MIT's Self-Assembly Lab Offers a Radical New Take on Active Footwear. By Kathlyn Swantko

Self-Transforming Shoes

Imagine using active materials to produce adaptive-fitting, one-size-fits-all shoes through a self-forming manufacturing process. This is the vision of Skylar Tibbits, director of MIT's Self-Assembly Lab, and his design team, Christophe Guberan and Carlo Clopath.

Three years ago, the team's 4-D printing research led to a new process, creating customizable "smart" materials. Initially referred to as the "Minimal Shoe," this research moved into what is now called the Active Shoe program, focusing on how 3-D printing can create materials that can change into a desired shape or change properties. The research involved the printing of everyday materials like wood, textiles, and carbon fibers, to create a product that can self-transform into a programmed shape with targeted properties.

A 3-D printer was used to produce the upper portion of the Active shoe shown here.

In 2014, an invitation for Guberan to exhibit at the "Future of Shoe" exposition in London was the incentive for the Self-Assembly Lab team to begin its research on the future of the 3-D printed shoe, and to look at how shoes are manufactured today.

Fused Deposition Modeling (FDM), a technique used in 3-D printing, is a minimal, reduced way to structure the fabric, and to simultaneously create comfort and stability. As the research progressed, the design moved into a more realistic Active Shoe, where the "Minimal Shoe" actively self-transforms to the shape of the actual foot.

Tibbits explains, "We were looking for the most minimal material that we could find that would transform itself into a shoe. We used minimal lines and minimal materials. In some ways, there is no design, because every single line was a function of the curve to take on the shape of the foot. So, it becomes super-minimal!"

The 3-D Printed Process

The project challenges footwear manufacturers to use 3-D printing on existing materials like textiles to shorten the production process. "We print onto textile substrates," notes Tibbits. "We take a stretch textile. We pre-stretch it, and print specific patterns on it. The shape of the patterns, thickness of the deposited materials, and the properties of that material dictates how the shoe is going to transform, once the textile is released."

The printed material can be used for the upper portion of the shoe. Instead of stitching or combining different pieces, or molding materials around a blank or a mold, the textile is printed flat and is then self-transformed into the shape of the upper shoe.

A second project involves an investigation in which the upper part of the shoe and the sole are printed in one single process. The team also researched a third design where the material doesn't just transform into the shape of the shoe, but actually self-transforms and molds around the foot.

The cellular 3-D printing materials being used by the team include a variety of standard polymers (i.e. nylon, PLA, ZDF, etc). Tibbits says the type of plastic doesn't matter much. Instead, the focus is on the flexibility of the material. The flexibility of the polymer causes shape changes, when the 2-D textile "jumps" after being cut into a 3-D shoe. It also provides the ability to make shoes that are easily customized.

Tibbits explains, "We're not using anything that's considered a 'smart' material. We're showing that everything can be 'smart' materials—textiles, composites, plastics, metals, foams, or rubbers that self-transform or react to certain energy sources."

Apparel is an obvious next step for the Lab. Tibbits says, "Our goal is to conceptually challenge the future by transforming the production process." ●

For more information on MIT's Self-Assembly Lab's Active Shoe, contact Skylar Tibbits at sjet@mit.edu, or Christophe Guberan at mail@christopheguberan.ch

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