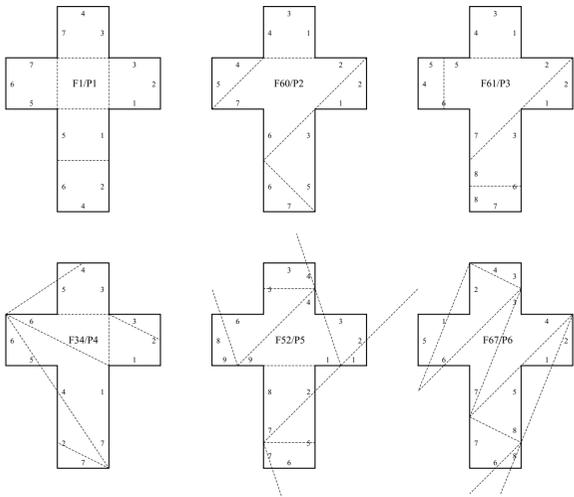
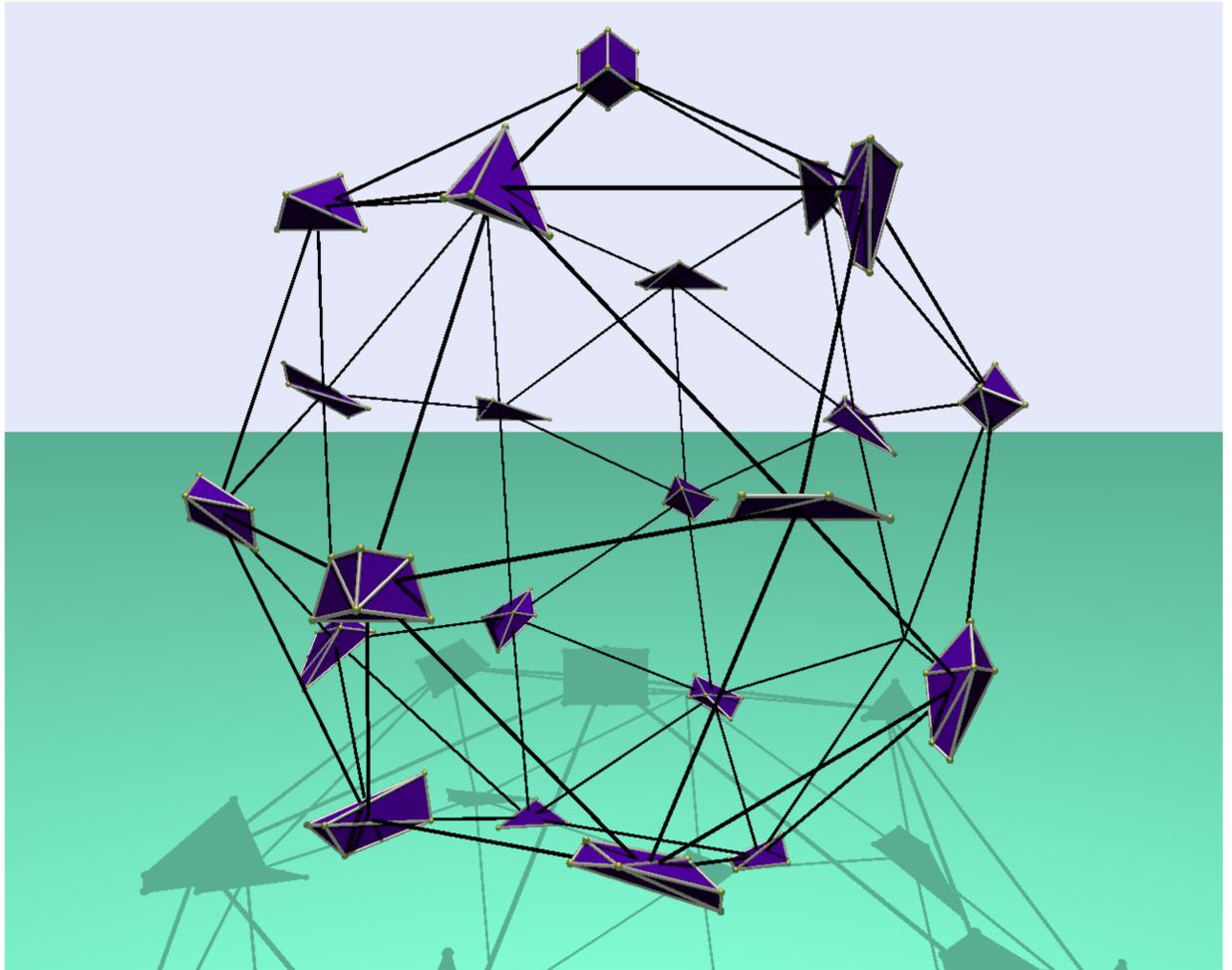


