Kung Fu Panda2: Rigging a Peacock Tail

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Illustration 1: Artistic Rendering of Lord Shen

The Lord Shen character in *Kung Fu Panda 2: The Kaboom of Doom*, is a peacock requiring subtle performance yet also the capability to achieve a variety of challenging kung fu stunts. We present the Lord Shen's tail rig and discuss an approach that streamlines the animation process while adhering to a broad and complex specification. Our peacock tail implementation allows for an arbitrary arrangement of feathers, varying in count and number of layers, while maintaining a concise animation interface and avoiding inter-feather collision.

1 Specification

Lord Shen is described as regal and sophisticated. His tail, comprised of roughly a hundred feathers organized in four concentric layers, is partially hidden under a robe, and based on the pre-production Art may change feather count per shot or even per pose. The animation is described as deliberate, utilizing an economy of motion. Its form and silhouette is smooth, "like a continuous surface" (*see Illustration 1*). The feathers are graphic, their pattern readable (story point), and arranged organically.

The animation requires subtle motion conveying body language, or acrobatic influenced kung fu moves: bunching his feathers together to use as a staff, sweeping his tail to knock down opponents, springing off his tail to propel himself upward, or fanning it to use as a parachute. He may use his tail as a shield, splitting the feathers at arbitrary locations and striking his opponent. The feathers need to move within the form without changing the silhouette, "like wheat in the wind". In the typical case, Lord Shen's four layers of feathers are partially hidden under a robe and drag across the floor, all the while avoiding feather to feather intersection.

2 Approach

With an estimated 20 joints along each feather (necessary to achieve the tightness of bends) and roughly 100 feathers, a brute-force animation approach is out of the question. We utilize a hero-spoke approach. This approach requires a highly controllable spoke posing system, and a robust interpolation algorithm to produce the in-between feathers.

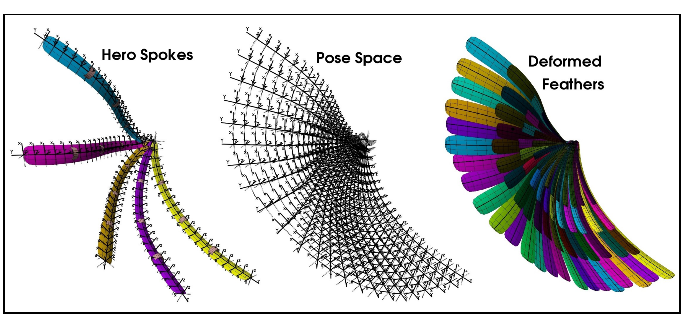

Figure 1: Hero Space with Interpolated Pose Space Approach

The pose space is the lofted space between hero spokes *(see Figure 1*). The placement and lengths of the feathers are established parametrically, and pose space controls are designed to take advantage of this. Shifting the bias of the placement, or bunching and spreading feathers within the pose space, can be accomplished with a simple algorithm for adjusting the parametric placement across the space. The splitting of feathers at arbitrary locations is accomplished in a similar fashion.

Dynamic motion of the hero spokes influences the pose space, and pseudo-dynamics are applied to the concentric layers by parametrically shifting the feathers laterally within the pose space. The parametric space is rotationally extrapolated to maintain feather lengths and allow for greater pseudo-dynamic overshoot.

3 Collision Avoidance

Typically, an approach to rigging a tail like this would utilize an input model consisting of the full compliment of feathers, free of intersection. The main challenge would be to keep them free from feather to feather intersection while posing. Collision response techniques tend to be unstable through a broad range of motion and jeopardize silhouettes, or employ costly simulations which can compromise posing interactivity. Our implementation takes a proactive to approach to collision avoidance instead of accepting the downsides of collision response.

To minimize the deformation requirement and accommodate an arbitrary feather count, we clone and vary all feathers from a single input feather internally. Rather than dealing with the typical collision detection issues we simply deform each feather in a manner which keeps them from colliding with neighboring feathers. We detect the proximity of each feather joint to each of its neighbors and as the feathers bunch up, a profile curve supplies a thickness scale value to remove the bow from portions of each feather. In this way, the feathers can all be animated in a close bunch while maintaining a relatively thin silhouette.

Ground contact is resolved on the pose space by marching down each parametric sample of matrices and resolving the contact while maintaining pose space length. The concentric layers compute their pose in the shared pose space. To ensure collision avoidance between layers, the final step applies an offset to each layer to create the separation that would have otherwise been modeled into the full compliment of feathers in the input model.

Figure 2: Production Render

4 Production

The Lord Shen Character is currently in production on *Kung Fu Panda 2: The Kaboom of Doom.* He is able to perform to the extreme range of animation and subtlety movement while lending itself to the artistic creation of performance and art direction without burdening the Animators' work flow (*see Figure 2*).