GLFurry - An Interactive 3D Fur Modeling System

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Abstract: We present GLFurry, an interactive system for modeling and rendering fur on 3D objects. The system has 6 main parameters which allow fast generation of many different furry effects.

1 Introduction
Modeling and rendering of fur and hair has long attracted the attention of computer graphics researchers [2]. The different approaches to this problem can be broadly classified into 2 categories: geometric and volumetric. The geometric approach models each hair as a geometric primitive (lines, Bézier curves, etc) [1], while the volumetric approach renders a sample patch and repeatedly apply it to cover the entire surface of the object [3]. Our goal in this work was to implement a simple system to allow us to further investigate the fur modeling and rendering problems.

2 The Model
In our system each hair is modeled as the path of a particle. Later, in the rendering stage, this path will be represented by a collection of line segments or cylinders. We will use the terms hair and particle interchangeably.

Initially, a given user-specified total number of hairs is uniformly distributed over the surface of the object. In order to guarantee an uniform distribution, each triangle will receive a fraction of the total number of particles based on its proportional area with respect to the total area of the object's surface. Therefore smaller triangles will receive proportionally less hairs.

Once we know how many hairs each triangle need, we have to generate the initial position of the particles inside the triangle. For each particle we pick 2 values \( u \), \( v \) from an uniform random distribution in the \((0,1)\) interval. Let \( \mathbf{P}_1, \mathbf{P}_2 \) and \( \mathbf{P}_3 \) be the 3 vertices defining the triangle and let \( w = 1 - u - v \). Using barycentric coordinates we have the position of random point \( \mathbf{P} \) inside the triangle given by \( \mathbf{P} = u \mathbf{P}_1 + v \mathbf{P}_2 + w \mathbf{P}_3 \).

The model main parameters are:
- **Initial direction of hair**: the initial direction of the particle's path is given by the direction of the normal vector to the triangle. This direction can be randomly modified by a user supplied parameter.
- **Length of hair**: the user defines the length for all hairs. This value can be randomized to increment realism.
- **Thickness**: express the thickness of each hair.
- **Color**: the user specifies ambient, diffuse and specular colors for hairs.
- **Number of segments**: the user defines how many samples we will have to represent the total length as a collection of segments.
- **Gravity**: the path of each particle will be affected by its initial position and a vector specifying the gravity, which will push the particles towards the ground.

The system allows the specification of these parameters for all hairs at once or different sets of parameters for different parts of the object. For instance, we could have short hair in the head and longer hairs in the rest of the body. The system was implemented in OpenGL which allows real-time, low visual quality of results. For higher visual quality, the system translates the fur and model geometry into a POVRAY rendering.

3 Results
Figure 1 shows a sample of our results. The 3D model has 5500 triangles. The parameters are: total number of hairs = 35000; initial direction with 5% random variation; fur length with 0.5% random variation. Each single hair has 3 segments and thickness equal to 1.13.

References