The 23 Foldings of the Latin Cross

Sasha Berkoff, Caitlin Brady, Joseph O'Rourke, Sonya Nikolova

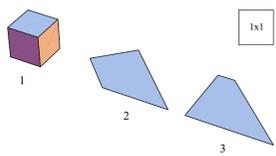
Smith College, 2003

A cube may be cut open and unfolded flat to the shape known as the Latin Cross, with four of the six square faces surrounding the bottom face, and the top face attached to one of the side faces. Theory developed in [1] and [2] has permitted exploration of all the convex polyhedra that can be folded from any given flat shape. Here we studied all the polyhedra foldable from the Latin Cross.

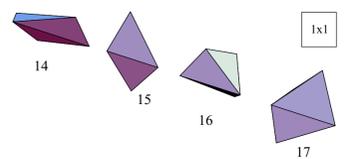


We started from crease patterns generated by several researchers [2]. Six typical patterns are shown above. There were all together 85 such patterns.

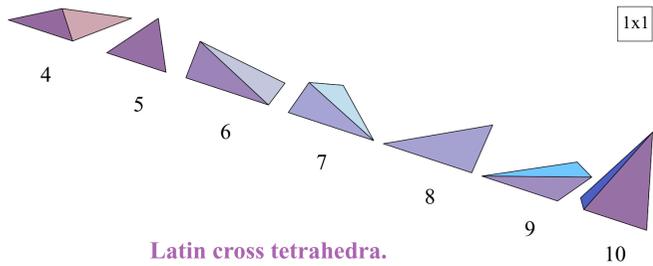
We then folded each by hand, and determined that they fold to exactly 23 distinct convex polyhedra. We computed the 3D structure of each of these shapes, and built models for each in Mathematica. We then converted these models to POV-ray files to create the above ray-traced image.



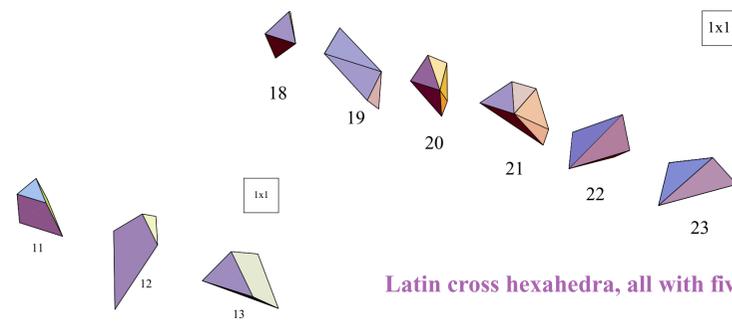
The cube and two flat quadrilaterals.



Latin cross octahedra, each of six vertices.



Latin cross tetrahedra.



Latin cross pentahedra.

Latin cross hexahedra, all with five vertices.

[1] J. O'Rourke, "Folding and unfolding in computational geometry." *Lecture Notes in Computer Science*, Vol. 1763, Springer-Verlag, Berlin, 2000, pp. 258-266.

[2] Erik D. Demaine, Martin L. Demaine, Anna Lubiw, and Joseph O'Rourke. "Enumerating foldings and unfoldings between polygons and polytopes." *Graphs and Combinatorics*, 18(1):93-104, 2002.