

Cartoon Motion Blur for 3D Animation

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1 Introduction

As computer-animated feature films divert from realism, the creative demands of directors and films change. A stylized or cartoon approach to motion blur in 3D animation is needed to support the exaggerated animation and visual style. Existing methods such as 3d motion blur, or 2d curved motion blur are expensive and the latitude for refining these results are limited. Three innovative particle-based techniques for stylized motion blur, developed and expanded over the course of three CG film productions, are presented here. Two are essentially point-based rendering methods, while the third includes simulated particles.

2 Rico's Sushi Knives in *Madagascar*

In the feature film *Madagascar* (2005), exaggerated motion blur was needed as Rico manically chops up sushi with knives. The direction given was that it needed to be very extreme and cartoon-like, in the spirit of Manga.

Four frames of the knives' positions were used and a spline generated through these four time points gave an adequate approximation of the curve needed for the current frame. Surfaces were procedurally derived from the knife models, which in turn were used to place particles.

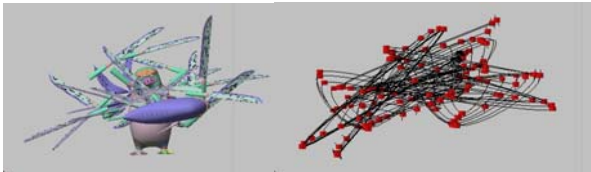


Figure 1: Curves generated from models over time

Mapping coordinates from the surface were used to assign positional and opacity noise. Particles along the length of the streak were assigned a color by sampling an independent image. Each knife's streak required half a million particles to be smooth and clean in the final rendered image.



Figure 2: Particles render and final image

3 Candy Bullets in *The Madagascar Penguins In A Christmas Caper*

In *A Christmas Caper*, peppermint candies were used as bullets, fired from Rico's mouth. At such high speed, standard motion blur would cause the candy to be rendered as an unrecognizable and uninteresting smudge. Directors asked to retain the shape and color of the candy, while adding a jagged-edged, trailing streak.

On each frame, the camera-facing surface of the candy was converted to a collection of particles. Each particle inherited a random shade of the color and velocity from its point of origin on

the candy surface. Each particle was then extended a variable distance away from the candy by generating extra particles along the negative velocity direction.



Figure 3: Candy bullets with jagged-edged streaky motion blur

In the final image, the candy was rendered with minimal standard motion blur to maintain its original form and color. The points were also rendered with some motion blur to create a detailed, variably shaded, jagged, volume-filling streak.

4 Sonic Hammy in *Over The Hedge*

For the hyperactive character Hammy in *Over The Hedge*, filmmakers asked for motion blur that supported his speed by helping him look hyper-fast or supersonic. Based on the workflow in Section 2, two additional elements were added: a) a contrail similar to the condensation of water off the tip of an airplane wing, and b) multiple, strobing legs, spinning in place.



Figure 4: Contrail surfaces and multiple legs

To generate the contrail, particles were emitted from procedurally generated surfaces as described in Section 2. Emitting from these surfaces eliminated the need to over-sample Hammy's motion and filled the entire space between key frames with particles.

In an effort to make his legs appear to be moving faster than they actually were, Hammy was given 2-6 extra, ghosted legs, inspired by Chuck Jones' character Wile E. Coyote. Hammy's leg models were copied from previous frames of the animation and added to the current frame. This was done procedurally, so character animators only needed to animate two legs and no additional work was required to achieve multiple legs at render time.

5 Conclusion

When the action and look of 3D animated films becomes more unrealistic and cartoony, the rendering techniques must match. This can be achieved by creating stylized motion blur through procedurally generated geometry and particle renders. Because these techniques are particle-based, the motion blur is camera-independent, can fill a volume and can be easily exaggerated to meet the demands that filmmakers put on CG production.