

# Animating Hair using LCP and SPH for Evaluating Expressive Virtual Characters

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February 24, 2015

## 1 Background

Realistic hair simulation is a challenging task due to the fluid motion of hair and the great number of strands [7, 4]. Simulating hair becomes a balance game between realism and performance. The realism of computer graphics animated hair in movies is really good with the newest technologies and might be indistinguishable from real hair under the right circumstances [7]. However, rendering such realistic hair motions in real-time is far from there yet. A fairly recent single strand approach by Nvidia shows promising results in real-time [5].

Creating expressive virtual characters is interesting and important for many different applications [6]. To create more expressive virtual characters, small details can make all the difference. For example by having expressive wrinkles [3] or by considering the surrounding environment [2]. So far, no studies on how having animated hair affect the perception of expressiveness have been done.

## 2 Problem

Investigate hair simulation with smoothed particle hydrodynamics and loosely connected particles at an interactive frame rate. Evaluate the effect of animated hair on expressiveness in virtual characters. Does animated hair help create more expressive virtual characters?

## 3 Implementation

*Smoothed Particle Hydrodynamics* (SPH), it is a computational fluid simulating method that is based on a mesh-free Lagrangian method [1]. It is suitable for giving a fluid motion to collections of particles and can thus be used in simulations of water, cloth, hair and other similar materials. *Loosely Connected Particles* (LCP), is a particle system method where the particles are unordered and only loosely connected to their neighbours, which means they can be separated unlike ordered connected particles [1]. *Unity* is a 3D games engine that will be used for creating a scenario where the hair can be visualized. It will help with the loading of models, rendering etc. *Blender* will be used for creating models and applying anchor points for the hair on models. To simulate the character movements motion-capture might be used.

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## 4 Evaluation

The project will focus on evaluating the performance of the method on smaller volumes of straight hair, i.e bangs and pony-tails. Different kinds of hair-types, curly for example, will not be attempted with this method. Also, hairstyles like braids with groupings of hair will not be tested. There will be two types of evaluation; technical performance and a perceptual study. The technical evaluation will focus on performance in terms of speed, computational power needed and possible optimizations and how this scales with the number of particles used.

The perceptual study will evaluate hairs influence on expressiveness of virtual characters. Similar to a study on wrinkles by Courgeon et al. [3]. Using a database of virtual character expressing emotions we will set up a scenario of a virtual character expressing a few different emotions. Users will then be able to grade the motion, if its sad, happy or neutral and of what intensity. Other emotions and questions might also be included in this study. This test will be done with around 20-30 people. (The users in the study will hopefully be students from Peters class in April-May. ) We will then evaluate whether or not animated hair have any effect on the perception of the virtual character.

## 5 Contingency plan

If the time runs out or not enough people can be found for the study I will not do the perception study but will instead focus on optimising the performance of the implementation and evaluate it more thoroughly from a technical point. And see to what degree the method has real-time applications. As it is now, modelling a full head of hair is done at about 10 fps, and there is not much else in the scene. Perhaps by modelling only small parts of the hair or applying other optimisations real-time performance could be achieved.

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## 6 References

### References

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