Simplifying the complex design of 3-D printed jewelry

May 10 2016, by Hannah Diorio-Toth

Credit: Carnegie Mellon University Mechanical Engineering

Do-it-yourself jewelry design can bring to mind visions of failed pony bead necklaces or braided friendship bracelets. So when it comes to fashionable jewelry, is it better to leave the design to the professionals? Ask Carnegie Mellon University's Professor of Mechanical Engineering Kenji Shimada, and the answer will certainly be "not anymore." Shimada's group has put the power of sophisticated jewelry design directly into the hands of the consumer with a tool that can be used to easily design and customize patterns on 3-D printed jewelry.

The 3-D printed jewelry market is rapidly growing and, according to

Forbes, is estimated to reach $11 billion by 2020. Shimada has applied his research expertise in computer modeling and simulation for product design to this expanding field of 3-D printed jewelry to fill a void in the market—simple consumer customization. His group has developed a computational method and software tool which easily creates geometric patterns with different sizes and orientations. Using this computer modeling software, anyone can design their own jewelry with precise, complex geometric patterns and then custom 3-D print the piece.

"Because of the evolving technology of 3-D printing, consumers can now quickly create functional, customizable items for their everyday lives, like children's toys or even utensils. But when you 3-D print jewelry, you want it to be aesthetically pleasing as well as functional. Designing interesting, repeated patterns for 3-D printed jewelry can be difficult and time-consuming when done manually," says Shimada.

Traditionally, designing a 3-D printed bracelet covered in a pattern, like a bubbled print or animal print, would require someone to manually draw out each part of the pattern in a computer modeling environment. To change just one part of the pattern would mean that the rest of the pattern would need to be manually adjusted. This new tool instead automatically populates the pattern and adjusts all areas of the pattern when changes are made.

To create the tool, the group developed an algorithm which calculates how the curvature of an area affects each feature in a geometric design. "We built a mathematical framework using a powerful technique called tensor field generation to represent the size and orientation of geometric patterns," explains mechanical engineering graduate student Diego Andrade. "It's interesting because by creating this algorithm, we are allowing everyday people to use this highly theoretical math to create beautiful jewelry."

Shimada and Andrade's design tool is currently available as a plug-in tool for commercial 3-D modeling software Autodesk Inventor, but the algorithm can be applied to any design software, including those available on smartphones and tablets. Once the user designs their jewelry in Inventor, they can bring the file to a local 3-D printing shop or upload the file to an online maker space like Shapeways.

This research, "Automated generation of repeated geometric patterns for customized additively manufactured personal products," was recently accepted by the Manufacturing Science and Engineering Conference (a conference hosted by the American Society of Mechanical Engineering). Shimada and his group will present the work at the conference in June.

Provided by Carnegie Mellon University Mechanical Engineering