

Simulation Preview in *Brave*

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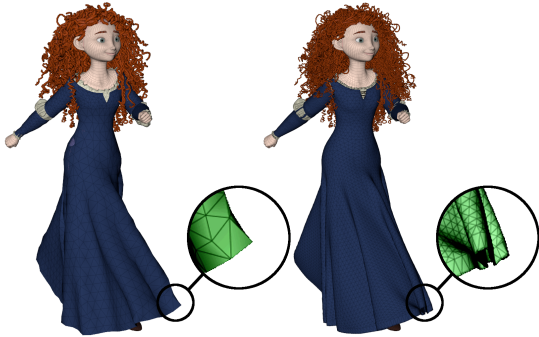


Figure 1: Low vs high-resolution garment. ©Disney / Pixar. All rights reserved.

The interaction between character animation and simulation can be a challenge in computer animation. On *Brave*, every character has clothes, hair or most of the time, both. Ranging from simple dresses to complex kilt arrangements, characters could often be wearing multiple layers of clothing changing their silhouette drastically. In order to judge the character's animation properly it was helpful for animators to see simulated clothes while working. For that purpose faster low resolution versions of cloth and hair models were created. Animators were then able to run these preview simulations themselves. Seeing how clothing and hair would react to the movement of the characters enabled animators to achieve a more natural and believable interaction between the two. These "preview" clothes and hair helped minimize the number of iterations between the animation and simulation department and became an important tool when conveying acting ideas to the director. It became common practice to show animation with clothing and hair during animation review in order to final it. Animators often saved a lot of time by only partially animating the legs of a character since they were covered by clothes.

1 Cloth Preview

In order to enable animators to properly interact with the characters clothes, possibly adjusting acting choices based on its movement and limitations, a fast, interactive and easy to use representation of the characters clothes is needed. On *Brave*, low-resolution garments were automatically generated through a build process. These "preview" clothes are inheriting all of the tailoring properties of the full garment and their tessellation resolution could be easily controlled through face selection sets. Preview garments were usually reduced by up to 80% of the original polygon count. To further speed up the simulation time, those parts of the clothes that were tight to the body were warped. Undergarments were usually ignored and the collision offsets adjusted accordingly. While we were able to reduce the total simulation time to about 10% of the original, preview garments maintained a very close parity to the high resolution simulation result. Furthermore simple controls were added

to the individual garments to allow for posing and grabbing the clothes.

2 Hair Preview

Merida is *Pixar's* first character that features long curly hair. Throughout the movie Merida is interacting with her hair in several ways. We provided the animators with tools for precisely posing her hair while preserving the overall look, length and volume. Animators created a wide variety of poses that were saved in a central library and could easily be accessed in any shot. Through our preview simulation tool animators could simulate her hair either starting in a particular pose or targeting the hair animation throughout the shot. To improve simulation speed animators were only exposed to a subset of hairs which could be reduced even further through LOD ("level of detail") controls. Similar tools were used on Angus' tail and mane as well as the WiseWoman. Angus' controls were especially useful when he was in full gallop or flicking his tail. Animators could roughly pose the basic shapes and convey timing and weight which could then be used during the simulation.

3 Directing simulation

In order to achieve directable simulation in *Brave*, *TRACKS* [1] forces were implemented. A *TRACKS* force is a diffuse force field that acts on a selection of points. The advantage of *TRACKS* forces over traditional constraints is that the integrity of the base simulation is kept. For instance, folds and wrinkles are preserved during the simulation allowing it to move more natural. On *Brave* *TRACKS* forces were implemented for both cloth and hair simulation in three different flavors, point, curve and patch based. These forces were used in a variety of ways. A single point based force was used as an easy tool by both animators and simulation TDs to visualize a character grabbing his dress or hair. More sophisticated curve based rigs were build to guide dresses hem lines and in rare cases a patch based solution was used to target a low resolution simulation during a full resolution simulation. Primarily Fergus' cloak used this approach since his low resolution simulation sometimes had better results than the high resolution garment.

References

- [1] Mikls Bergou, Saurabh Mathur, Max Wardetzky, Eitan Grinspun. *TRACKS: Toward Directable Thin Shells*. *ACM Transactions on Graphics (SIGGRAPH)* 2007.

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