

DreamWorks Art-Driven Shot Sculpting Toolset

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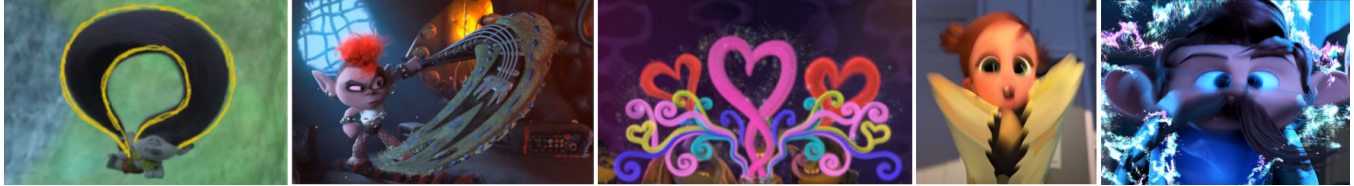


Figure 1: Art-directed shot sculpting examples in DreamWorks films.

ABSTRACT

This talk presents DreamWorks’ art-driven shot sculpting toolset used by the *Character Effects* (CFX) Department to efficiently and logically sculpt shapes of character skin, clothing, hair/fur, and props in shots. The ability to visualize an *Animator’s* drawovers during CFX shot work introduced an improved visual communication language between *Animators* and CFX artists. The toolset’s wide range of shot sculpting abilities helps achieve the different artistic styles of various films and enhances the visual impact of animation. This efficient toolset makes the shot sculpting an intuitive process for an artist rather than one littered with cleanup work.

CCS CONCEPTS

• Computing methodologies → Shape modeling.

KEYWORDS

sculpting, shape, art, direction, style, motion, simulation, animation

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1 INTRODUCTION

With the advent of different artistic styles in various *DreamWorks* films, the shots in those films are heavily art-directed to match the style and increase visual impact [Figure 1]. *Animation* and CFX simulation rigs for assets such as hair, fur, cloth, skin, and props produce shapes derived from physical, procedural, or anim-rig controls. Heavy art direction, however, requires shapes beyond those possibilities, such as clean and simple silhouettes, organic/functional/artistic hair or string shapes, stretched shapes to

emulate motion blur, or cloth wrinkles in precise locations, just to name a few. Often times the art direction involves achieving specific shapes to camera view, which can lead to distorted shapes in 3-D. The sculpted shapes may need to travel and blend with animation. Using traditional finaling tools such as 3-D Lattice, 3-D Sculpt Brush, Soft Modification, or pushing and pulling of vertices, can create painstaking work to achieve the complex shapes. The shot sculpting toolset described below allows for an efficient and logical approach to sculpting, allowing the artist to achieve the shapes and forms required by complex art-direction.

2 VISUAL COMMUNICATION : DRAWOVERS

The *ImportDrawover* tool exports the *Animator’s* drawovers from *PREMO* (DreamWorks’ Animation Software) or from the movie player and imports them (or any other images) into 3-D packages that the CFX artist works with. The artist can view the drawovers in the 3-D viewport and match the shot work to the art direction. This visual communication language lets visual art accurately drive the shapes, significantly reducing iterations between departments and removing guesswork. The drawover colors can be modified for optimal viewing. The tool uses custom image planes for Z-depth and transparency adjustments. Letterbox adjustment is also provided for images that don’t match the aspect ratio.

3 SILHOUETTE / INTERIOR SCULPTING

These tools help the artist to edit the silhouette or interior edge shapes to get a clean flowing shape language. The *SilhouetteEdit* tool provides exterior silhouette curve(s) of the object which influence the deformation of the object in camera view. First, the object is rendered to an image in the camera view with a constant shader. Then, silhouette curves are traced in that image and projected to an image plane to be viewed in the 3-D viewport. Next, the object is projected to that image plane in the camera view. The curves control that projected geometry using a curve-driven mesh deformer with a user specified falloff [Figure 2]. Finally, the geometry is projected back to its original depth from camera. The *DeformByEdge* tool allows the artist to interactively select a geometry edge line (even an internal edge line) to generate a deformable curve from it. Deformations to this generated curve will propagate to the original geometry using a curve-driven mesh deformer. The control curves generated by these tools can be shaped by curve editing tools.

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4 CURVE SCULPTING

4.1 Sketching Curves

The *SketchCurve* tool allows artists to edit curves in the 3-D viewport by sketching in screen space. Its capabilities include forward and backward sketching (w.r.t. curve point order), sectional curve sketching, length preservation (if required), uniform segment length maintenance (if required), undo/redo option, and keyframing. The tool also allows the artist to sectionally linearize curves to make it easier to sketch straight lines. The tool provides two screen space projection modes to account for the fact that the same 2-D screen space positions can be obtained from multiple 3-D positions. While sketching, the first mode maintains the original depth from camera of each affected curve point, whereas the second mode projects the points to the depth from camera of the first closest chosen point, thus flattening the curve to the camera plane at that depth.

