Multi-resolution Geometric Transfer For Jurassic World

Rachel Rose   Yuting Ye

Industrial Light and Magic*
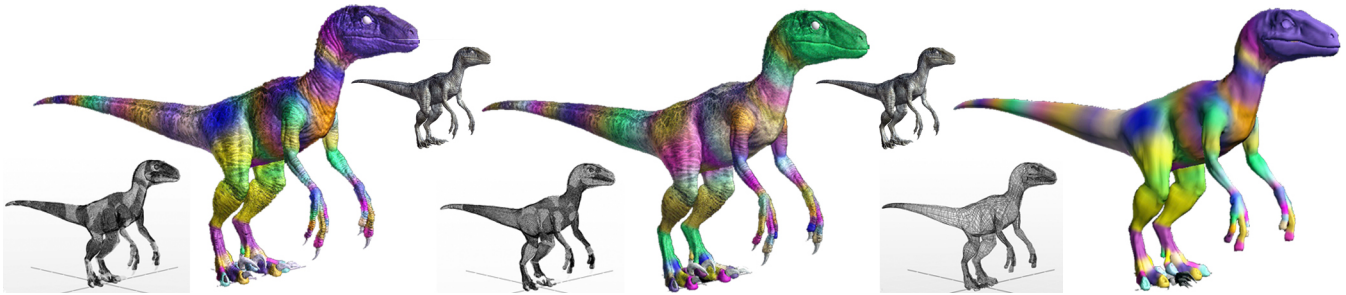
Figure 1: *From left to right, the hi-res, mid-res, and low-res models in wireframe and shaded with skinning weights.* ©*Universal Pictures*

Abstract

For Jurassic World at Industrial Light & Magic (ILM), artists brought to life a wide range of dinosaurs to populate the ill-fated amusement park. Key to the realism of these dinosaurs is the detail built into their geometric representations. During asset development and shot work, this realistic detail can slow down an artist's workflow; so ILM developed a new transfer-based system for creating and maintaining multiple resolution versions of each creature that allows an artist to work at whatever resolution is best for the current situation.

The ILM multi-resolution transfer tool automates the process of moving *changes* in the geometric shape or properties of the creature between corresponding vertices; *changes* to vertices without direct correspondence are interpolated using a poisson interpolation scheme. The tool is capable of maintaining overall body shape, skinning weights, blendshapes, simulation mappings, etc. from any resolution to any other without losing the added detail at the target resolution.

1 Overview

During creature development at Industrial Light & Magic (ILM), complexity and performance are often competing goals. For Jurassic World, we used a multi-resolution pipeline that allowed the dinosaur assets to be both performant and highly detailed. A dinosaur model has three primary geometric resolutions containing 100%, 25%, and 6.25% of the vertex count of the model seen on the big screen. Every higher resolution mesh is a one-level subdivision of the lower resolution quadrilaterial mesh, so vertices on the low resolution (low-res) meshes are subsets of those in the high resolution (hi-res). Each resolution of a dinosaur asset comes with a set of *geometric properties*, such as the blendshape rig, skinning weights, texture coordinates, and per-vertex simulation setup values.

*e-mail:{rrose,yye}@ilm.com

Since a multi-resolution pipeline adds complexity to asset development, the challenge is to provide an effective tool for modelers and riggers to maintain parity between the different resolutions. This challenge was overcome through development of a new geometry-based transfer tool that can automatically push edits from any resolution to all other resolutions; the tool allows modelers and riggers to edit creature setups at the resolution of their choice and pick up their edits later in another resolution without worry that these resolutions will become out-of-sync. The tool uses correspondences between pairs of resolutions to transfer *changes* in geometric shape and properties using a poisson interpolation scheme.

2 Transfer of Geometric Edits

When a creature asset is first created, the geometry transfer tool automatically builds correspondence maps between all pairs of resolutions. These maps are stored along with the asset for later use.

When edits have been made to a base mesh or to the geometric properties associated with the mesh, these edits can be transferred from the resolution where they were made to all other resolutions. Edits are transferred from higher resolutions to lower resolutions easily by using the new value on corresponding vertices. However, when transferring edits from low-res to hi-res, the values of the in-between vertices on the hi-res mesh not only need to be fabricated but must also account for existing added detail. For example, one modeler may be sculpting broad stroke shapes on a 6.25% mesh, while another modeler is sculpting fine details on the 100% model. When the 6.25% model is checked in, we must maintain the fine details on the 100% model. Therefore, our tool transfers the *change* between the two resolutions by comparing corresponding vertices and then smoothly interpolating these *changes* to inbetween vertices using poisson interpolation. In this way, the corresponding vertices remain coincident, while the inbetween vertices retain details relative to the *change* of the corresponding vertices.

This multi-resolution workflow not only allows for collaboration between modelers but also across disiplines. For instance, a rigger may be working on skinning weights or simulation setup at one resolution while a modeler is changing the base geometry at a different resolution. The tool will make sure all edits make it to all resolutions without user intervention.

Since Jurassic world, the tool has been deployed to several shows and enjoyed great success thanks to its simplicity and flexibility.