

Hair Grooming with Imageworks' *Fyber*

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Figure 1: Black Wind from Disney's *MULAN*. ©2019 Disney Enterprises, Inc. All rights reserved.

ABSTRACT

Fyber is our new proprietary standalone grooming software solution for hair and fur on all current and upcoming film projects.

It was developed at Sony Picture Imageworks (SPI) to address the need for a faster, more interactive and more artist-friendly tool to generate any kind of hair, ranging from a characters head hair to fully furred animals, with the goal to significantly lower grooming times and an easier learning experience for new artists.

As a node based software, *Fyber* offers great flexibility to achieve any look an artist might desire while also providing fast visual feedback thanks to its highly multi-threaded computation graph and integrated OpenGL and Arnold viewports.

Fyber's underlying engine is fully separated from its user interface which allows for a seamless and easy integration into 3rd party applications like Maya and Katana where it can be used to compute hair on the fly or to render it to their respective viewports.

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It was first used for SPI's work on Disney's *Mulan* and has replaced our previous grooming solution on all shows ever since.

CCS CONCEPTS

• **Computing methodologies** → **Computer graphics**.

KEYWORDS

hair, fur, grooming, interactive

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1 MOTIVATION

Our previous in-house grooming solution has served us very well for a long time, but after many years of use we felt that deficiencies in performance and ease of use could not be addressed easily. And after comparing many existing third party solutions we decided to build a new system from scratch to make sure all our current and future goals and needs can be fully addressed.

The primary goals were:

- High performance, so minimal time is spent waiting for visual feedback.
- Easy to learn and use to minimize training times.

- No differing between grooming with guide hairs vs. final hairs.
- Complex procedural effects.

2 GENERAL WORKFLOW OVERVIEW

In an easy to use interface the artist has a wide range of available nodes to chose from:

- Import / Export nodes to bring in existing curves, meshes or textures, as well as to export them.
- Creation nodes to create curves and geometry live in Fyber.
- Effect nodes to manipulate curves, e.g. instance, curl, clump, length.
- Math nodes to control input parameters of nodes.
- Utility nodes like merge and split to control the flow of the graph.
- Mesh nodes to manipulate mesh geometry.

Once a character model is imported into Fyber, the artist can either bring in existing guide curves or start generating new ones with tools inside Fyber. Instancer effect nodes are used to generate any amount of new hair, either based on guide hairs, or on user-defined parameters. A wide variety of effect nodes can be used to procedurally add some curls or clumps, shorten or lengthen the hair, or apply any imaginable manipulation to curves. Almost all parameters on any node are exposed to the node graph and therefore can be controlled by math node networks ranging from simple multiplication of two values all the way to painting masks live inside Fyber. The Sculpt node allows the artist to not just procedurally shape the hair, but instead to use interactive brush and scissor like editing tools in the viewport. And since Fyber does not differentiate between guide and final hairs all those modifications can be performed at any point in the node graph.

Fyber's node graph allows the artist to view the groom in the viewport at any node and the integrated Arnold viewport offers some incredibly fast near-final render previews.

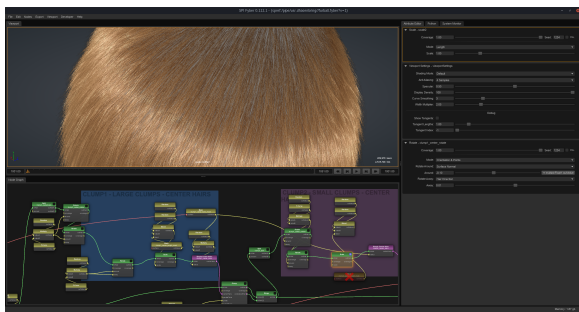


Figure 2: The main interface of Fyber.

Finally, the groom is brought into Katana via Fyber Engine for final lighting and rendering of a shot.

Fyber Engine is also used to bring our grooms into Maya where it can be used to preview hair for animators live in their scenes. The plug-in allows to intercept the node graph at any point, so Maya Nurbs curves can be generated based on the output of a Fyber node, then be simulated via Maya's nHair, then brought back into Fyber's

node graph where they finally are rendered by Fyber's OpenGL renderer to the Maya viewport.

3 TECHNICAL DETAILS

Fyber is written as a DCC-independent C++ library and features a custom node and compute graph that is highly multi-threaded and offers easy ways to perform certain operations on the GPU via OpenCL kernels. Smart memory management ensures that memory allocations are kept to a minimum for maximum performance and custom multi-threaded memcopy functions allow for maximum bandwidth usage when necessary.

Connections between nodes are separated into two groups: simple and complex. Simple connections (Floats, Colors, Numbers, ..) are evaluated on the fly by a downstream node. Complex connections (Hair Buffers, Meshes, ..) are computed once and then passed on to the next node. In other words, simple data is pulled, complex data is pushed.

Fyber's API allows for easy creation of new nodes, as well as easy integration for custom viewport renderers. The default OpenGL renderer converts curves from lines to nicely shaded ribbons on the fly via geometry shaders and can handle millions of hairs in real-time.

Fyber's standalone user interface is written with Qt 5 in C++ as a fully separate layer on top of Fyber Engine and features the aforementioned viewport and node graph, as well as the attribute editor, a python console and system monitor. It supports all common user interface features like full undo/redo support, copy/paste of nodes and aims to give the best possible user experience.

Textures and masks can be painted directly in Fyber. It offers a Photoshop-like brush that can be used in either screen-space or world-space and fully supports tablet input for Wacom users. The paint tool uses a mix of OpenGL and OpenCL for maximum performance, allowing the artist to paint multiple high resolution maps spread over UDIMS at once.

Since Fyber is built around the concept of a non-destructive workflow, the Sculpt tools can also operate in this manner. Every brush stroke performed is recording the necessary actions like mouse position, camera view and tool settings to replay what it did. This allows for the whole manual sculpting process to be replayed whenever the input changes.

The Hair Select tool allows the user to select curves in the viewport and uses OpenGL Geometry Shaders and transform feedback to compute the selection on the GPU for accurate ribbon selection and instant feedback even when selection millions of curves.

ACKNOWLEDGMENTS

We are grateful to Joe Eckroat and his team who were the first early adopters of Fyber, as well as to everyone at SPI for giving us the chance to come up with and work on such a big development project!