Discrete Developable Meshes

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Geometric modeling of developable surfaces is an actively researched topic, with important practical applications ranging from manufacturing and architecture, to art and paper-craft or *origami*. In particular, there still exists a demand for an intuitive design paradigm for composite piecewise C^2-smooth developable surfaces, which decompose into ruled pieces and planar patches. Such a type of surface can be equivalently characterized in several forms, such as:

- defined as torsal ruled surfaces; that is, surfaces containing at least one parametric family of lines, with constant tangent planes along such lines;
- through the theory of isometric mappings, by being mapped to local planar domains;
- surfaces with a singular shape operator; or, equivalently, exhibiting zero Gaussian curvature.

Each of these definitions has been the motivation for new classes of discrete developable meshes in recent work [1, 2]. We review some of these, propose a novel one, and explore related tools for interactive manipulation, such as handle deformation, curve folding, cutting and gluing, and others.

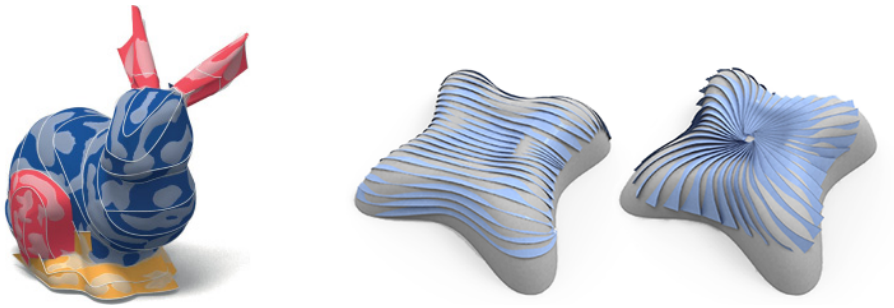

Figure 1: Recent advances in geometric modelling of developable surfaces have produced methods to approximate reference surfaces with piecewise developables (left) and with curve-pleated surfaces (right) [2, 3].

Joint work with: Florian Rist, Johannes Wallner, Helmut Pottmann

References

[1] Caigui Jiang, Cheng Wang, Florian Rist, Johannes Wallner, and Helmut Pottmann. Quad-mesh based isometric mappings and developable surfaces. *ACM Trans. Graph.*, 39(4), jul 2020.

[2] Chengcheng Tang, Pengbo Bo, Johannes Wallner, and Helmut Pottmann. Interactive design of developable surfaces. *ACM Trans. Graph.*, 35(2), jan 2016.

[3] Caigui Jiang, Klara Mundilova, Florian Rist, Johannes Wallner, and Helmut Pottmann. Curve-pleated structures. *ACM Trans. Graph.*, 38(6), nov 2019.