Rogue One: A Star Wars Story - Jedha Destruction

Ciaran Moloney
jcmoloney@ilm.com
Industrial Light and Magic

Jamie Haydock
jhaydock@ilm.com
Industrial Light and Magic

Mathew Puchala
mpuchala@ilm.com
Industrial Light and Magic

Miguel Perez Senent
mpsenent@ilm.com
Industrial Light and Magic

Figure 1: The Jedha destruction sequence from Rogue One: A Star Wars Story.

ABSTRACT

The Jedha sequence involved a colossal wave of destruction emanating from the epicenter of the Death Star attack on the planet Jedha. At ILM London, our task was to carefully plan the evolution of planet scale destruction from initial impact to final escape. Tectonic sized plates of rock, earth and sand had to rise up into the sky and form a wave 30,000 feet high. To achieve this we created a wide range of elements using well established ILM workflows. The scale of the scenes and simulations also meant that new workflows needed to be developed and the setups needed to be efficiently art directable.

CCS CONCEPTS

• **Applied computing** → *Media arts*;

KEYWORDS

Effects Simulation, Lighting and Rendering, Environments

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1 ENVIRONMENT CREATION

The environment of Jedha was based on Jordan and reference photography helped us recreate the land that would eventually become the wave. The fx department was tasked with creating this effect due to the shear amount of simulation work that would go into it. All the pieces would need to be animated, simulated, or manipulated in some way.

The land was generated procedurally which meant we could quickly iterate the size of pieces, the wave height, and lengthen or shorten it's reach based on the shot requirements. VDB modeling techniques were used to generate the geometry and fracture larger plates into smaller pieces. The entire wave was generated so that any given tectonic plate could be selected and broken up into smaller pieces on demand thus reducing the potential need to re-fracture geometry later. During this stage, each piece of geometry was also assigned an identifier that placed it in a hierarchy. This data identified each piece's association to the greater wave structure. Identifiers include the top-level cluster id which is defined as a single tectonic plate and all the pieces that make it up, the sub cluster id is a collection of pieces that would be considered a large portion of the overall cluster, and piece, which is an individual object that is not broken up further.

The extensibility of the wave setup came from a type identifier which tells the different stages how to treat it and what behavior to apply. The core type is a default object that has no special properties, the erosion type is a piece that makes up the edges of the cluster and are meant to break off over time, and the interior type is a piece that makes up the edge of where two sub clusters meet and are meant to break away when the sub cluster itself breaks away from the cluster. The type identifiers provided a way to add new functionality to the setup at any point. A new type could be defined and placed into the cluster hierarchy without changing work done in later stages. Erosion and interior types did not even exist until half way through production and were added to shots that had already been laid out and animated. The functionality and behavior was added in later stages through new tools that were developed along with the new type definition.

2 ANIMATION

The land was deformed and animated into a wave using a geometry deformer. We could introduce noise to add interesting movement and choreograph the various evolutionary stages.

The set up provided flexibility to animate clusters breaking up or moving independently of each other to provide visual interest. Artists could simply select a cluster, sub cluster, or piece and then the tools would automatically grab all the associated pieces and animate them together. These were presented as smart transform tools that are aware of the data structure and stored information on how the artist was using them. An example is when an artists animates a cluster breaking up, it will record when this event happens and will automatically trigger the interior type pieces to fall away in the simulation stage.

The animation tools also maintained the work of key frame animation even if the underlying wave geometry would change as long as the change occurs on a level lower then you are operating on. For example, animation of a cluster will be maintained even if the cluster is broken up into smaller sub clusters.

3 SIMULATION

The entire wave always went through a simulation pass. Building on the ideas we used to animate the wave, artists had a set of tools to flag clusters, sub clusters, or pieces to switch from an animated body to a dynamic body at any point. Here artists also had control over the erode type pieces and could adjust rate and patterns in which the pieces would break away. Next, the simulation now activated the interior type pieces that resulted from any cluster breaking up in the animation stage. This same effect would occur if an artists simulated a cluster breaking up.

Secondary elements such as debris and avalanches were introduced at this stage so they interacted properly with the larger falling pieces. A challenge we faced with the avalanches was the erratic behavior as a result of the complex terrain of the wave and its steep incline as it progressed. We needed the pieces to be constantly flowing down the wave, not in free fall, and collecting along the ridges. A tool was created that forced there pieces to keep moving along the tangent of the wave until it reached the bottom. It also forced pieces to cling to the surface when there was a steep incline to prevent free fall and maintain a sense of flow.

For the sand, a setup was created that takes the wave geometry and automatically emits sand across the surface. Instead of a true sand simulation, a fast and efficient post process made denser areas of particles look like a thicker pile. The particles recorded data on their position on the wave allowing it to inherit the color from the rock shaders.

The mountain destruction was done using a point based dynamics approach. Each mountain could be simulated as a set of points that could break apart and collide with each other. Then the points would be converted back to geometry using VDBs. This provided a great amount of detail in a fast simulation.

With the collapsing wave, the sky was filled with a mass of falling boulders. A library of pre-simulated boulders were instanced onto a particle system. With a simple collision detection test, each could be automatically promoted to hero rigid body element, allowing a seamless switch between cached animation and simulated destruction. Secondary emission of dust and sand as previously described completed the effect.

4 LIGHTING AND RENDERING

The wave was rendered entirely by the fx department. Along with creating the land wave environment, extensive look development was done. Reference photography of Jordan was used to match the look and textures of the sand and rock. The shaders were completely procedural as well so there was no need to have texture painters painstakingly paint geometry that changed each shot. When rendering the wave and other fx elements, we took advantage of our fast and efficient in-house instancing tools.