Wig: The Hair Story From *Shrek 2* to *The Croods: A New Age*

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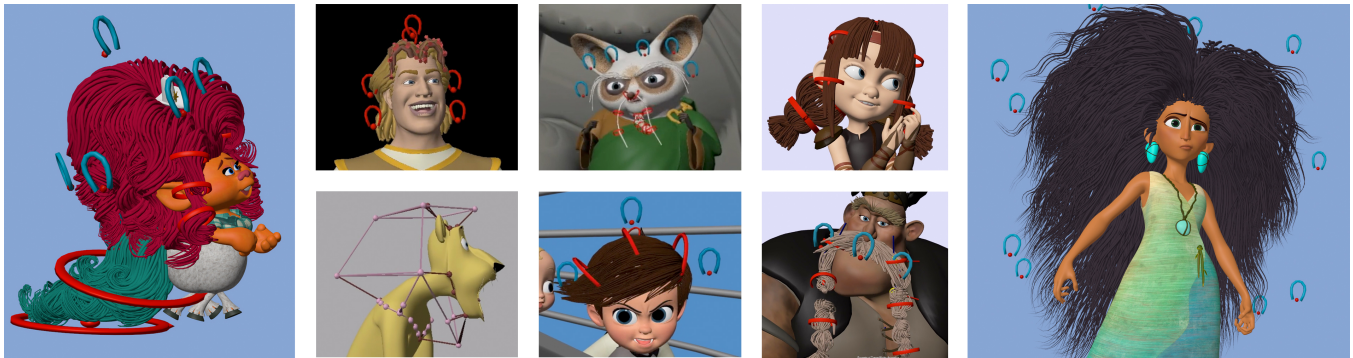USA
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Figure 1: Example character hair rigs from *Wig* used in film shots across all our franchises

ABSTRACT

This talk presents the features and history of DreamWorks' Wig system, which has been used over the past twenty years on 28 animated feature films and over 2,000 hair setups and growing. The principal philosophy of the system since its inception has been to place control over simulations into the hands of animators. Over time, the system and its related tools have been updated to meet the challenges of evolving technologies and respond to animator needs. With its production proven history, and flexible architecture, the system continues to adapt to recent hair-heavy productions.

CCS CONCEPTS

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

KEYWORDS

hair, rigging, motion, simulation, procedural animation

1 INTRODUCTION

From the dashing hair on *Shrek 2*'s Prince Charming to the elaborate hairstyles of *Trolls: World Tour* and *Croods: A New Age*, DreamWorks' Wig system has provided an easy-to-install, full-featured solution, meeting the needs of rigging, character effects and animation. Over nearly two decades, the system has had to evolve in order to keep pace with generational changes in the industry and DreamWorks' proprietary rigging and animation tools. Features have been added and core underlying simulation technologies have been replaced.

2 INDUSTRY CONTEXT AND PIPELINE CONSIDERATIONS

One thing that sets DreamWorks apart from other studios is the importance for animators to pose and simulate hair during animation has always been central to the technology and workflow approach. During much of the period our Wig system has been in use, the rest of the industry has largely treated hair simulation as a post-process: animating bald characters or static hair, then giving simulation notes through draw-overs. DreamWorks has historically provided animation with customized motion and simulation rigs for each character to achieve hair poses and performances appropriate for the art direction of the shot. Our hair rigs provide animation with

control over posing and high-level simulation parameters, with the simulation offset data living within animator control.

After DreamWorks' character effects (CFX) department and pipeline was established, with a robust toolset with advanced simulation solvers, rigging began providing CFX with animator-posed curves that act as the starting point for final hair simulation for hero characters. Once approved, an indicative (lightweight) simulation that approximates the CFX simulation is installed, for animation to work with for the rest of production. Our generic variants and crowd characters typically utilize Wig simulation for their final on-screen performances.

3 PRE WIG

Prior to *Shrek 2*, simulation was already a part of character rigs, beginning with the antennae on the characters on *Antz* (1998), then on the custom hair elements (including tail hair) on Fiona, Farquaad and Donkey on *Shrek* (2001). Several key concepts and expectations were established, and these early explorations laid the groundwork for the Wig system.

4 WIG 1.0 (2002-2009)

Initially created during the development phase for *Shrek 2* (2004), the first version of the Wig System was made possible by then-recent advancements in modular data representations, something that affected our rigging workflows in general. As the name implies, the Wig system was initially intended for the hair on human(-ish) characters' heads, but was later extended to work on full body hair for *Over the Hedge* (2006).

The original Wig system was written in PDI Script (an interpreted language similar to C), iterating over the vertices of organized sets of guide hair curves.

The feature set of Wig 1.0 included:

- Attachments – Defines how hair moves with character heads and skin surfaces
- Magnets – Easily-understood animation metaphor for moving masses of hair
- Length Preservation – Minimizes stretching due to simulations
- Compress/Repel – Creates the illusion of hair-to-hair interaction and volume
- Dynablend – Easy control over the magnitude of simulation results
- Global2Local – Animator control over the effective scale of the simulation space
- Sim Strand – Used for bangs and ponytails, with collisions
- CV Sim – Lightweight secondary simulation to provide per-guide-hair variation

5 WIG 2.0 (2009-2011)

The second major version of Wig was a complete overhaul of the base code in response to a major shift in DreamWorks' rigging paradigm, which underwent a transition from executing a procedural script to a node-graph representation.

The features from Wig 1.0 were split into a set of script operators (nodes) that were then connected together to create the same net result. The main advantage of this node representation was flexibility: depending on the complexity of a given hair setup, nodes could be bypassed, removed or reconnected in different orders. It also made parallel execution more straightforward, something that would become increasingly important in the real-time experience of DreamWorks' Premo Animation System.

Two new simulation technologies were created for this generation of Wig: CDY, which was an implicit particle-based system, and Rigid Rod, an implicit strand-based system. Both included collision detection and response.

While there was a user interface for Wig 2.0, it was rudimentary and changes to wig setups were done by rewiring nodes in a graph.

6 WIG 3.0 (2011-2014)

The primary improvement in the third major development of Wig was its user interface. Without editing a graph, users were now able to create and edit hair setups, using a drag-and-drop paradigm to add "steps," which corresponded to the various features from Wig 1.0 and Wig 2.0. This made hair authoring more intuitive, making it possible for more rigging artists to work on hair without specialized training.

Another advancement during this period was the refactoring of the Wig codebase and hair methods into modular functions, effectively creating a Python API for Wig, which enabled future development and expansion. This made it easier for users to write their own custom "steps" to adapt to the growing creative requirements and challenges of the more recent productions.

7 WIG 4.0 (2014-PRESENT)

The development of the fourth generation of Wig was primarily driven by the production use of a new proprietary hair model, Willow, requiring much of Wig's low-level code to be rewritten. In addition, the user-friendly interface from Wig 3.0 was extended to include support for variant warping, which allowed users to create a single hair rig for a character and then easily share that rig across variants.

It was also during this time that another simulation technology was developed and used for long hair setups. DynaWhip provided superior simulation for medium and long-strand situations, as well as collision detection/response.

8 CONCLUSION AND RESULTS

Although DreamWorks' Wig system has undergone multiple major updates, overhauls and paradigm shifts in its near-twenty-year history, the main concepts and features have largely endured. Along the way, the system has been adapted for newer, superior technologies, and hair rigging workflows have been streamlined, providing an adaptable framework for a changing landscape of increasing complexity. Nineteen years, 28 films and over 2,000 hairstyles later, Wig's principal mission remains the same: placing control over hair simulation into the hands of animators.