

# Rat-Sized Water Effects in *Ratatouille*

Gary Bruins   Jon Reisch  
Pixar Technical Memo #07\_14  
Pixar Animation Studios

A particularly heavy effects sequence in the film *Ratatouille* depicts a colony of rats fleeing their home and crossing a long narrow river in several makeshift boats during a rainy afternoon. Nearly the entire sequence was photographed inches above the ground from a rat's perspective. Although this perspective provided a very interesting point of view of the world, it also brought an extra level of difficulty to an already challenging sequence. A raindrop creating a seemingly insignificant two-inch splash in the river could easily span one third the height of our final image. Described below is our approach to achieving believable water related effects from the point of view of a rat.

## 1 Splashes



Figure 1: River Splash in *Ratatouille*. ©Disney / Pixar. All rights reserved.

This sequence required several splashes caused by such actions as rats jumping into the river to explosive shotgun blasts that threaten the flotilla. Working in a world of low camera angles and extreme close-ups required a learning period to achieve believable splashes. A delicate balance between details in the splash's structure and its dynamics had to be carefully maintained to achieve believable results.

Physically based simulations provide convincing water dynamics. However, such simulations are difficult to art direct at the level of detail at which we were operating. A simulated splash that went one quarter of an inch higher than the previous iteration could mean the difference between a composition that works and one that fails. With this consideration we chose to create our splashes with particle dynamics that could afford us much more precision based control.

To create splashes, one or more NURBS surfaces were modeled to represent the overall shape and structure of the splash at first impact. This modeled shape included a flanged bottom that was tangent with the river surface to help blend the two discrete splash and river models. Particles were emitted from the NURBS surface with upward and outward velocities that were dependent on their birth height from the river surface. To further aid in the construction of a successful splash, particles above a user-defined height from the river surface were culled out based on a threshold test using a three-dimensional noise pattern. The modeled shape in conjunction with the noise based culling created a natural looking initial state for the splash. Beyond the initial state, particles were given varying masses based on an additional three-dimensional noise pattern. The

varying masses allowed the splash to rise and fall at different rates, creating a distorting splash shape that resembled the complicated dynamics a splash has while falling.

## 2 Raindrops on the River

As the camera follows the action of the crossing flotilla we find ourselves immersed in a frantic dance of water splashes from falling raindrops. As mentioned earlier, however, what would normally be a small event now has a much more visual impact and importance. Since these small splashes would be seen extremely close and occupy a large portion of screen space, extra care was required for a successful rain splash and interaction with the river.

The river was a dynamically generated model displaced by a procedural system of flowing waves. This model also allowed for additional displacements via projected texture maps.

A splash from a raindrop in this sequence consisted of a rebounding up splash from the river, as well as a small circular wave train centered at the point of the raindrop's impact. A particle system was used to create both the up splashes and circular wave trains. The up splash particles were rendered directly as blobbies; Whereas the circular wave train particles were first rendered from above looking down onto the river, image processed, and projected as displacement onto the river. As it were, the up splash and circular wave trains were not enough to create a convincing splash event. The up splash particles rose from the river surface with no reaction from the river (with the exception of the circular wave train). To alleviate this, we rendered and processed the up splash particles in the same fashion as the wave train particles. This additional set of displacement maps pushed the river surface upward in a small bell curve type shape that successfully connected the river to the splash, creating a single cohesive splash event.



Figure 2: River Raindrops in *Ratatouille*. ©Disney / Pixar. All rights reserved.