

Title: Bistable Auxetic Mechanical Metamaterials Inspired by Ancient Geometric Motifs

Link: https://www.researchgate.net/publication/310476869_Bistable_Auxetic_Mechanical_Metamaterials_Inspired_by_Ancient_Geometric_Motifs

Contributions

There are auxetic structures which are monostable and some which are bistable. Monostable structures are one which have auxetic properties but are unable to maintain their deployed state.

Square and triangular auxetic structures are created by creating cuts into a sheet of material that create a repeating pattern of unit cells connected by hinges. The hinges connect the network of unit cells at the vertices.

Auxetic structures derive their mechanical properties are influenced in large part by the unit cell design rather than the chemical composition of the material from which they are constructed.

When the network of unit cells is pulled along one direction the hinges connecting the unit cells rotate causing an expansion in the transverse direction, leading to the negative Poisson's ratio.

The paper's main focus is on triangular or square unit cells which have 3 or 4 intersecting lines. Simple variants of these unit cells are also created by changing the angle of the intersecting lines.

The principal strain in auxetic structures is on the hinges which serve as the rotational mechanism that allows the structure to move between states.

As I had hypothesized the theoretical deployment of auxetics uses the assumption that the hinges are points. In practice this is not the case because there needs to be a thickness which keeps the components together. This thickness also restricts the range of motion that the unit cells can undergo.

Limitations

Testing the effect of hinge thickness on mechanical properties. The paper mentions that they explored it but did not talk about the results in the paper.

Origami tessellations can also be used to make auxetics but they are time consuming.

Future Directions

Varying the geometric properties of the unit cells to develop new designs which can be used to make different kinds of structures.

Citations

References

- [1] Ahmad Rafsanjani and Damiano Pasini. Bistable auxetic mechanical metamaterials inspired by ancient geometric motifs. *Extreme Mechanics Letters*, 9, Part 2:291–296, 12 2016.

Tag: motif [1]