Crafting Feathers for the Bird Kingdom in Hoppers

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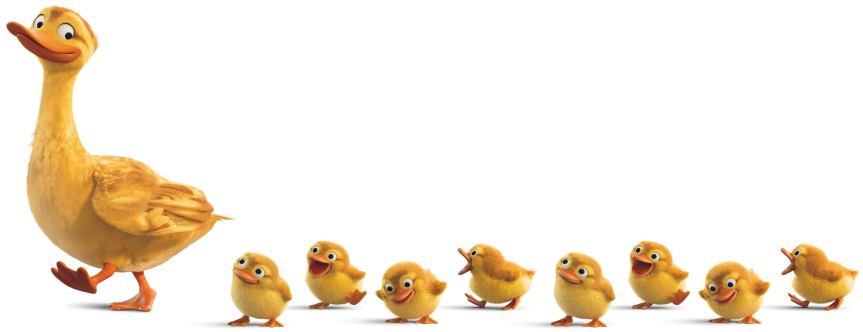

Abstract

Hoppers features a diverse range of animals, with birds among the most prominent. We needed to support multiple species—from geese and ducks to songbirds, herons, and patterned owls—each with distinct silhouettes, feather structures, and flight behaviors. A key challenge was creating feathers that supported expressive animation while remaining natural and cohesive across a large cast. To address this, we adopted and customized Houdini's hair grooming system to match the film's visual style and production needs. The system allows groomers to visualize, design, and artistically shade feathers while providing controllable secondary motion that complements wing animation and enhances the realism of birds in flight. On the shading side, we leveraged the Lama hair shader to create a flexible network capable of handling both simple single-color feathers and complex, two-sided patterns, such as those seen on owls.

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1 Surface Model to Render Feathers

The feather system was developed in close collaboration with the rigging and tools teams to ensure compatibility with the film's deformation and animation requirements. The character models included both a skin and a silhouette surface that indicated the extent of the feather volume. The skin and silhouette surfaces (Figure 2a) were imported into Houdini, where feathers were groomed using customized versions of the Houdini hair grooming tools (Figure 1).

Figure 1: Houdini feather network. ©Pixar

Feather surfaces were attached to the guide hairs (Figures 2b & 2c), then oriented and de-intersected using a vellum simulation. High-resolution curve-based render feathers were generated for each feather surface and attached using Pixar's Weave render time deformation system (Figure 3).

Grooming was organized by body regions, such as scapulars, coverts, and flight wings, allowing precise control over feather type and distribution across the bird. This approach provides immediate visual feedback, enabling groom artists to adjust feather size and type while adhering to the guided groom framework provided by the rigging team. Body color textures can also be applied during grooming, which is particularly beneficial for patterned birds, such as owls, where the groom closely approximates the final render.

2 Rigging Groomed Feathers

The subdivision feather surfaces were exported from Houdini into USD and integrated into the Presto character rigs. Character rigging concentrated on articulating the silhouette surfaces. A Cage warp was used to carry the skin surface along with the rigged silhouette. A new Presto feather deformer was created to drive the feather surfaces with the rigged skin and silhouette surfaces. The deformer could also loft and scale any feather, and using weight maps could achieve fluffing and fluttering effects.

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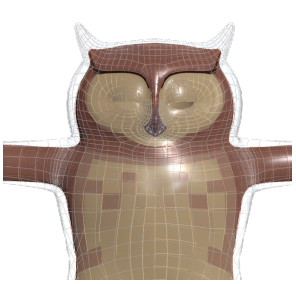
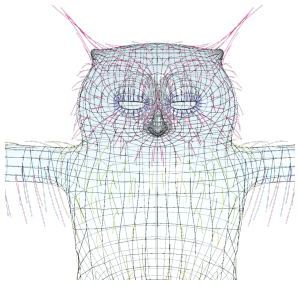


(a) Skin & Silhouette surfaces



(b) Wire guides

(c) Feather surfaces

Figure 2: Feather groom components ©Pixar

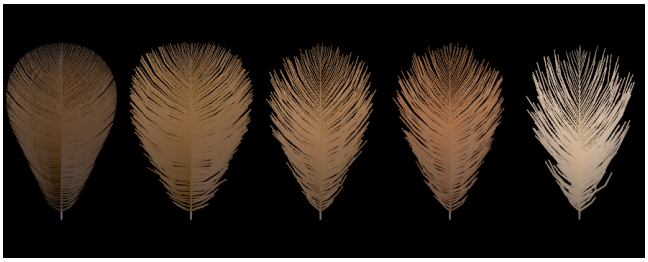


Figure 3: Curve-based render feathers ©Pixar

Figure 4: Materials exploration on feathers. ©Pixar

3 Feather Shading

We developed a feather shading framework that supports both full-body color painting and per-feather variation, including gradients and soft edge transitions. Custom primvars authored in Houdini expose shading controls, with each feather carrying both feather-space and skin-space UV sets (Figure 4). To support species with two-sided flight feather coloration, we implemented a custom op script that could evaluate feather orientation relative to the camera and select the appropriate side-specific color or pattern at render time. Integrated with our in-house feather weave system, this data is visualized in our shading tool - Flow. This enables simultaneous skin and feather shading. With Pixar's Hydra 2.0, this workflow extends to interactive shading of posed bird characters.

4 Flutter Effects

From a performance perspective, the feathers needed to respond to things like wind, flight, and high-energy movement in a natural way. We also wanted to provide an interface for animators to emote with the feathers in a controllable and directable way.

We developed multiple tools on top of the core feather deformer to allow shot artists to procedurally create flutter, wind, and emoting effects directly within Presto. This was done by authoring weights on the loft and scale controls in the feather deformer. By layering various noise fields, body regions and other spatial masks, shot artists could quickly create the appearance of a breeze flowing over the feathers or have specific tufts of feathers puff out and wiggle around to add to a character's expression.

When needed for specific shot situations, the feathers could be fed into a cloth-based physics simulation to achieve higher fidelity collision and wind response. The simulation treated each individual feather as a cloth strip. A tiered approach allowed the artist to choose whether to simulate all body feathers, just hero wing feathers, or some blend in between. Often, a simpler simulation was combined with the procedural flutter controls to achieve the desired performance.