RepTile: How To Skin A Dinosaur

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Animal Logic*

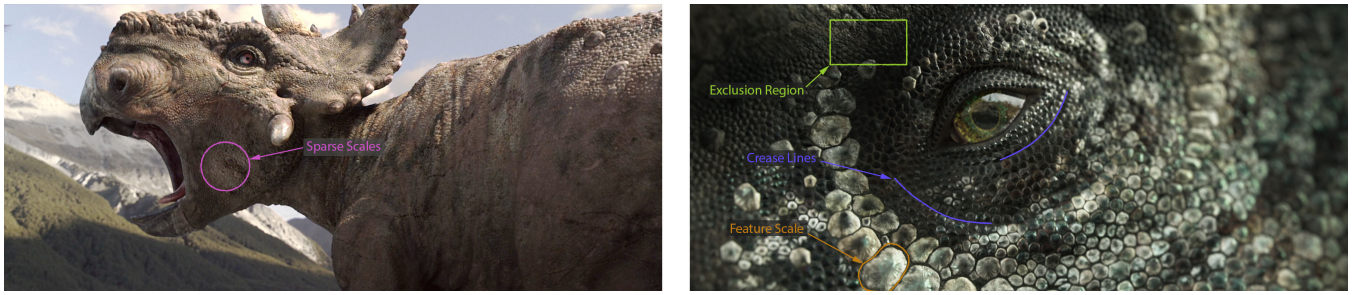

Figure 1: *Characters from* Walking With Dinosaurs 3D.

Abstract

Creating repetitive geometric features such as scales or cobblestones for computer graphics is difficult and tedious to perform manually, particularly for seamless 3D surfaces. However, procedural approaches rarely provide the fine-grained control required for motion picture production. Representation of shape detail does not fit easily into traditional modeling (geometry) or texturing (displacement) techniques, especially when animation is required. We present a highly controllable procedural system, *RepTile*, for efficiently creating, animating and rendering such features developed for *Walking With Dinosaurs 3D (WWD)*.

1 Overview

RepTile provides both direct and procedural tools for creating interlocking polygonal regions on the surface of a 3D polygonal mesh and controlling shape primitives that fill these regions. Primitives have geometric and dynamic properties, e.g. our scale primitive incorporates a parametric rigid center joined to adjacent scales by flexible skin. This was used to realize hundreds of different dinosaur characters from nine different species for *WWD*.

Manual techniques using geometric modeling or textures suffer from the difficulty of creating a non-overlapping and seamless surface partition for a typically very large number of features. Features created in this way are not readily transferrable to different shapes, procedurally varied, nor modified in visually simple ways such as global resizing. Previous work presents procedural methods with limited artistic control. Input in [Landreneau and Schaefer 2010] is a single explicitly modeled scale primitive with controls affecting scale distribution. The procedural mosaic system in [Collier and Smeltzer 2011] provides either geometric or displacement output but has limited control and only arranges quadrilateral shapes on planes.

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2 Algorithm and Artist Controls

Manually created *inclusion* and *exclusion* regions determine where features will be created on the surface. *Hero* features are completely configurable: their center, boundary region and shape parameters are directly controlled. Procedural features are created by distributing center points according to a user created radius map, respecting region, *hero* feature and *crease line* boundaries. Procedural sparse features can be placed before surface voronoi tessellation tiles the remaining area into primitive regions. Primitives generate a shape to fill their polygonal outline, based on surface-varying parameters. Figure 1 shows these elements used for dinosaur scales.

Direct control of regions (and *hero* feature boundaries) is acheived by defining piecewise linear curves on the surface mesh. Procedural features may be controlled with a combination of direct mapping of parameters and weighted blending of parameter presets. A region-of-interest system combined with the ability to generate scales individually once the voronoi tessellation is cached allows for rapid and efficient workflow.

3 Rendering

For expressive power and efficiency a subdivision surface represents each scale. Creasing is used to minimise mesh detail and adaptive reduction of topology is based on renderer level-of-detail. Stitching allows adjacent primitives to be emitted separately without sacrificing boundary continuity. Greater efficiency is acheived by using a dynamic displacement at render time (an RSL plugin for *PRMan*). This approach is particularly suitable for ray-tracing as it minimises resident geometry. Feature shading exploits attributes of the original surface and additional attributes provided by the primitive. Attributes are consistent between geometric and displacement representations and are chosen to allow effective filtering when shading samples span more than a single primitive.

References

COLLIER, R., AND SMELTZER, J., 2011. Procedural mosaic arrangement in “rio”. SIGGRAPH 2011 Talk, SIGGRAPH 2010, Vancouver, Canada, August.

LANDRENEAU, E., AND SCHAEFER, S. 2010. Scales and scale-like structures. *Comput. Graph. Forum 29*, 5, 1653–1660.