Approximate Inter-Fur Shadowing Effect Using Shells

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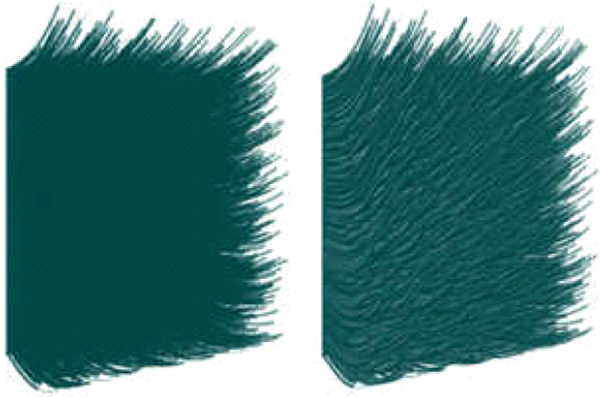

Figure 1: *(Left) No Inter-Fur Shadowing, (Right) Per Hair Shadowing Offset.*

Abstract

In this paper, we introduce a method for creating an approximate inter-fur shadowing effect. We synthesize the complex geometry of fur and hair using the popular 'shell' layering technique. Textures are mapped onto these shells and represent cross sectional slices of the geometry. These textured quads are rendered at the relative position where the slice is positioned. The more slices the more detailed the visual representation. This method enables us to create fur effects that run in real-time with high visual detail. Typically, the layered textures possess no lighting/shadowing. This can be a disadvantage in dynamic scenes with changing lighting condition. Additionally, for fur and hair of a constant colour neighbouring hairs blur and we are unable to identify the differences (i.e., appears a constant color). We demonstrate a method that modifies the shell texture to emphasis inter-fur shadows.

Keywords: shadows, shells, video games, animation, life-like, adaptive, dynamic, 3D, layers

Introduction

The shells are built up like layers on an onion create the visually illusion of seeing a complex mesh. The shells let us achieve high detail objects using a reduced poly model. This method demonstrates excellent real-time results. A minor problem with an otherwise inspirational concept is lighting. As shown in Figure 1(left) a geometry with constant color does not show the high level detail that we would expect. This is because our geometry is just 'slices'. Hence, this paper introduces a concept to adapt the texture slice to emphasis the inter fur/hair shadows (Figure 1(right)).

Background and Related Work

There has been a broad range of exciting and interesting approaches across different disciplines (e.g., graphics, robotics, and biomechanics) towards creating more interactive life-like fur and hair animation solutions. With the advancement of the graphical processing unit (GPU) and parallel computational power, recent developments have provided highly realistic hair which goes as far as modelling individual hair strands! While this concept may seem overwhelming, the amount of power available on the GPU is enormous. However, we have yet to reach the point were we are able to create real-time characters for interactive environments, such as, serious games and training simulations, that have all the resources to use on hair/fur effects. Hence, shells are still an attractive solution for creating realistic hair and fur quickly and easily that appears aesthetically pleasing.

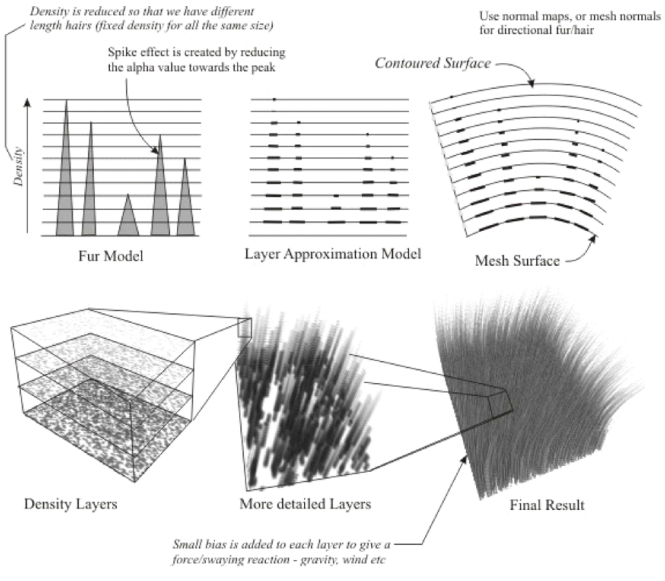

Figure 2: *Visually illustrating how multiple shells (slices) build up fur effect.*

Method

The textures for each shell that make up our fur/hair effect are created using random noise function. The shell quads are created and projected along the normal of the shapes surface. A few problems exist with the basic method of fixed shells. If too few layers or viewed from side angles the visual effect breaks down. We need to keep the number of shells at a minimum, while producing the most visual realistic effect possible.

We achieve inter-fur shadowing easily, at the cost of editing the shell textures and embedding a shadow displacement. We render each fur layer, introducing memory and computational overhead. We take each layer and offset the uv coordinates very slightly, using the surface normal as a bias, so each layer made up of dot (representing a hair slice) is offset. Rather than just render the same color though - as we are trying to generate a shadow effect, we convert the RGB offset value to a grey color. This grey offset is rendered underneath each layer, so as the layers are built up, we get a shadowing effect, which makes the individual hairs stand out Figure 3.

Figure 1 above does not do the concept justice. While we could emphasis shadows more radically by biasing the offset more and instead of a grey shadow color, use a pure black, i.e., float4(1,1,1, fcolor.a) in the shader - causing hairs to have a strong bold outline. The shadows would appear unnatural and break the illusion of realism - still, this allows for artistic creativity - freedom of creativity - since the ability to customize the visual effect (less repetitive tool).

Experimental Results

The solution runs at real-time frame-rates and is ideal for games or interactive environments. Produce excellent visual effects. We are able to vary the fur types e.g., fine, thick, clumpy, and messy, as with the original fur/hair technique, while adding shadow emphasis. The method is simple and intuitive and can be combined with customized textures to create artistic solutions.

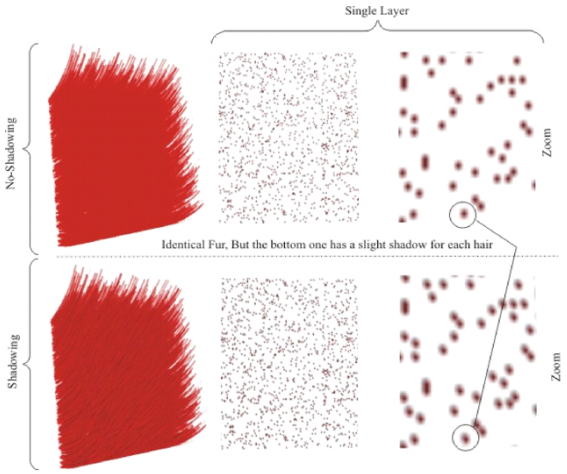

Figure 3: *Layer with and without offset shadow method.*

Conclusion and Discussion

We have presented a computationally fast and straightforward technique for synthesizing aesthetically pleasing life-like hair and fur effects. While our technique focused on hair and fur, it could, nevertheless, be applied to other volumetric viewing solutions. Moreover, our model effectively adds visual details without sacrificing the elegant simplicity and advantages of the original shell technique. We anticipate our approach could be combined with additional hybrid techniques to produce ever more realistic and engaging solutions. For example, one promising direction would be the combination of fins, with strands of hair, to create coherent hair. Short hair using shells and longer hair using strands.

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