

# Composing Right Frusta to fold Axially Symmetric Origami

Cheng Heng Yi

Massachusetts Institute of Technology

77 Massachusetts Ave, Cambridge, MA 02139, USA

herngyi@mit.edu

## Abstract

An original method has been derived to use origami to fold three-dimensional polyhedra that have axial symmetry. In origami terms, the polyhedron is folded by sequentially grafting right frusta on top of each other. That is, a frustum is extruded and then its surrounding paper is used to fold the next frustum, until the entire polyhedron has been extruded.

The crease pattern of the polyhedron is generated by *composing* together the crease patterns of the individual frusta. An algorithm has been devised to compute the crease pattern that results from grafting two frusta together, basically by “splitting apart” the second crease pattern using the pleats within the first crease pattern. This algorithm is recursively applied to compute the crease pattern of the polyhedron. A computer program has been written, allowing users to specify a target solid and generating its crease pattern.

The sequential grafting modularizes the design and folding processes, as compared to existing *ad hoc* design algorithms. The modularization allows more versatile design from combining individual frusta in novel ways. The process of folding from the crease pattern is also sequential and thus easier, as opposed to a single-step crease pattern collapse.

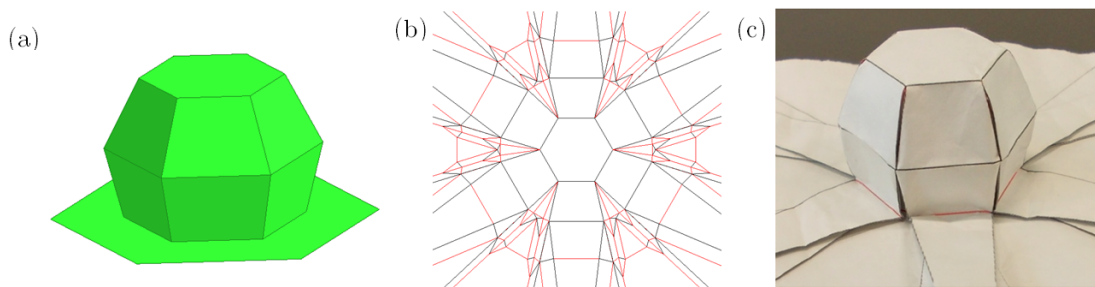


Figure 1: Folding an axially symmetric polyhedron.  
(a) Target solid (b) Crease pattern (c) Folded product