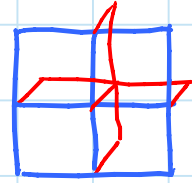


6.849

Class 6

Sept. 25, 2012

◦ Origamizer folding exercise



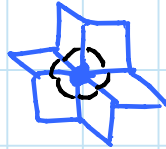
TIPS:

- Rhino's Face3D + Join + Weld (180) FTW
- export OBJ as Polygon Mesh
- turn on Angle Condition

◦ Convex vs. nonconvex vertices



$$3 \cdot 60^\circ = 180^\circ$$



$$6 \cdot 90^\circ = 540^\circ$$

$$\sum \theta_i \leq 360^\circ$$

$$\sum \theta_i > 360^\circ$$

- DEMO of ↗ in Origamizer

◦ Freeform Origami DEMO

◦ Geometric constraints:

- Rigid Origami Simulator
(parameterized by fold angle)
 - closure around a vertex
- Freeform Origami
(parameterized by 3D vertex coordinates)
 - developability
 - flat foldability
- Origamizer
 - w/ θ variable setup
 - closure around a vertex
 - convexity of paper boundary
 - convexity of edge-tucking molecule
 - tuck angle condition
 - tuck depth condition

◦ Solve these nonlinear constraints via sequence of linear systems $\rightarrow$ to reduce error pseudoinverse ~ underconstrained

- ① Euler step to make infinitesimal motion satisfy constraints
- ② Newton step to correct 2nd order error

- NP-completeness: what, me worry?
 - local foldability seems to be enough for small rigid motions
 - OPEN: theorem?
 - amount of valid motion varies
- Automatic folding:
 - simple folding robot [Balkcom & Mason 2008]
 - Printed Circuit MicroElectricalMechanical System (PC-MEMS)
 - [Harvard Microrobotics Lab 2011]
- Open problems in rigid origami?
 - OPEN: complexity of deciding rigid foldability of a crease pattern?
 - degree-4 vertices $\Rightarrow$ easy
 - [Demaine & Tachi 2012]
 - OPEN: design rigidly foldable origami (any interesting class)
 - paper shopping bags
 - OPEN: unfold from flat state with extra creases
 - PROJECT: port Tachi's software to MacOS
- Multiple origami from subsets of 1 CP?
 - $\rightarrow$ LECTURE 7!