Skunk: DreamWorks Fur Simulation System

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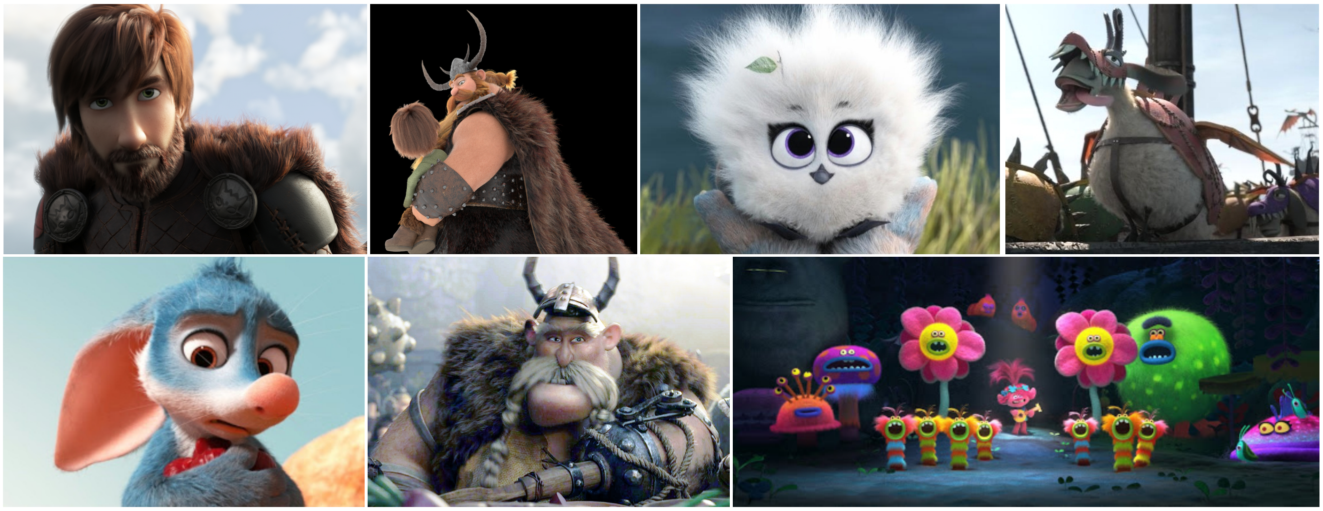

Figure 1: Examples of fur simulated using Skunk

ABSTRACT

This talk presents DreamWorks' fur simulation system *Skunk* which is used to simulate fur on characters, garments, and props. *Skunk's* ease of use, speed, stability, interactive nature, flexible framework, layered simulation approach, on the fly fur setup capabilities, consistency, and artist controls pushed boundaries of fur motion and interaction, and expanded artist usage at DreamWorks. The system was widely used in the film *How to Train Your Dragon: The Hidden World*, the short *Bilby*, and is being used on current feature films and shorts at DreamWorks.

CCS CONCEPTS

• **Computing methodologies** → **Physical simulation**; **Procedural animation**.

KEYWORDS

fur, curves, simulation, procedural animation, collision, wind

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1 INTRODUCTION

In reviewing the upcoming complexity with fur at the studio, it was evident character and environment demands meant fur setup needed to improve. The growth in tools and technology allows for more character exploration into environments and character interactions. The previous motion system for fur, in particular, was a place that hindered this advancement due to long setup times and the need of specialized setup artists. A challenge was to eliminate the restriction on the creation of character and environments for interaction and simulation purposes. This led the way to creating a system that is fur creation agnostic (due to ever changing or evolving creation tools) as well as conforming the output to studio standards for an evolving pipeline. Skunk allows usage by non specialized artists and can also be a test bed for pre-production fur development. The goal was to create a strong container for procedural and simulation based collision and motion systems to live, while not needing to conform to evolving pipelines or a high level of setup knowledge. This allows every artist to setup and create a fur system in a shot, and freely share it with others, without the need of questioning which character or environment would be collided with or simulated against.

2 FRAMEWORK

Skunk uses *USD* to identify every character or environment asset in a shot that has a fur cache (curves at reference pose) attached. Each character, with a relevant fur cache, is then placed in its own folder. As fur groups are added or subtracted, *Skunk* adds or removes the necessary overrides (deformation attributes and motion guides' file locations) for downstream departments to pick up the change

