adidas TAPE — 3-D Footwear Concept Design

Mario Poerner
Jochen Suessmuth
adidas AG
Herzogenaurach
mario.poerner@adidas-group.com

Davoud Ohadi
Vincenz Amann
adidas AG
Portland
davoud.ohadi@adidas.com

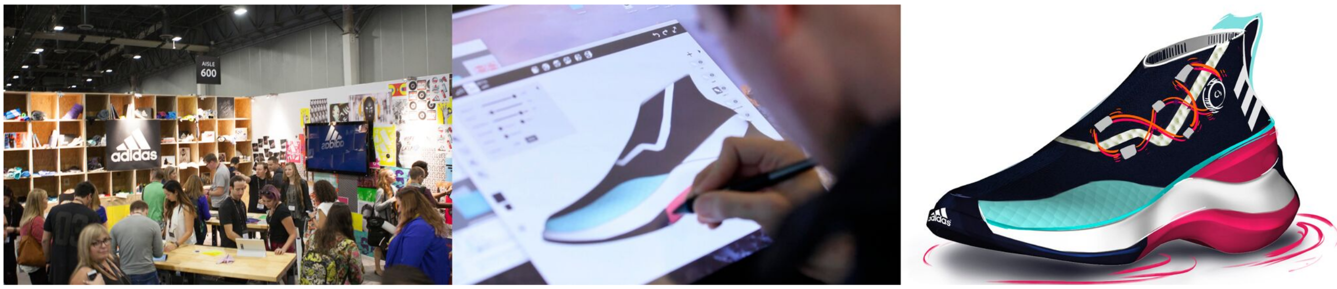

Figure 1: Tape, an accessible tool for footwear concept design in 3-D

ABSTRACT

3-D tools have been successfully established in several areas of the footwear design process. Yet, 3-D tools often find little adoption during initial concept creation for various reasons. These tools are often slow, difficult to use and limit creativity in ways unacceptable to most designers. The lack of 3-D content creation in the beginning makes it inherently difficult to implement ideal production pipelines that enrich and reuse assets during all steps of the content creation. At adidas, we have successfully established a simple, sketch based 3-D tool which feeds into our 3D design pipeline and finds astonishing acceptance within the design community. Our team presented a digital 3-D footwear design process and pipeline at Siggraph 2017 [Suessmuth et al. 2017]. Tape, the first tool in this pipeline, allows our designers to create meaningful 3-D assets in the early stages of design. In this talk, we explain the origin of Tape and walk the audience through all key features, their purpose in terms of footwear design and their implementation.

CCS CONCEPTS

- **Computing methodologies → Rendering**; **Shape modeling**;
- **Theory of computation → Computational geometry**;

KEYWORDS

Footwear, 3-D Design, Digital Creation, Sketching, Virtual Materials

ACM Reference Format:
Mario Poerner, Jochen Suessmuth, Davoud Ohadi, and Vincenz Amann. 2018. adidas TAPE — 3-D Footwear Concept Design. In *Proceedings of SIGGRAPH '18 Talks.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3214745.3214761

SIGGRAPH '18 Talks, August 12-16, 2018, Vancouver, BC, Canada

ACM ISBN 978-1-4503-5820-0/18/08.
https://doi.org/10.1145/3214745.3214761

1 INTRODUCTION

In the early stages of footwear design, our designers often prefer paper sketches to communicate design ideas. In general, designers are free to use whichever tools they like. This creative freedom poses a problem when one wants to establish a complete 3-D content creation pipeline. Such a pipeline requires structured and traceable output from ideation to product creation. There is a fundamental gap between the way a designer works and these requirements. Designers do not enjoy working in complex, feature-rich 3-D tools, which therefore see little to no adoption in our design community. These tools are often slow and make it difficult to change and refine an existing design. Early concept design however requires many quick iterations on the initial design idea. Usually the industry bridges the gap between design and 3-D content creation by specialized technical designers who translate concept designs into usable 3-D assets. Our goal with Tape was to allow all designers to produce meaningful 3-D assets while keeping much of the simplicity of paper sketching.

2 BUILDING BLOCKS

Initial concept design consists of several building blocks, which we tried to represent in TAPE. Modeled on the tasks done by designers for every new project, we tried to create a simple workflow which leads to useful 3-D assets with minimal training.

2.1 Last library

Each Tape project is based on a 3-D model of a footwear last. These virtual lasts are scanned from physical lasts via an image based scanning process. This last mesh will be constant during the evolution of the virtual shoe. The known surface parameterization ensures that information attached to the last's surface will be consistent

throughout the entire 3-D creation pipeline. Since all lasts share the same topology it also becomes possible to share information between different lasts, albeit with some distortions.

2.2 Perspective Drawing

The user sketches freely over the virtual last, not constrained by geometry borders. Our drawing engine is tuned for minimum latency, which is essential for drawing to feel natural. In our experimentation with different kinds of texture painting methods, we discovered that simple orthographic projective painting is the most easy to grasp method. The ability to start and end a stroke outside of the surface mesh was a big benefit to our artists.