4.2 Volumetric Curve Sculpting

The *VolumetricCurveSculpt* tool grows curves volumetrically through a convex NURBS cylinder/tube. A curve's root point, P_r , and the tube's base points are first projected onto a plane. A curve is then registered by casting a ray from the center, P_c , of the tube's base towards P_r . The tube's parametric 'u' at the ray-tube intersection point, P_i , and the distance ratio $|(P_r - P_c)|/|(P_i - P_c)|$ is stored. The curve is grown throughout the length of the tube using this registration. Since the curve registration is at the base of the tube, the method is robust in handling narrowing shapes along the tube's length, whereas flow based methods can fail through those regions. The curves are shaped volumetrically by shaping the tube.

4.3 Procedural Curve Sculpting

The *CurveScale* tool scales curves from their root points with length-ramp control. The *CurveContract* tool shrinks curves along their length. The *CurveSmooth* tool smoothes curves' shapes while maintaining their segment-length ratio. The *CurvePuffPat* tool lofts curves up or down relative to the skin. Given a set of curves, *BlendCurvesToCore* provides a core curve and blend-to-core controls.

5 SCREEN SPACE SCULPTING

Since many art-directed shapes are specific to the shot camera view, screen space sculpting becomes crucial. Screen space sculpted shapes can appear distorted in 3-D view, and thus sculpting can be difficult to do with regular sculpting tools. *SilhouetteEdit* and *SketchCurve* allow screen space sculpting. The *ScreenSculpt* tool allows the artist to sculpt/smooth/erase in screen space using brush strokes. The tool can sculpt either visible or all portions of the surfaces that lie within the brush radius in screen view. While sculpting curves, it also provides the option to maintain length when the curves are expanded. *2-D Lattice Edit* provides the artist with a 2-D lattice around the geometry aligned to camera view. Similar to *SilhouetteEdit* the lattice deformations happen in the 2-D lattice plane (to which the geometry is projected first) and the geometry is projected back to its original depth from camera after deformation. Also, a custom *Z-Depth Push* tool was built to allow capability to push points in positive or negative Z-depth relative to the camera without changing the screen space shape.

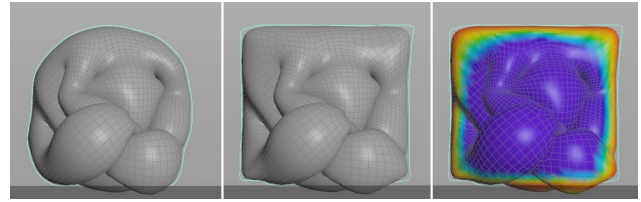


Figure 2: SilhouetteEdit used to sculpt the *Everest* character from *Abominable* from a roundish to a squarish shape. The silhouette curve's influence falloff is color visualized.

6 CLOTH WRINKLE SCULPTING

Art direction often requires precise control over cloth wrinkles. *WrinkleAddRemove* tool allows the artist to add or reduce/remove wrinkles by interactively sketching wrinkle curves onto the garment. The cloth mesh is offset around those curves to create wrinkles. The height/width/falloff of each wrinkle can be procedurally controlled along its length and width, and/or painted to produce organically varying wrinkles, including the merging or separation of wrinkles. The tool can also reduce/remove an existing wrinkle by smoothing the garment around that wrinkle curve to create a simplified look. The appearance and disappearance of those precise wrinkles can be driven by the character's pose. The sketched wrinkle curves wrap to the cloth and travel with its motion.

7 SCULPTING THROUGH ANIMATION

The *ShotSculptManager* tool allows the artist to choose and use any of the shot sculpting tools at any frame. It automatically sets up the local offset deformation (with geodesic neighbors' influence) nodes needed for carrying those mesh sculpts robustly through animation and it allows for blending in and out of those sculpts. Using the *GeoFreeze* tool, curves can be frozen at a certain frame, sculpted, and moved to other frames using a variety of techniques such as root-attach, curve-to-curve wrap, or curve-driven mesh wrap. The *AverageOverTime* tool can also be used to provide clean transitions between sculpted shapes by averaging each point's position over a user controlled region of time and blending to it. Some of the tools, as described in prior sections, can also be controlled procedurally for sculpting through animation. The *SpatialComp* tool allows for locking the global motion of a moving object, making it easier for sculpting, and then unlocks it. While the sculpted shapes can be applied post simulation or animation, they could also be applied to rest shapes and goal shapes prior to simulation. These pre-simulation sculpts help direct simulation organically into art-driven shapes.

8 CONCLUSION AND RESULTS

Working with *Animation* drawovers significantly reduces guesswork, and inter-department iterations. Utilizing that visual language brings accuracy and accountability. Sketching and sculpting from the camera view reduces the gap between 2-D and 3-D animated shape work. The advanced tools boost the confidence of the artists in terms of speed and logic, bringing directability to the wide ranging shot sculpting process, and springing some of the most complex shots to life. The tools have been used in a number of films at DreamWorks over several hundred shots. The tools artistically improve the impact of animation and help realize the styles of films.