Powering up Rig Deformation: Shot Sculpting on DC League of Super-Pets

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Figure 1: a) Shot sculpting in process on Superman's suit; b) Final shot with sculpted muscles;

ABSTRACT

We present the shot sculpting toolset used on *DC League of Super-Pets* to enhance rig deformation in order to meet creative goals in animation shots. This toolset repurposes rigging tools, primarily Animal Logic's proprietary deformation system *Bond* [Baillet et al. 2020], to give animators intuitive and flexible ways to expand upon a rig's deformation stack and push the rig past its intended range of motion. Shot sculpting workflows have been fully integrated into our pipeline and designed for minimal playback speed loss, providing an overall seamless experience for artists.

CCS CONCEPTS

• **Computing methodologies** → **Computer graphics**; **Animation**.

KEYWORDS

animation rig deformation maya

1 INTRODUCTION

Because *DC League of Super-Pets* is a super-hero movie with a squash and stretch animation style, production decided early on they would require a way to meet any kind of ad-hoc creative challenges on shots, as often is the case for super-powered characters, without looping back into asset departments. In particular, they wanted all character silhouettes to remain within control of animation. This meant that the tool needed to be fully integrated into existing animation workflows, as opposed to other shot sculpting tools [Somasundaram et al. 2021] that might be designed for character effects.

Shot sculpting generally fit into two use cases. Performance-driven usage included for instance sculpting bulging muscles, fitting a giant pig into small spaces or adding animation to rigid props such as opening a drawer on a desk. Silhouette-driven corrections would ensure cleanliness of lines based on draw-overs. By making shot sculpting part of the production process from the beginning, animators were able to final shots early on while rigs were still being developed, even allowing them to show rigging TDs prototypes of any desired deformation.

2 OVERVIEW OF TOOLSET

The main interface of the toolset, implemented in Autodesk Maya®, is shown in Figure1. It lets users manage deformers per rig and per geometry with easily accessible options to paint weights, edit blendshape targets and toggle active states.

2.1 Deformers

A subset of the deformers available to rigging were selected by animation based on creative needs and technical accessibility. Most commonly used were blendshapes, the only part of the toolset that requires literal sculpting, used to achieve very specific design details. Also provided are softmod, push, smooth and cluster deformers which can be used to add or reduce volume, buff out crunchy and lumpy areas, or move rigid objects such as buttons or jewellery. Finally, lattice deformers were useful for adding squash and stretch effects and creating smear frames. Lattices include a collision mode that was used extensively to help address the challenges of our hero pig's fast growth superpower.

2.2 Weight maps

The tool makes use of the *Bond* paint tool for all weight map painting functionalities. However, to reduce the learning requirements for animators, weight maps can be initialized from a vertex or face soft selection on deformer creation with no need for actual painting, unless a specific map is necessary.

2.3 Grouping

Lattices and softmods support geometry grouping, meaning you can add or remove selected shapes to be affected by the deformer using a shared control. This is particularly useful when working on character's faces which include multiple geometries.

2.4 Import/Export

The pipeline IO processes have been exposed to users to allow sharing and re-usability of deformation setups, with a dedicated IO tool that handles deformer name conflicts and flags topology incompatibility as seen in Figure2.
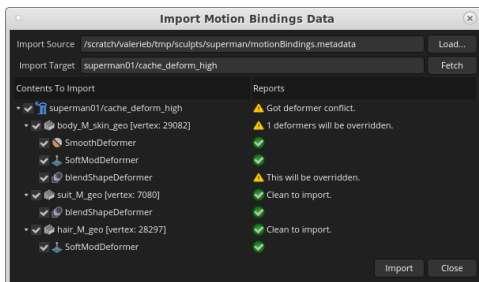

Figure 2: The shot sculpting import dialog.

3 EDITING RIGS IN SHOTS

Our shot sculpting toolset is built upon *Bond*, a hybrid CPU/GPU deformation system integrated with Pixar™ Universal Scene Description (USD), as well as *Beast*, our data-centric rigging framework. Rigs at Animal Logic have a strong separation between the control rig, loaded in the scene as a Maya reference, and the deformation stack, referred to in *Beast* as binding data. The latter is comprised of *Bond* nodes created at rig load time to bind the geometry in the UsdStage with the referenced control rig. The deformation stack is therefore available to be edited in a shot context to layer in additional deformation.

All binding data in *Beast* includes USD data to store blendshapes, weight maps, skin data and more, using Animal Logic's custom USD schemas. In an animation context, to provide authoring flexibility, some of the binding data is generated on the fly from nodes in the scene by *Bond* binding generators. Blendshape targets, for instance, are sculpted directly on Maya meshes in scene and the *Bond* evaluation chain computes the offsets at runtime.

As the workflow is deformation driven, we do not have any dependencies on the control rig, the one exception being for localisation purposes of the deformer setups.

4 CYCLE-FREE RIVETED CONTROLS

A key aspect of the user friendliness of the tool is the ability to have controls attached to the geometry so animators can find and move them easily after creation. To avoid introducing evaluation cycles and ensure consistent playback speed, we duplicate the *Bond* compute chain into a principal chain, which includes the entire deformation stack, and a secondary chain, which is tasked with evaluating rivet positions at a defined level of the deformation stack, as seen in Figure3. The current design of the chains means we redundantly compute the rig deformation, however profiling showed that *Bond*'s GPU evaluation is currently fast enough to make that extra computation trivial.
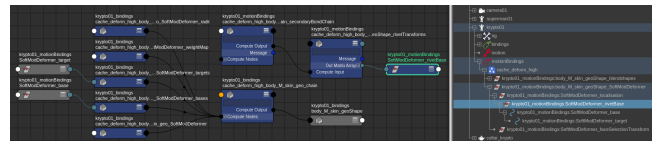

Figure 3: The node network for a softmod's riveted control using primary and secondary evaluation chains.

5 RESULTS AND FUTURE WORK

The shot sculpting toolset was used on 945 out of 1800 animation shots, as well as for various prototyping purposes. We have recorded up to a 10% fps loss in playback speed per couple dozen deformers on a single rig with GPU evaluation. We generally see no more than two or three deformers used per rig, making the use of shot sculpting have virtually no impact on playback for users.

Based off their success in animation, the *Bond* secondary chains and generators are now extensively used in rigging. Deformer IO processes have also been integrated into our animation library for easier sharing and reuse. Furthermore, the riveting utilities were integrated into a new tool that lets users click on rigs or geometry caches in the viewport to attach controls used for constraints.

Future development includes integrating our rigging deformation transfer procedures into the import process in order to support importing deformers across different topologies, as well as adding support for curves as opposed to just meshes currently. We will also be looking into adding support for inserting deformers into the rig stack, specifically for caged deformations.

ACKNOWLEDGMENTS

We would like thank Aloys Baillet for his mentorship, the Animal Logic Animation and Rigging R&D team for their help on the project, and our amazing animators for their trust and feedback during the development process.

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