2.3 Silhouette Deformation

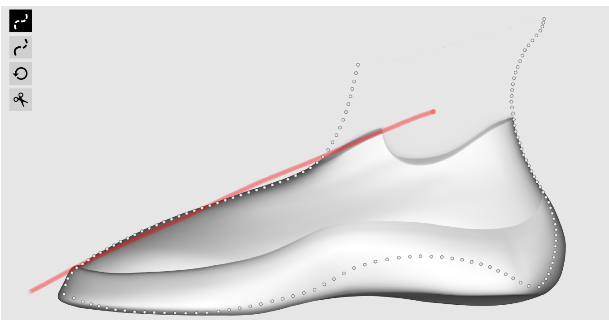

Figure 2: Sketching to reshape the silhouette

Although the shoe's silhouette in large part is dictated by the last, designers often require a slight change in silhouette in order to communicate their design intention more clearly. Through the use of space deformation methods [Zollhoefer et al. 2012], we allow users to locally adapt the shoe's silhouette by sketching it from different directions. This gives them the freedom they need while still allowing for quick iterations.

2.4 Tooling Builder

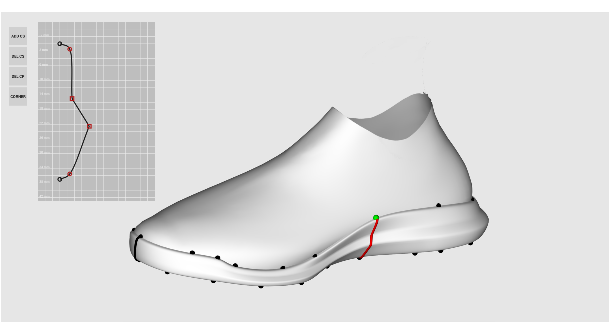

Figure 3: Shaping the sole with side section splines

The look of the sole is very important to the overall appearance of a shoe. Being limited to a fixed set of reusable soles does not offer the complete creative freedom we envisioned for TAPE. Traditionally, the 2-D sole design is modeled in complex CAD application to obtain a 3-D model used for manufacturing. Modeling these soles is a complex task done by experts. We managed to develop a method to shape a reasonable complex sole via a minimal and intuitive user interface. The top sole outline is defined via a spline [Catmull and Rom 1974] within a geodesic embedding [Panozzo et al. 2013] of the last surface. The bottom outline can freely be modified in 3-D. Some constraints might be applied to the bottom outline, which ensure that the resulting sole remains anatomically usable. The side profile of the sole can be shaped via profile splines interpolated along the top and bottom sole outline. The final surface is constructed similar to a tow-rail sweep in traditional CAD applications. To define the correct rotation of the profile spline samples, we use normal information from the last and knowledge about the bottom plane.

2.5 Collar Shaping

To create the look of an actual shoe it is required to remove parts of the last in the collar area. We used to solve this by painting those last areas transparent, which should not be part of the shoe. However, since this does not modify actual geometry, this approach creates problems with interoperability in later stages of the 3-D pipeline. We therefore now use our spline based user interface to exactly cut the collar geometry. All footwear uppers – i.e. the top pieces of the shoe – are eventually constructed from 2-D patterns cut from flat pieces of fabric. Therefore, having properly shaped geometry also gives us a precisely cut 2-D parameterization, which is useful for interoperability with 2-D design tools.

3 VISION

There still are many gaps which need to be filled for TAPE to be fully adopted by our design community. We get many feature requests from designers regarding usability and interoperability with other tools. Sharing data between TAPE and other internal and external applications is one major area of improvement. Many interoperability request can be attributed to the minimalistic drawing engine used in TAPE. Users would like to edit layers in a more full featured drawing application and import them back into Tape. Therefore, bringing a more powerful drawing engine into Tape would eliminate most of these requests. Future improvements in mobile hardware will also allow more sophisticated texture painting and rendering techniques. The ability to directly draw our digitized materials within TAPE will soon be possible. While working on all these features, our team always tries to retain the simplicity that made Tape so appealing in the first place.

REFERENCES

Edwin Catmull and Raphael Rom. 1974. A Class of Local Interpolating Splines. In *Computer Aided Geometric Design*, Robert E. Barnhill and Richard F. Riesenfeld (Eds.). Academic Press, 317 – 326.

Daniele Panozzo, Ilya Baran, Olga Diamanti, and Olga Sorkine-Hornung. 2013. Weighted Averages on Surfaces. *ACM Transactions on Graphics (proceedings of ACM SIGGRAPH)* 32, 4 (2013), 60:1–60:12.

Jochen Suessmuth, Sky Asay, Conor Fitzgerald, Mario Poerner, Davoud Ohadi, and Detlef Mueller. 2017. Concept Through Creation: Establishing a 3-D Design Process in the Footwear Industry. In *ACM SIGGRAPH 2017 Talks*. 50:1–50:2.

Michael Zollhoefer, Ezgi Sert, Guenther Greiner, and Jochen Suessmuth. 2012. GPU based ARAP Deformation using Volumetric Lattices. In *Eurographics 2012 - Short Papers*. The Eurographics Association.