Concept Through Creation: Establishing a 3-D Design Process in the Footwear Industry

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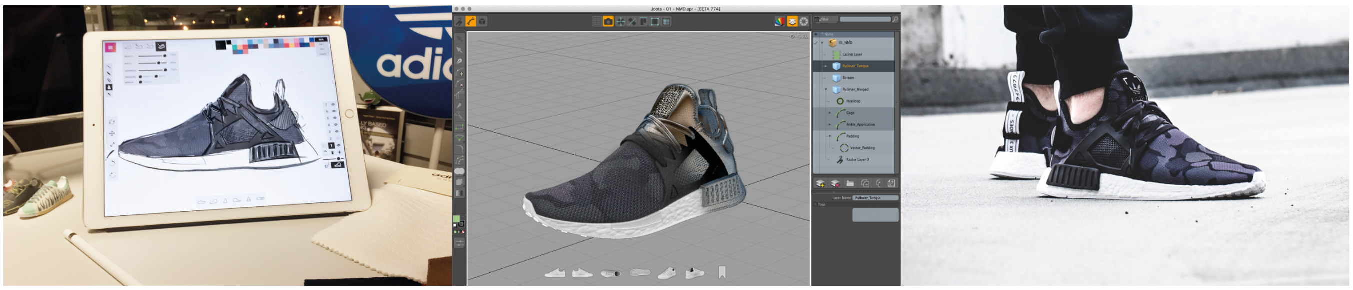

Figure 1: Our 3-D design tools enable a fully digital design to production process for the fashion industry.

ABSTRACT

The aim of the adidas digital creation program is to build an industry leading system of 3-D tools that empowers creativity and connects creators digitally. Our pipeline is tailored for a product design and creation community that is non-technical. Our users benefit from better visualization and information for decision-making such as concept reviews or improved factory handovers. The brand benefits from more useful assets for sell-in, and consumers benefit from products that fit ever changing trends. 3-D tools for product design that enable constant change through non-destructive behavior at a speed of workflow that is competitive with traditional 2-D methods haven't been available in the past. In this talk, we'll share how working side by side with our footwear designers, we were able to find novel workflows that inspire new tools and integrations.

CCS CONCEPTS

•**Computing methodologies** →**Computer graphics;** *Shape modeling;*

KEYWORDS

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

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1 PIPELINE

Designers today use a multitude of analog and digital tools in all steps of the footwear design process. This empowers creativity but makes it challenging to achieve the benefits of a clearly defined digital creation process from ideation through product creation. Recognizing the importance of both, we have found it to be very important to provide easy entry points into the 3-D workflow in order to have a chance of adoption. We have done this by implementing integration points to as many analog or digital tools as possible. Our pipeline allows designers to evolve the shoe from a paper sketch into a physical sample in the most natural way, while generating useful 3-D assets in the process.

1.1 adidas Tape

Early in their ideation process designers often sketch on paper, which allows them to communicate and iterate their designs quickly. Therefore, it seems natural to introduce the concept of working in 3-D via an easy to use sketching tool. Based on this observation, our research team created adidas Tape, a tool which allows only the most essential operations required for communicating the initial idea of a shoe design, while creating data which is useful for the next stages of our 3-D creation pipeline. Fundamentally, we wanted to create a tool which is mobile, easy to use and above all fun to use. At its core, each Tape project is based on a specific digital 3-D footwear last, which is scanned from the physical last. This last will be constant during the evolution of the shoe. A known parameterization of the last surface, which is defined by the scanning process, ensures that information attached to the last's surface will be consistent throughout the entire pipeline. Since all lasts share the same topology it also becomes possible to share this information between different lasts, albeit with some distortions.

The user sketches freely over the last, not constrained by the geometry borders, using a responsive and reasonably full featured digital drawing application. 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. To a large part this can be attributed to the fact that it allows the user to paint a complete stroke even in areas which cannot be projected onto the last.

In order to create a complete design proposal, at least a basic footwear sole needs to be displayed as well. We therefore offer a library of standard soles and furthermore allow brushstrokes outside the last and wrap them around an invisible tooling block to create the illusion of a three-dimensional sole if no appropriate sole template is available in the library.

