating the cartoon style were more neutral.