The Art and Technology of Simulating Hair in Disney's Moana

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Figure 1: concept art by Jin Kim ©2017 Disney

Figure 2: hair sim by Iker de los Mozos Anton ©2017 Disney

ABSTRACT

From the early concept art, we knew the level of complexity in hair interactions and dynamics on Moana was beyond anything we had handled in the past. In order to meet these challenges, we developed the Disney Elastic Rod model and introduced persistent, simulatable frames to our curves. In this presentation, we will discuss the motivation and details of our hair simulation and technical animation process, as well as the implications of the new model both to artist interactions and our pipeline.

1 OVERVIEW

Moana's demanding simulation needs required a change in the way hair was handled. From hair grooming to technical animation the process had to evolve to handle long curly hair. First was to create a new bend model, Disney Elastic Rods, in order to support twist for curly hair. A way to store that new twist information was also needed which lead to a new data structure, the Multicurve. This was more involved than just creating a new data type. The rig build process and deformers would also need to be updated to support the multiCurve Node. The new data type not only supported frame data but it allowed for dramatically increasing curve count in grooms and simulation rigs.

2 SIMULATION

One of the keys to achieving more natural looking hair, in simulation, was to change the approval process. In the past, hair was evaluated in a static turntable and approved before moving on to simulation. This created unnecessary difficulties and hamstrung hair performances for simulation when the structure of the groom needed to be adjusted to support proper motion but was unable to modify an approved groom. The show embraced evaluating and approving the groom and simulation in motion. This meant the directors were not shown the groom until after simulation had put them into motion.

This allowed simulation to vet the structure of a groom for motion while it was still in work, which allowed for more back and forth with the Look department. Grooms could be simulated and settled before look finished and the process became a lot more fluid. With these improvements in the process, the simulation rigs became less engineered and in turn became simple. By adjusting a handful of settings, hair could become wet or appear underwater. The structure that had previously held highly stylized grooms in place was removed. Another improvement that made this possible was the addition of dynamically created wire-wire connections. When the hair moved off the groomed style it was now possible to hold this new shape. Previously the hair would try and pull back to its original shape often causing unnatural motion.

3 TECHNICAL ANIMATION

The technical animation team adapted their in-shot hair simulation process around the Disney Elastic Rod model. Collision driven hair rigs opened up the possibilities of what the character's hair was able to do. Consequently, this freedom of motion also impacted artistic direction and continuity. The hair rigs contained more individual sim curves than we had worked with previously. Dealing with a higher curve count meant staying in the sim longer and heavy handed post work would stand out compared to the detailed sim. Post shaping and cleanup were still done but the majority of the performance was achieved in simulation. Detailed interaction when simulating actual curled curves proved to be difficult and a new grab node was developed to help with complex interaction and collision. The outdoor setting of the film required various levels of wind on the character's hair. From subtle keep-alive to turbulent storms, the hair needed to fit into the surrounding environment. In the end, almost every hair shot in the film used wind fields which was a first for the studio. Wind shadowing functionality was added to the solver for Moana. Before it's implementation, we found a lot of time was being spent trying to replicate the effects of wind shadowing by painting custom maps and adding extra fields per shot. After wind shadowing was added to the solver, we were able to achieve a much more natural result with less custom setup per shot.

(http://www.cs.columbia.edu/cg/pdfs/143-rods.pdf)