

Golden Compass Daemon Deaths

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Visualizing fluid motion around CG and live characters.



Final death with flowing *dust*.

1 Introduction

The daemon death effect for *The Golden Compass* called for an elaborate daemon decomposition when a person met their demise. The effect had to consist of natural and directable flow of layers of galactic matter which tied together the dust concept, central to the plot. The solution we developed advected layers of particles through fluid simulations driven by the deterioration of the host creature. The fluid simulations were fully 3D Computational Fluid Dynamics, using QUICK advection to minimally dissipate vortices, multigrid mass conservation, and Iterated Orthogonal Projections to handle the boundary conditions with the bodies of the host and daemon. The particles seeded several different species of volumetric density and color layers, which were generated in the Felt volumetric system, then rendered in a proprietary volume renderer.

2 Fluid and Particle Simulations

Gas simulation at Rhythm and Hues is based on the Ahab fluid simulator. Artists work directly with Ahab through a graphical interface in Houdini. By using the minimally viscous QUICK advection scheme, vortices in the gas flow persist for long periods of time without dissipating or slowing down, giving rise to more vortex stretching and turbulence than can be computed otherwise. With this level of quality coming from advection, it is unnecessary to use vorticity injection algorithms to keep the gas stirred. Mass conservation is enforced using a very simple and fast multigrid scheme, which is made possible by the Iterated Orthogonal Projection method for enforcing boundary conditions in the multigrid solution.

Several particle systems were emitted from the surface and interior of the daemon, each corresponding to a species of smoky, wispy, or sparkly galactic material. The particles were advected using the fluid simulation velocity field, then used as the parent particles from which volumetric density was created.

3 Volume Framework

The framework for generating and manipulating volumetric models and simulations at Rhythm and Hues is a custom scripting language called Felt. In this particular situation, the advected particle systems were converted to volumetric density and color with several different noise-based stamping procedures that use the particle as a seed position with attributes that drive the noise and volume filling procedures. In this conversion the volumetric data is held in a grid structure that is aware of volume occupation rates and smartly conserves memory when possible. Felt then interprets the volume data for the volume renderer at rendering time.

Felt also provided artistic control of model animation in the daemon death process. The decaying daemon vanished over a short interval via levelset eroding. Ahab also generated model erosion as part of the fluid forcing.

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