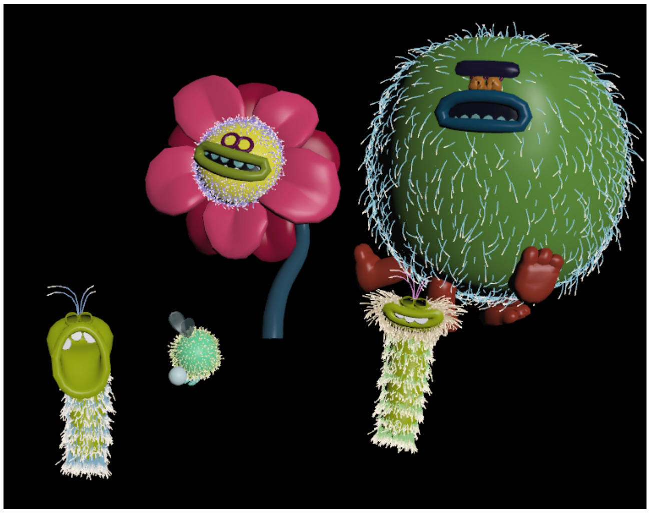

Figure 2: Multiple characters interactively set up in a shot with artist controlled collision and decimated motion guides per selected character.

in motion. Each fur cache is pruned to a usable level of detail interactively settable by the artist, at which time those fur curves are attached to the animated model, and then output to disk with the added motion/collisions as motion guides. These motion guides act as a driver for the full set of renderable curves to follow. Each fur group is passed through the motion system identically, both for ease and troubleshooting. *Skunk* takes the waterfall approach for fur setup and interaction. At the top level of *Skunk*, an artist can globally set the wind/collision/interactions of every character and their fur at the same time in a shot. Then, if needed, an artist can dive one level deeper into a specified character and edit the wind/collisions/interactions separately from the other characters in the shot.

3 SIMULATION

The new workflow was designed to minimize future limitations and this includes how the fur is simulated as well. The current framework uses *FollicleSampler* on the fur cache to quickly get a spatially uniformly sampled set of follicles/curves, then uses *FurAttach* to attach those curves to the animated skin. This approach guarantees a solid platform for the artist to use *FurCollide* [Somasundaram 2017], which provides robust fur collisions, and/or use *CurveWind*, which provides procedural wind with gusts and wind shielding capabilities. If the artist needs a little something extra, or does not need collision or procedural wind, they can activate *CurveJiggle*, which provides fast controllable jiggle/secondary motion. Each of these processes can be used individually or strung together giving the artist full control and flexibility for the task at hand, versus a traditional hero fur setup which would attempt to account for every possible situation in an ever evolving film. *Skunk* is implemented to allow these methods of movement, whether it be the *FurCollide* process or the procedural *CurveWind* nodes, to be updated and improved with technology or needs. The tools sit inside *Skunk* and are not tied to it, allowing full autonomy to evolve along with workflows and situations.

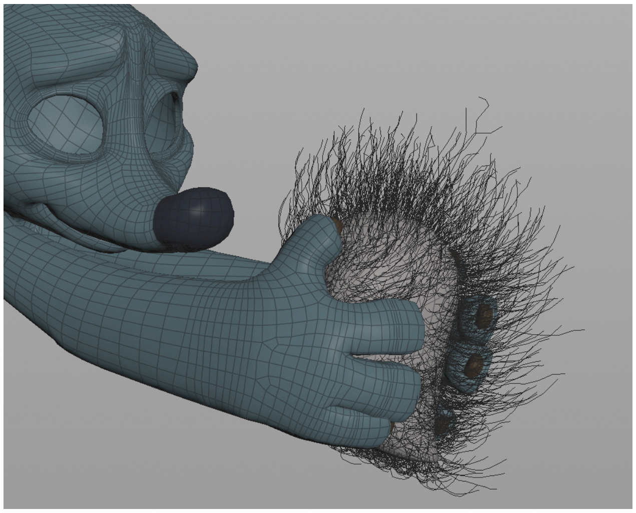

Figure 3: Fur collision with wind added on the artist controlled decimated motion guides.

4 IMPLEMENTATION

Skunk was implemented in a node-based procedural third party package. The various custom nodes *FollicleSampler*, *FurAttach*, *FurCollide*, *CurveJiggle*, and *CurveWind)* are multi-threaded and implemented in C++ and the third party's expression language. The nodes are optimized and allow the artist to work interactively with tens of thousands of curves. Once *Skunk* has simulated the spatially sampled curves, the final full set of curves at render time are deformed in the in-house fur geometry shader using a custom wrap node [O'Hagan et al. 2015] that also maintains the collision free state established by *Skunk*.

5 CONCLUSION AND RESULTS

Skunk has allowed many projects to open the eyes on what is possible with fur interaction and motion. Projects are encouraged to explore and interact with furred characters and one-off shots, where past productions may have strayed off due to time or limited resources. Information is consistent from character to character or environment. If problems occur, the same artist who created a fur setup is able to debug the shot. *Skunk* enforces good practices while ensuring exploration and growth towards future ideas in fur simulation and collisions.

Skunk was used extensively in the film *How to Train Your Dragon: The Hidden World* and the short *Bilby* on hundreds of shots on various fur assets and is being used on the current feature films and shorts at DreamWorks.

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