Golden Compass Auroras

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Aurora veil layer with reference artwork (upper left).

Final aurora structure, combining all of the layers.

1 Introduction

Aurora Borealis effect for the North Pole sequence on *The Golden Compass*, originally called for 100+ shots of animated sky Auroras that needed to transition to a ground level phenomenon for the characters to cross through them as a portal to another world. After consulting reference footage of auroras[1], we assembled them from five volumetric layers, each mimicing particular features in the footage. The various layers employed a mix of techiques for creating volumetric density and color from splines, noise, streaks, and particles. One layer used very thin, almost two dimensional gas simulations as animated solid textures for animated volumetric grids. The decision to model the layers volumetrically gave us the power and flexibility needed to control the range of animation and visual detail required. In this talk we deconstruct the auroras and examine the techniques used for each layer.

2 Volumetric Layers

The Auroras are composed of five volumetric layers: (1) A Background layer with large scale noise structure and color gradient; (2) a Band layer with rapidly animating transients of variable height; (3) A Cloud layer with noisy structure running along the base of the aurora; (4) a Ribbon layer with fine vertical filaments slowly traveling; and (5) a Veil layer of thick gaseous curtains of vortices and fluid motion. The Veil layer includes a CFD gas simulation from our Ahab Eulerian grid Navier Stokes simulator.

3 Fluid Simulations as Solid Textures

Fluid flow along auroral limbs visually appears mostly two dimensional. We simulated these conditions with Ahab by using only rectangular simulation domain that was typically $128 \times 256 \times 5$, with the short dimension perpendicular to primary direction of the auroral limb. The thermally driven gas simulation had both hot and cold sources in order to mix the density and produce vortices. Because of the minimally viscous QUICK advection scheme in Ahab, the vortices in the simulation persist and evolve for long periods of time, allowing the build up of visually interesting motion. Positioning the Ahab simulation volume colocated with the major axes of each limb, the volumetric density of the Veil layer was multiplied by the gas density, effectively transfering the fluid simulation to the veil along a slice in the shape of the curved limb.

When the aurora reached the ground level, Ahab fluid simulations were positioned separate from aurora layers to emphasize more violent and turbulent conditions.

4 Volume Framework

The framework for generating and manipulating volumetric models and simulations at Rhythm and Hues is a custom scripting language called Felt. The volumetric layers were modeled, assembled, and rendered using Felt to compute the volumes and handle them for other software systems. This allowed the layers to be created independently with separate resolutions and grid structures, if any. Color and density fields generated in Felt were controlled via attributes of sparse particle systems. The gas simulation density was combined with the Veil layer using Felt scripting as well.

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[1] http://www.phys.ucalgary.ca/ trondsen/