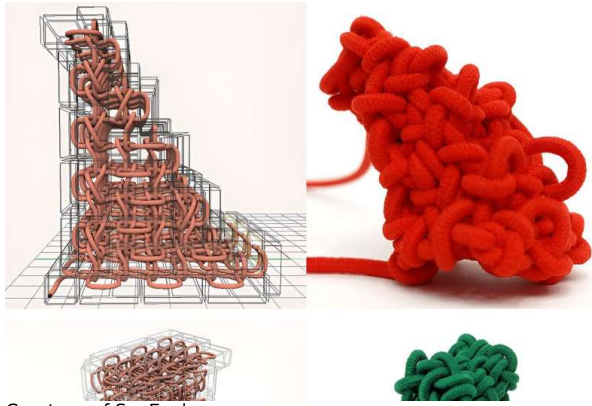


Scholars Present Knitted Furnishings

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Courtesy of SynEvol
Credit: Carnegie Mellon University

Yuichi Hirose has a dream: one day, a machine that can knit furniture will be available to everyone. This machine could weave solid, three-dimensional chairs, tables, and other things in addition to the furniture's outside cloth. Are you sick of that love seat? Simply untangle it and utilize the yarn to crochet an ottoman for yourself.

Solid knitting is the term for this novel manufacturing method, which was initially conceptualized by Hirose, a robotics Ph.D. candidate at Carnegie Mellon University's School of Computer Science. He became enthralled with the concept about ten years ago. And he's now made it a reality, collaborating with a research team led by Robotics Institute associate professor James McCann.

"My dream is to have these solid knitting machines everywhere in the world," Hirose stated.

Hirose came into an online article about McCann's software effort, which simplified the process of reprogramming commercial knitting machines, while he was still creating the machine. With this technique, the machines might be used to create personalized 3D knit items in a useful way. These weren't solid knit pieces; rather, they were hollow shapes, like stuffable bunny rabbits, but Hirose and McCann started discussing the possibility of working together.

By 2020, Hirose's knitting machine was almost complete, but the pandemic halted the partnership. Hirose eventually started working as a research assistant in the Textiles Lab in 2022, and he later enrolled in the robotics Ph.D. program.

The CMU team got an honorable mention in the Best Paper competition at SIGGRAPH 2024, the annual Conference on Computer Graphics and Interactive Techniques, where they presented their robust knitting research and the prototype machine. SIGGRAPH wrote a blog post about the undertaking.

The prototype, which is roughly the size of a clothes dryer, can currently only create a finite number of forms and sizes. It can be used to create prisms that are rectangular or triangular in length. The objective is to build a machine that can autonomously generate solid objects, although further work is needed to enhance its functionality.

The researchers utilized elastic cord as their yarn because the machine stretches the loops quite a bit. Despite being composed of flexible cord, the resulting solid knits are "surprisingly firm," according to McCann.

"It feels sort of like a stack of felt or the sole of a shoe," added the man.

The process can be used to hand-knit larger, more sophisticated shapes, like a pair of sandals, albeit the machine's output is currently limited.

Future research, according to Hirose, will go in two separate directions: creating a smaller machine for precision things and constructing a larger machine for generating furniture.

"We hope that other people out there are going to build their own solid knitting machines and come up with ideas we haven't yet explored," McCann stated.

Apart from Hirose and McCann, the research team also comprised Angelica Bonilla Fominaya, a former student of computer science and arts who is currently employed as a software engineer at Google, who employed the method to create artistic pieces. The project's 3D visualization software was created by Mark Gillespie, who recently earned his Ph.D. in computer science. It has been very helpful in comprehending the intricate design process.

If all of that seems a little unclear to you, you're not alone. Solid knitting is comparable to three-dimensional printing. Solid knitting creates shapes by adding knitted layer after knitted layer, much like 3D printers do. But each subsequent layer is sewn to the preceding one, not fused together with plastic or glue.

To get a better knowledge, solid knitting can be made by hand as opposed to using a machine. For knitters interested in learning more, the researchers have produced a video and a set of hand knitting instructions.

McCann, the head of the Carnegie Mellon Textiles Lab, remarked, "It can be difficult to wrap your head around the concept." "But it's a very cool idea, and one that has a lot of promise."

While pursuing his master's degree in digital fabrication at Keio University in Japan in 2012, Hirose had the notion. His interest in reconfigurable objects stemmed in part from the Claytronics project in the computer science department at SCS. The goal of that project was to construct tiny, modular robots that could put together to form a wide variety of designs.

"Those robots were very cool, but not very versatile," he stated.

Like LEGO bricks, the modular robots were typically attached to one another by friction or magnets and were easily movable. Hirose was searching for something that was still changeable but also more robust. It was then that he had the notion for solid knitting.

After completing his master's degree, he entered the workforce, but he never abandoned the solid knitting concept. He eventually succeeded in obtaining a few funds, left his work, and started developing a sturdy knitting machine in 2018. Similar to industrial knitting machines, his device

worked by manipulating yarn and holding loops open for the subsequent stitching row using rows of latch needles, which are needles with adjustable latches.

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