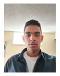
Gyroid Lattice Structures

The analysis of mechanical properties



PRESENTER:

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BACKGROUND:

3D printing technology such as fused deposition modelling has made it possible to manufacture components with tunable mechanical properties and geometries by using lattice structures. One of the useful structures for fabricating mechanically reliable pressure sensors is the Gyroid design because it behaves as a multi-directional spring with a distributed stress concentration.

METHODS

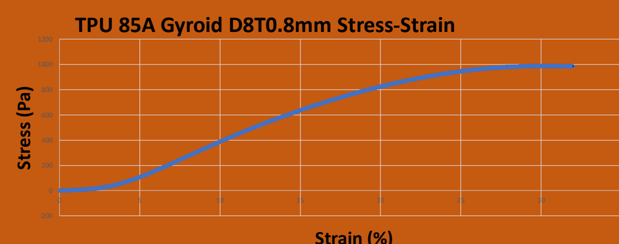
1. CAD modelling of lattice structures with varying wall thickness and unit densities. Collected [what] from [population]
2. FEA simulations of compression tests for attaining the theoretical stress to strain relation.
3. 3D printing and real compression testing for attaining the experimental stress strain relation.
4. Plotting the relative modulus of elasticity as a function of relative density to compare with the Gibson-Ashby theory.

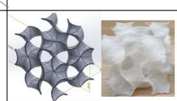
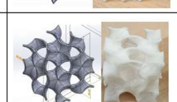
Comparison of simulation, experimental, and mathematical theory.

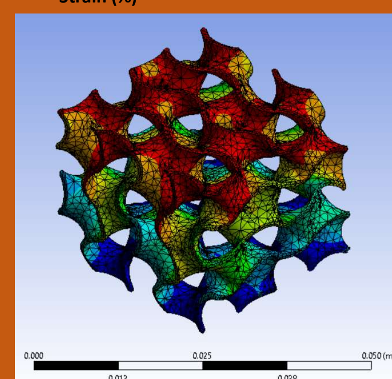
Findings

- The stress strain curve follows a linear trajectory followed by a plateau response.
- We anticipate the relationship between relative density and relative elastic modulus to be exponential as predicted by the Gibson Ashby model (GA model)

The **Gyroid** is an infinitely connected triply periodic minimal surface which is fabricated by 3D-printing and has mechanical properties ideal for the design of tactile pressure sensors.

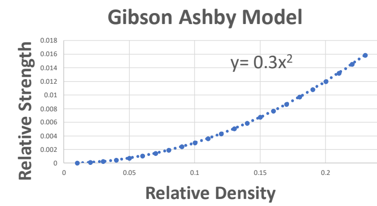


Density / Thickness	3.375 units per 3X3 cm cube	8.0 units per 3X3 cm cube	15.625 units per 3X3 cm cube
0.6 mm			
0.8 mm			
1.0 mm			



DISCUSSION

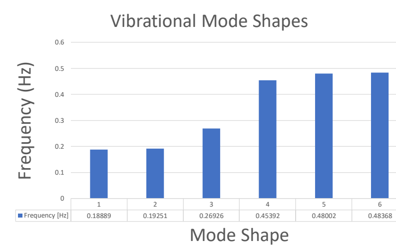
- The Gibson Ashby model predicts that as the relative density increases linearly, the strength of the structure increases exponentially.
- By printing conductive traces on the surface of the Gyroid, pressure sensors can be developed for use in soft robotics



$$\frac{\sigma^*}{\sigma_s} = C\left(\frac{\rho^*}{\rho_s}\right)^n$$

$$\frac{E^*}{E_s} = C\left(\frac{\rho^*}{\rho_s}\right)^n$$

Each vibrational mode shape corresponds with its own natural frequencies. The mode shapes include rotational, transverse and longitudinal vibrations.



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Additive Manufacturing Laboratory

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