Apparent and real Gaussian curvature in axisymmetric kirigami

Dominic Vella*[1], Jason Barckicke , Lucie Domino[2,3], and Mingchao Liu

[1]Mathematical Institute [Oxford] (MI) – Mathematical Institute University of Oxford 24-29 St Giles' Oxford, OX1 3LB UK, United Kingdom

[2]Institut universitaire des systèmes thermiques industriels – CNRS – France

[3]laboratoire IUSTI – Aix Marseille Université (Aix-en-Provence) – France

Abstract

Cutting material from planar sheets has recently emerged as a strategy for generating three-dimensional shapes, particularly in flexible electronics. One particular form creates a planar structure that resembles a bicycle wheel with a central hub connecting multiple spokes. When this structure is compressed, it buckles out of the plane creating a structure that appears approximately axisymmetric and hence the structure appears to have Gaussian curvature, even though it was fabricated from a flat sheet. We begin by discussing how this strategy can work, showing that the cut pattern can be chosen to create either a tesselated 3D structure or an arbitrary axisymmetric shape with at most one inflection point. We emphasize that the 'spokes' of the structure deform cylindrically and so the Gaussian curvature of the axisymmetric structure that is generated is only 'apparent'. However, the hub region, which is approximately circular, deforms with real Gaussian curvature. We discuss the origin of this Gaussian curvature, showing that it is localized to the edge of the hub and give scalings for its size.

*Speaker