Fast Simulation of Hair with the Tractrix Curve
Exposé
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1. Topic

The simulation and rendering of hair in video games or other real time environments is an ongoing scientific topic. Hair consists of tens of thousands single thin hair strands and simulating all of these strands realistically requires a lot of performance. That´s why to this day it is important to search for new and improved ways to simulate or render hair in an effort to simplify the necessary calculations or improve the visual quality.

2. Basics

Most hair simulations in real time environments today are based on mass spring systems. These systems have the advantage of being easy to implement and are already used in many other simulations, but they have drawbacks. To produce realistic hair simulations with mass spring systems many springs are necessary which requires much performance. Additionally the spring constants of the systems have to be adjusted manually to produce realistic results. This creates additional workload for artists and programmers, who have to design multiple hair styles.

The tractrix curve[1] can be used to realistically simulate single strands of one dimensional objects like rope, snakes or hair if these objects are pulled in a direction. This simulation does not include any springs and thus removes the necessity of manually adjusting spring constants. Up until now the tractrix was used to simulate singular ropes, but there is no scientific paper which uses this curve to simulate hair in real time.[2]

3. Goals

The goal of this master thesis is to find out if it is possible to use the tractrix curve to reduce simulation time needed for realistic hair simulation. To achieve this goal a hair simulation based on the tractrix curve will be implemented and compared to openly available frameworks like TressFX.[3]

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1 Tractrix Definition, https://en.wikipedia.org/wiki/Tractrix
2 Midhun S. Menon, B. Gurumoorthy, Ashitava Ghosal, Efficient simulation and rendering of realistic motion of one-dimensional flexible objects,
3 TressFX Hair Real-Time Hair Physics System, https://www.amd.com/en/technologies/tressfx