

# Virtual Tailoring for *Ratatouille*: Clothing the Fattest Man in the World

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Figure 1: Gusteau's first appearance in the film *Ratatouille*. ©Disney/Pixar. All rights reserved.

He's fat. Enormously so. Essentially a clothed sphere. (A very deformable and complexly animated sphere, with legs, arms, and no neck.) For *Ratatouille*, creating dynamic costumes for every human character in the film required extensive development and innovation in Pixar's cloth pipeline, particularly for the character Gusteau. Modeling and shepherding high-quality simulated costumes through the production of an animated feature is a feat in itself, let alone for a character with such extreme proportions who dramatically squashes, stretches, floats and bursts through the air.

We describe the development of several new modeling and simulation techniques required for Gusteau's costume in *Ratatouille*. These techniques were required to deal with conflicting goals of rendering versus simulation meshes, deliver improved simulated cloth behavior, resolve impossible collision situations, and achieve director-mandated shapes on portions of Gusteau's costume.

## 1 Modeling and Simulation Development

We constructed Gusteau's costume by created a double-breasted cotton chef jacket, cuffed pin-striped pants and an apron. These garments were modeled using a 2D flat pattern-making technique and simulated as irregularly spaced triangular polygon meshes. The jacket and pants were rendered as triangular loop subdivision surfaces, using essentially the same topology used for simulation. The apron, however, was rendered as a quadrangular Catmull-Clark subdivision mesh. The reason for the disparity centers on the conflicting requirements of mesh regularity and irregularity as it pertains to rendering subdivision surfaces and simulating polygonal meshes. (As far as we know, the problems involved are currently known to very few people in the graphics community.)

Past experiences at Pixar indicated that dealing with multiple layers of cloth (four layers of cloth was typical for all the chefs), extreme

character deformations, cloth capable of maintaining a "volumetric shape" (such as shoulder pads), collars, and recovery from excessive intersections and collisions were, not to mention improving the underlying dynamics of the cloth itself were all worthy development projects. We also researched the appropriate level of mesh complexity to achieve an appealing level of realism and behavior for the cloth's folds. We describe some of these projects in the next few sections.

## 2 Auto-Scaling

No constraints were made on the amount animators would be able to squash and stretch Gusteau. As a result, sometimes very unappealing accordion folds would form across the chest when the chest was shortened or the jacket would look extremely taught when stretched. To manage proportion changes, we leveraged the UV coordinates generated from our flat pattern modeling to strategically stretch the clothing depending on Gusteau's body measurements. The same technique was also applied to Gusteau's pants due to the extreme length changes of his legs. The application of this strategic stretching prevented the cloth from engulfing his shortened legs and his pants never appeared too short.

## 3 Anti-Ooze and Shape Maintenance

A particular vexing problem in past films was "oozing" cloth i.e. a slow but perceptible change in cloth shapes over time, on a character with little motion. We developed two different "anti-ooze" simulation techniques which were used extensively; the first technique, "velocity dragging" proved extremely powerful but required keyframing on and off during a shot. The second, "shape friction" was more subtle in its effect, but could be left on over an entire shot if necessary.

Very careful attention to the flow of lines on the shoulders and the waist was also required. The director required a very smooth reverse curve from the neck to sleeve cap. Iterations of modeling the character's body proportions were costly due to the effects of re-modeling on the rigging. Such a fine level of control over the line of the shoulders called for hand tweaks to the shape that would be maintained over the course of a simulation. This required the development of a new force in the simulator to control shape and rigidity. Interestingly, the core ideas behind the shape-friction technique did double duty to create semi-rigid shoulder pad cloth regions.

## 4 Kinematic Targets/Collision Algorithms

Even given our best efforts with the strategic stretching of the pants, gross intersections at the hips and knees sometimes caused Gusteau's pants legs to fall off. This necessitated an underlying target for the pants to track the body. Raw hard spring constraints of the pants points onto the skin are too coarse to yield appealing visual results. We used a training simulation to generate a (non-ballistic) statistical model of the cloth. The actual simulated pants were loosely tethered to this kinematic target, to keep the pants on the legs. Statistically-based (or even cruder) targets also helped our collision algorithms generate even smoother cloth surfaces when encountering deep body-to-body collision intersections. Distance-based collision inverting was also used to reduce collision artifacts.