Skin Deep Beauty
A production friendly creature geometry pipeline used on HULK

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Introduction
Given the daunting task of creating a scantily clad overdeveloped photorealistic “human” in several hundred shots, surface weighting alone couldn’t produce satisfactory results, yet full muscle systems require extensive rigging and provide indirect control over the resulting geometry. By breaking the skin performance down into three separate categories, form, function and dynamics, the aesthetics of a full muscle system were achieved without the heavy creature rigging. Other benefits of this approach included fast simulation, more direct feedback for animators, and UV independent sculpting of surfaces.

Three Tissue Issues
Simplifying geometry concerns three areas: form, dynamics and function. This allowed a modular approach to the problem.

Form throughout a wide range of motion was crucial. For each major joint in the creature, we used simple up-vector and directional constraint rigs to obtain local polar coordinates. These two angles indexed a matrix of shapes. The remaining rotational transform was handled by traditional surface weighting technique. This hybrid enveloping/posed-based system gave Hulk his basic form. Additional shapes were used to animate muscle tension. To simplify this shape animation of muscle relaxation and tension, common patterns of muscle firing were choreographed and combined into single “MultiStage Shapes”. A breathing cycle, for example, was controlled by a single slider, yet drove a pre-choreographed series of twelve independent shapes.

Dynamic flesh would also be needed to help sell the weight of this creature. Hulk was to be closer to an Olympic athlete than elephant, and with high muscle tone, the problematic “folds of flesh” needed for a dinosaur or elephant were not a concern. We opted for a paired down set of individual springs that would drive an additive skin weighting system to create a subtle but convincing overlap in muscle motion. Each spring was adjustable on an individual transform basis to allow muscle masses to bias motion along a particular orientation. In hero close-ups, texture anomalies would be visible.

Function. The slight offset between the form and the texture of a creature is where the realism is created. “Skin over bone” was needed to seal the other elements into a cohesive and believable creature. Polygonal meshes corresponding to the surfaces geometry were simulated with traditional cloth parameters augmented by two new types of spring. A “shape” spring that connected this mesh back to its “home” location on the surface and a “model spring” which connected the mesh dynamically to the nearest point on the surface. The mesh was given dual biphasic springs to control in plane stretching allowing the mesh surface to compress easier than stretch. By balancing these in plane stiffness parameters against the model and shape springs, the mesh distributes motion evenly across a surface. The mesh is then pulled in plane with the closest point on the surface (its current model spring attachment point) assuring minimal distortion to the original silhouette of the creature. This mesh is then used to deform the original surface. This technique was used to minimize texture stretching but also proved to be a useful tool in correcting span distribution in the creation of the pose shapes. Modellers could sculpt without concern for span distribution, and the spans would be relaxed over this form. Allowing the simulation engine to distribute the spans also helped avoid UV swimming from pose to pose.

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