Wrangling a Gas Giant for Jupiter Ascending

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Double Negative*

Jupiter surface, Jupiter tunnel and refinery destruction scenes © 2015 WARNER BROS. ENTERTAINMENT INC., VILLAGE ROADSHOW FILMS NORTH AMERICA INC. AND RATPAC-DUNE

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Abstract

For the film Jupiter Ascending Double Negative were required to deliver shots that included the creation and rendering of huge environments composed completely of gasses, as well as large scale smoke clouds covering and flowing between kilometers of built up industrial area. We will discuss the use of clustered simulation to distribute large volume simulations, the use of Volume UVs to speed up look development, the use of a timeless advection technique to easily apply movement from a sculpted vector field to a volume and the use of VDB volume stamping to create pyroclastic clouds with minimal simulation.

1   Creating the Surface of Jupiter

Due to the sheer size of the gaseous environments and the distance from camera (distant to extreme close up) we had to approach the simulation of the gasses in a procedural manner that would allow for distributed simulation over multiple machines. We diced the environment to create simulation domains that were roughly the same resolution in screen space while having roughly similar voxel counts. We used a wedging tool to batch submit all the diced simulations to the farm which would isolate a single domain per machine. We also applied custom volume deformers and sculpted velocity fields to use in our Timeless Advection tool.

2   Timeless Advection

One of the deformers we used to add motion to static volumes is Timeless Advection. This process is as follows: We construct a velocity field, the velocity field is processed to become non-divergent to preserve volume, the density is advected through the velocity field with a strength as a function of time. This allows the volume to be processed independent of history and allowing volume processing on huge VDB grids to be distributed one frame per ma-

chine, vastly speeding up the processing time on multiple machines. Velocity fields could be created by sculpting velocity directions on a mesh, using vopsops, or any method the artist sees fit.

3   Volume UVs

To introduce more detail and colour into our volume renders we applied texture maps to our volume shaders. As render times were huge and we could not present a low resolution version for review, we were only able to see a new textured version once a day at the most. We propose a method of deriving UV information to use as data to re-texture the rendered volume in Nuke as a postprocess to rendering. The UV point cloud or volume would be loaded into the volume shader to shade the UV values to an AOV. Texture maps were applied to the volumes in Nuke for quick look development. Any approved look could be applied at the shader level in houdini and rendered correctly, therefore only requiring a full render once the look was approved.

4   Art-Directing pyroclastic clouds

Throughout the final destruction sequence taking place on Jupiter, the acid gases of the planet start to leak into the Refinery on a huge scale. In order to art-direct the pyroclastic clouds and speed up turnaround times we decided to go for a non simulated approach. We used the VDB stamping tool to copy animated volume instances on top of the base cloud to achieve the typical pyroclastic feel. Finally we used Timeless Advection to add directional movement to the cloud.

5   Adding the lava layer

In addition to the pyroclastic cloud the gases react with the metal scaffolding and buildings of the refinery. To avoid converting the whole city into one collision SDF, we developed a tool based on the VDB copy-stamping concept and camera frustum culling to generate a VDB collision-representation of the refinery. For the actual simulation we used the native Houdini flip-solver with variable viscosity. In order to render both the pyroclastic cloud and the lava we converted the result into a custom set of fields by mapping the particle velocity to temperature and transferring the particle velocities to a velocity field. This approach then allowed us to use the Houdini shading tools to render both gas waves and lava elements together in Mantra including interactive lighting between the two.

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