# Hair Modeling and Animation

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## Research Goal

Our goal is to add realistic, styled hair to computer representations of humans.

While hairstyle is not an important consideration in most human interactions, unrealistic or missing hair on a virtual character *is* a potentially important problem -- it contributes to a "robotic" look and can divert attention from the intended interaction.

## Role in IMSC

• One of several IMSC projects that are intended to allow expressive human representations in virtual spaces.

• Both Hair Modeling and the Facial Gesture Analysis project focus on problems that need to be addressed in order to allow natural interaction with virtual characters.

## Research Approach

The *thin shell volume* is a control structure for sculpting and rendering large numbers of hairs. A *multi-resolution* application of thin-shell volumes allows hair to be manipulated at any level of detail from an individual hair to a large area containing hundreds of thousands of hairs shaped into various structures.

*Opacity Shadow Maps* is a fast technique for producing aggregate self-shadowing in hairs.

The *Adaptive Wisp Tree* algorithm adaptively recomputes a multi-resolution thin-shell volume like representation for hair as it clusters and separates due to physical dynamics.

## Accomplishments

• T-Y. Kim and U. Neumann, A Thin shell volume for modeling human hair, *IEEE Computer Animation*, pp.121-128, 2000.

• T-Y. Kim and U. Neumann, Opacity Shadow Maps, *Eurographics Workshop on Rendering*, pp. 177-182, 2001.

• T-Y. Kim and U. Neumann, Interactive Multiresolution Hair Modeling and Editing, *ACM SIGGRAPH 2002* (special issue of *ACM Transactions on Graphics* (TOG), v.21 n.3, July 2002).

• E. Plante, M-P. Cani, T-Y.Kim, and U. Neumann, Adaptive Wisp Tree – a multiresolution control structure for simulating dynamic clustering in hair motion. *ACM Symposium on Computer Animation 2003.*

## Uniqueness & Related Work

Hair is one of the most difficult problems in computer graphics. Bi-level modeling approaches in which a "wisp" or cluster of hair can be sculpted as a single entity have been proposed by several groups. Our contributions are:

• A full multi-resolution approach, allowing styling at any level of detail

• Modeling, rendering, and animation are addressed within the same framework, resulting in a practical interactive system.

## 5-Year Plan

The Hair Modeling project is approaching completion of its current phase. A remaining challenge is the estimation of the many parameters defining hair styles from imagery.

| | Milestone Chart | |
|---|---|---|
| **2002-2004** | **2004-2006** | **2006-2008** |
| Multi-resolution dynamics and animation | Investigate image analysis of hair parameters | Interactive hair rendering with dynamics |