

The Cosmic Spiderweb and Design of General Origami Tessellations

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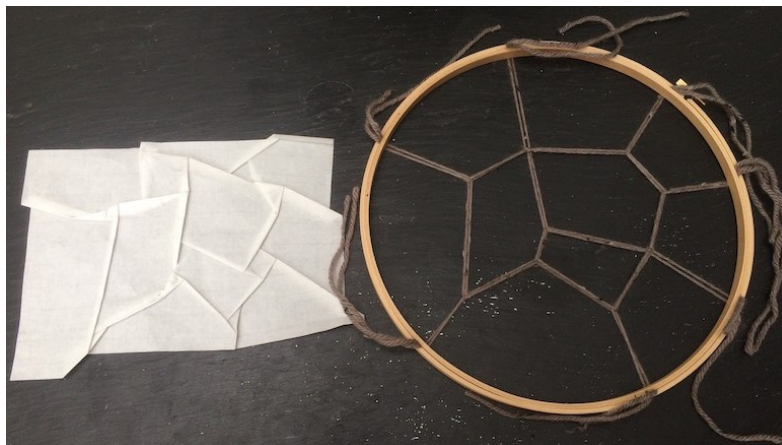
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Abstract

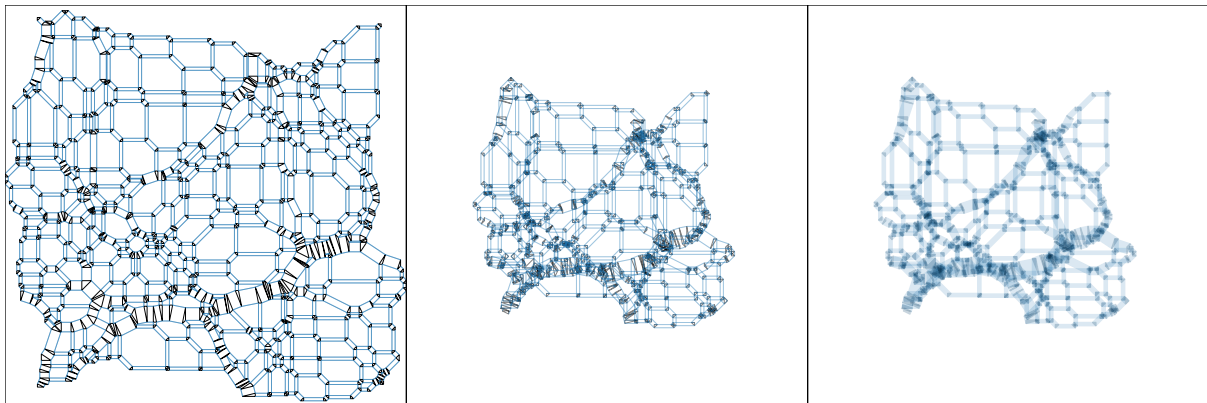
Contributions to 5OSME and 6OSME ([Lang and Bateman, 2011](#); [Lang, 2015](#)) explained how to produce origami tessellations from an arbitrary spiderweb. In structural engineering, a spiderweb is a spatial graph of nodes and strings between them, which can be strung up to be entirely in tension.

A large class of spiderwebs are Voronoi diagrams (tessellations of cells around generating points such that the cell around each generator is the patch of space closer to that generator than to any other). But most generally, spiderwebs are sectional-Voronoi diagrams, i.e. sections through higher-dimensional Voronoi diagrams ([Whiteley et al., 2013](#)).

As we ([Neyrinck et al., 2017](#)) explained in a recent paper, the same geometry linking origami tessellations and spiderwebs applies also to the large-scale arrangement of matter in the cosmos, in an accurate approximation called the adhesion model. Thus the term ‘cosmic spiderweb.’ This rigorous geometric link further motivates the origami-cosmic web correspondence ([Neyrinck, 2015](#)). It also clears up the previously ambiguous relationship between the cosmic web and arachnid spiderwebs, which for example has inspired artist Tomás Saraceno to build intricate room-sized installations of greatly magnified black-widow spiderwebs. Below appear my origami and dreamcatcher representations (both built from the same spiderweb geometry) of the nearby dozen or so galaxies, the ‘Council of Giants’ ([McCall, 2014](#)).



The current paper will also present some practical computational tools, drawn from cosmic-web research, for designing arbitrary origami tessellations based on sectional-Voronoi tessellations. Below, left to right, appear: an idealized (with large, 90° angles, not actually paper-foldable) origami crease pattern generated with these tools from a sample cosmic web; the crease pattern folded up; and a representation of the number of layers of paper at each location after folding.



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