

Puzzle lamps attain new dimensions with Disney Research computer design tool

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Puzzle lamps capture the imagination - and the eye - by combining identical, interlocking flat elements to create a wide range of shapes. An interactive design tool developed by Disney Research now makes it easier to use this approach to create ever more intricate decorations.

The software enables people to think in terms of the shapes they want to create with the interlocking elements, rather than be distracted by the often complex task of figuring out how to connect the pieces to achieve those shapes.

"It's easy to become enthralled by the beauty that can be achieved by simply connecting identically shaped pieces of plastic or paper together," said Markus Gross, vice president at Disney Research. "But the designs

aren't intuitive, so we sought a way to let people express their creativity without tedious trial and error."

The research team will present their work at ACM SIGGRAPH Asia 2015, the Conference on Computer Graphics and Interactive Techniques, Nov. 2-5, in Kobe, Japan.

The researchers used the same basic interlocking quadrilaterals commonly found in puzzle lamps - also known as jigsaw, or Ze shades. The [shape](#) is easily recognized by anyone familiar with puzzle lamps, but difficult to describe - a rhomboid with opposite sides of equal length, adjacent to unequal, slanted sides. At each corner is a hook that serves to connect one puzzle piece to the next. By bending and connecting these angled pieces in different orientations, a wide variety of shapes can be achieved.

"One of the most intriguing aspects of interlocking elements is that the geometry is entirely determined by topology," said Bernhard Thomaszewski, research scientist at Disney Research. "But having to think in terms of element connectivity and orientation to achieve a desired shape is very unintuitive for most people."

Using existing puzzle lamp designs, the Disney researchers built a library of base shapes that can be created with the pieces. During the virtual design process, the user selects the desired base shapes, positioning and orienting them as desired. To merge the individual shapes into a single one, the design tool quickly and automatically determines which elements to connect to achieve the final shape.

In addition to merging, the user can also pick and drag parts of the form to extend it into the desired shape.

Though complex shapes can be quickly designed with the tool,

assembling the structure is challenging because the order in which elements are interconnected can have a major impact on difficulty, said Méлина Skouras, a researcher now with MIT. So the Disney tool also automatically produces assembly instructions.

The researchers used the tool to design and build a number of example shapes. A turtle, for instance, required 123 pieces and was assembled in about 2 ½ hours; a flower with 288 interlocking [elements](#) took four hours to build.

More information: "Interactive Surface Design with Interlocking Elements-Paper" [[PDF, 4.66 MB](#)]

Provided by Disney Research

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