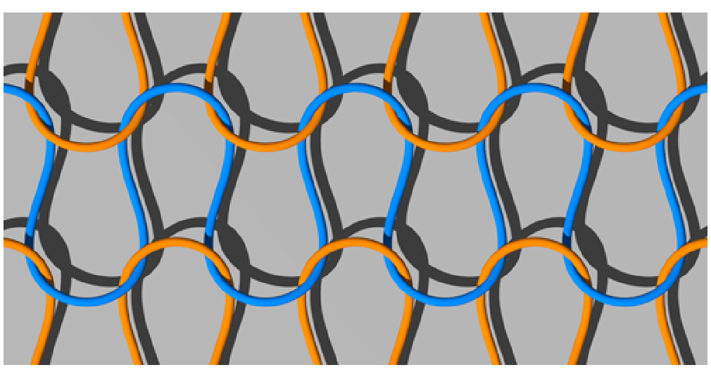
Predicting the Behavior of Knitted Fabrics

A simplified model of how yarns interact shows that a piece of knitted fabric can have many stable resting states depending on its history of deformation.

By **Elizabeth Fernandez**

Despite the ubiquity of intertwined materials—a class that includes birds' nests, knotted shoelaces, and your favorite sweater—scientists struggle to understand their mechanics and to predict the shapes that they adopt at rest. Now Jérôme Crassous at the University of Rennes, France, and colleagues have come up with a simplified description of the mechanical properties of these materials that helps the researchers to infer how they behave [**1**]. The team's research may have implications for the development of a wide variety of materials, from conventional clothing to smart textiles and soft robotics.

The researchers focused on knitted fabric, which is formed by interlocking yarn in a series of loops. The behavior of this material is complicated by the elasticity of the yarn and the complex geometry of the contact zone between strands, which can change shape and rotate as the fabric moves.



Credit: J. Crassous/University of Rennes

To understand the effect of these motions, Crassous and colleagues knitted a sheet of fabric using the jersey knit stitch, a common stitch also known as stockinette. They stretched and manipulated the fabric and modeled a contact zone between the strands. This modeling, though simplified, allowed the researchers to accurately predict the shapes of the fabric as it moved. They showed that knitted fabrics have not one but a continuous range of metastable states.

The researchers say that their result explains how an interlinked fabric can have more than one resting configuration depending on its history of being rumpled, folded, or stretched. "Knitted fabrics do not have a unique shape when no forces are applied, contrary to the relatively common belief in textile literature," says Crassous.

Elizabeth Fernandez is a freelance science writer based in Raleigh, North Carolina.

REFERENCES

1. J. Crassous *et al.*, "Metastability of a periodic network of threads: Shapes of a knitted fabric," **Phys. Rev. Lett. 133, 248201 (2024).**