Although the silhouette of the shoe is in large part dictated by the used 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, we allow users to locally adapt the silhouette by sketching it from different directions. This gives them the freedom they need while still allowing for quick iterations.

1.2 Mesh and Color Way Creation

In the next step through the pipeline, geometry and raster textures from the TAPE project are imported into a more full featured shoe modeling and rendering application called JOOTA. The features sketched in TAPE are now turned into actual geometry by tracing vectors and extruding so called parts in a non-destructive tool set. Additional geometry in the form of premodeled components can be added to the shoe. Parts and components can then be equipped with colors and virtual materials from our library. JOOTA can manage material variants which is required in order to support multiple colorways. The final 3-D asset can then be rendered in photorealistic quality.

One challenge in our pipeline is dealing with mixed 2-D and 3-D representations of products. Until every product is designed in 3-D, users in our pipeline will need to efficiently interact with content that may be 2-D or 3-D. An additional challenge is that presentations, decisions, and design work often happens in a single file which contains an entire range of related products. A common representation is usually preferred in these ranges, both for visual consistency and for efficiencies like copy and pasting design elements between products or recoloring many products with little effort. To address these workflows, we have created two plug-ins that allow designers to work efficiently in Adobe Illustrator but provide an easy path to a 3-D result.

This first plug-in is called VECTORIZER and integrates into both, Illustrator and our 3-D modelling tool. VECTORIZER is aimed at coloring entire ranges of shoes. From the 3-D model, the plug-in creates SVG line art of the shoe. The style matches the line art designers are used to, but the SVG also contains information from the 3-D model. This metadata allows color changes to be transferred between Illustrator and our 3-D modelling tool seamlessly at any point. Color designers can design a range of shoes the way they are used to, and easily move their work to 3-D when it makes sense.

The second plug-in is PROOF, aimed at quickly visualizing designs in context. PROOF allows designers to design in an Illustrator template that matches the UVs of a 3-D product. PROOF then creates a photorealistic 3-D visualization of their design. It relies on pre-rendered passes composited in Nuke to remap designs and integrate them into a final image. Using PROOF, designers can create color and graphics variations with a high quality result, while still being able to work very efficiently across many files in Adobe Illustrator.

Our final 3-D files can be used either for production or marketing. JOOTA generates techpacks which contain production information and are passed to our factories. The finished 3-D assets can be exported into fully featured CGI tools like Modo or Blender and used to create high quality marketing material.

Figure 2: Lightbox setup for material creation: reference photo and corresponding (rendered) material creator view.

1.3 Pursuing an industry standard material system

One major challenge when exporting an asset from one CGI tools into different one is having a consistent material appearance across both tools. We address that by implementing the same material model and underlying BRDF throughout all tools in out pipeline. It quickly turned out that Burley's physically based BRDF [Burley 2013] is a good choice for our needs: It offers sufficient flexibility to cover the materials typically used in the fashion industry and at the same time is well documented and reference implementations are available. We also actively work on integrating this BRDF into further tools. Our blender implementation meanwhile became part of the standard installation starting from Blender 2.79.

Since we have to create thousands of virtual materials each season, our virtual material creation happens decentralized in our creation centers which are spread across various locations over the globe. We enable this by implementing a simple and robust, nevertheless reasonably priced, virtual material creation process. This is achieved by placing inexpensive texture and normalmap scanners in our creation centers. After the textures of the material sample have been acquired, the physical material sample is photographed under known illumination conditions inside a standardized light box. In our virtual material creation tool, we have rebuilt this physical scene virtually and use this scene to interactively adjust the remaining BRDF parameters until both images match. Complex compound materials are supported by allowing layering of and blending between materials. In order to make the material creation process even more efficient, we are currently developing algorithms for automatically estimating BRDF parameters based on the acquired image data.

REFERENCES

Brent Burley. 2013. Physically-based shading at disney. In *ACM SIGGRAPH Talks 2012*.