Towards Thick Shells with Isostatic Microstructure
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Motivation
- Manufacturing at micro-scale requires accurate material structure representation in order to predict physical properties
- Therefore a variety of constrained, isostatic, irregular micro-structures need to be accurately and efficiently represented
- Self-similar and foliated (layered) structures support design across scales

Inspiration from Nature

Analysis
- Classical Finite Element Analysis is not enough!

Approach
- Input: Coarse macro-geometry with physical characteristics and response
- Output: 3D framework of interconnected 2D isostatic layers suitable for manipulating, analyzing, and optimizing design of physical characteristics
- Steps:
  - Fine macro-geometry
  - Foliation of enclosed solid
  - Layers conforming to the foliation
  - Realistic fabricated/assembled material micro-structure
  - Provably complete generators for all irregular isostatic frameworks
  - Self-similarity and repetition for hierarchical representation
  - Gluing to boundary or neighboring regions while preserving isostaticity

Foliation of solid

Mapping micro-structure onto and stacking foliation layers

Generating irregular isostatic frameworks

Results
- Distance defines isostatic micro-structure (realizing the structure)
  - Algorithm for finding a convex search space
  - Algorithm for constructing the structure

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