Geometric Folding Algorithms: Linkages, Origami, Polyhedra [DO07]

Updates to Chapter 3, Planar Linkage Mechanisms, Open Problem 3.2

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Open Problem 3.2: Noncrossing Linkage to Sign Your Name (p. 40), was suggested by Don Shimamoto. The problem asks if any given algebraic curve can be traced by a linkage that avoids self-crossing throughout the tracing. The answer YES was established in [ADD+25]:

> "In particular, we show that any polynomial curve $\phi(x, y) = 0$ can be traced by a noncrossing linkage, settling an open problem from 2004. More generally, we show that the regions in the plane that may be traced by a noncrossing linkage are precisely the compact semialgebraic regions (plus the trivial case of the entire plane). Thus, no drawing power is lost by restricting to noncrossing linkages. We prove analogous results for matchstick linkages and unit-distance linkages as well."

References

[ADD+25] Zachary Abel, Erik D. Demaine, Martin L. Demaine, Sarah Eisenstat, Jayson Lynch, and Tao B. Schardl. Who needs crossings?: Noncrossing linkages are universal, and deciding (global) rigidity is hard. *Journal of Computational Geometry*, 16(1), 2025.

[DO07] Erik D. Demaine and Joseph O'Rourke. *Geometric Folding Algorithms: Linkages, Origami, Polyhedra*. Cambridge University Press, 2007.