

Surface-Based Aperiodic Structures for Additive Manufacturing

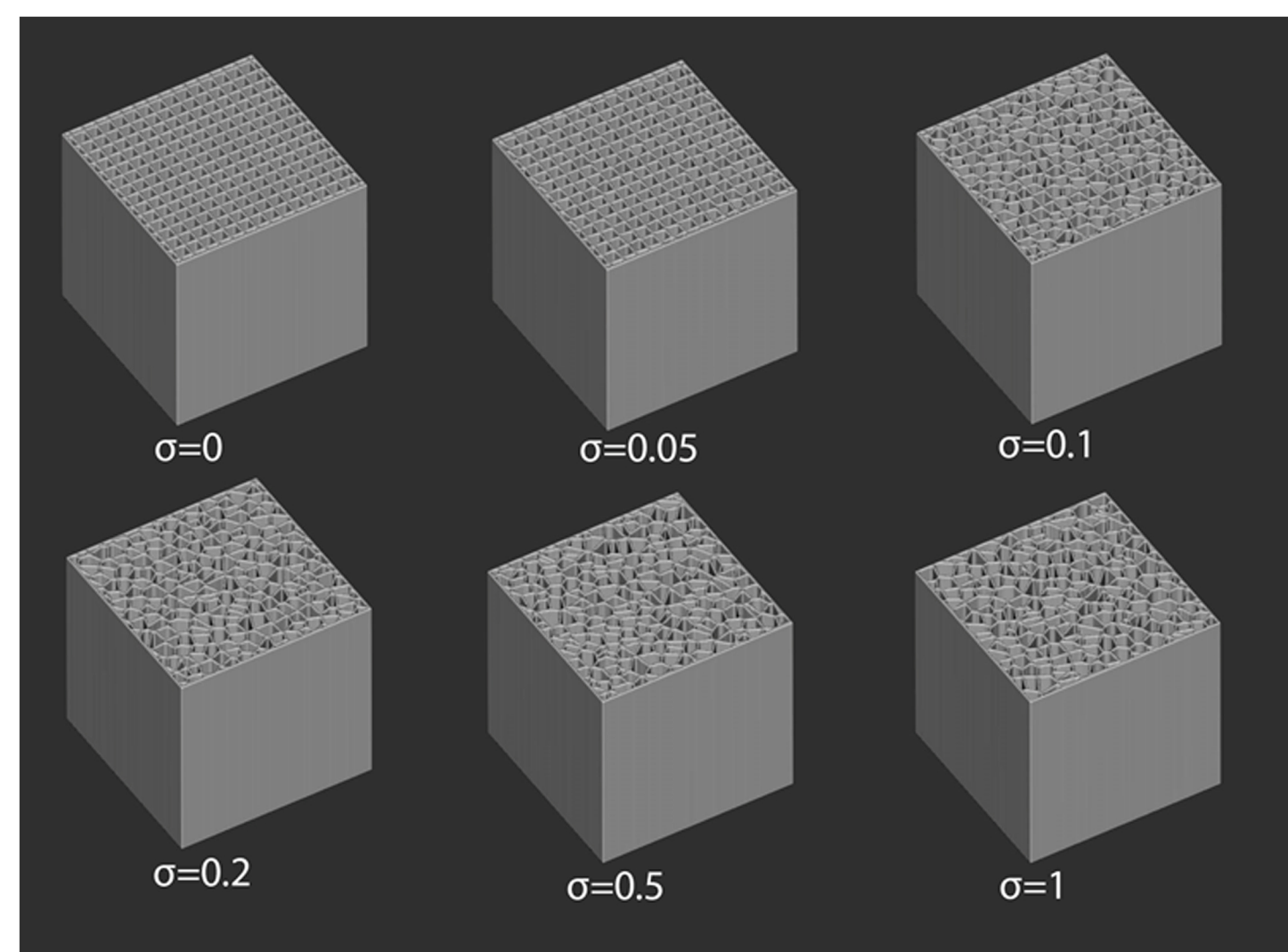
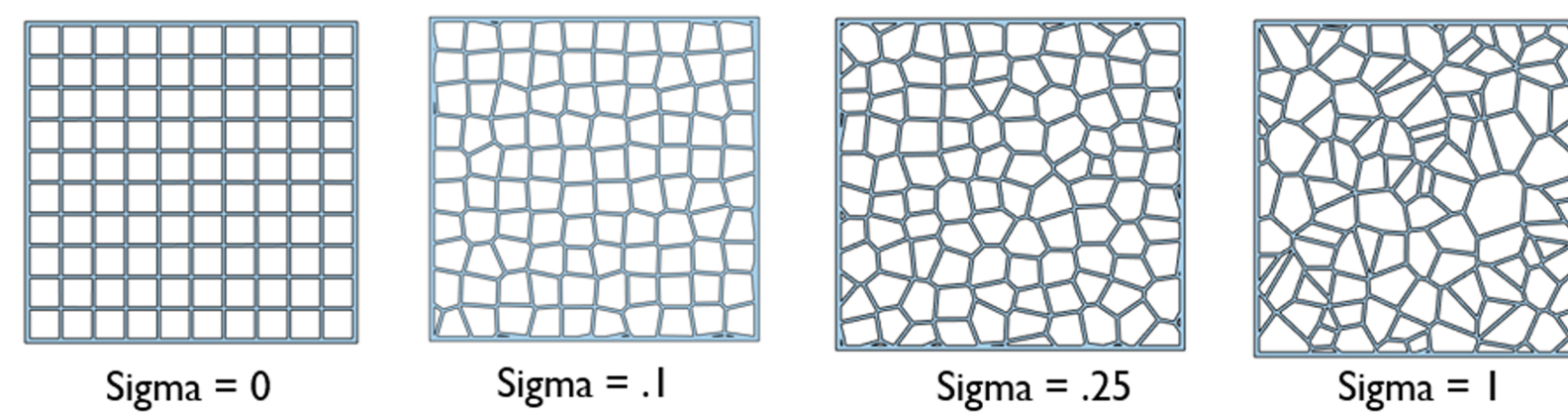
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Research Objective

The objective was to develop a method to design Aperiodic Surface-Based Cellular Structures. These structures can be produced using additive manufacturing. They are then tested under compression to determine the effect of randomness on the structure's behavior.

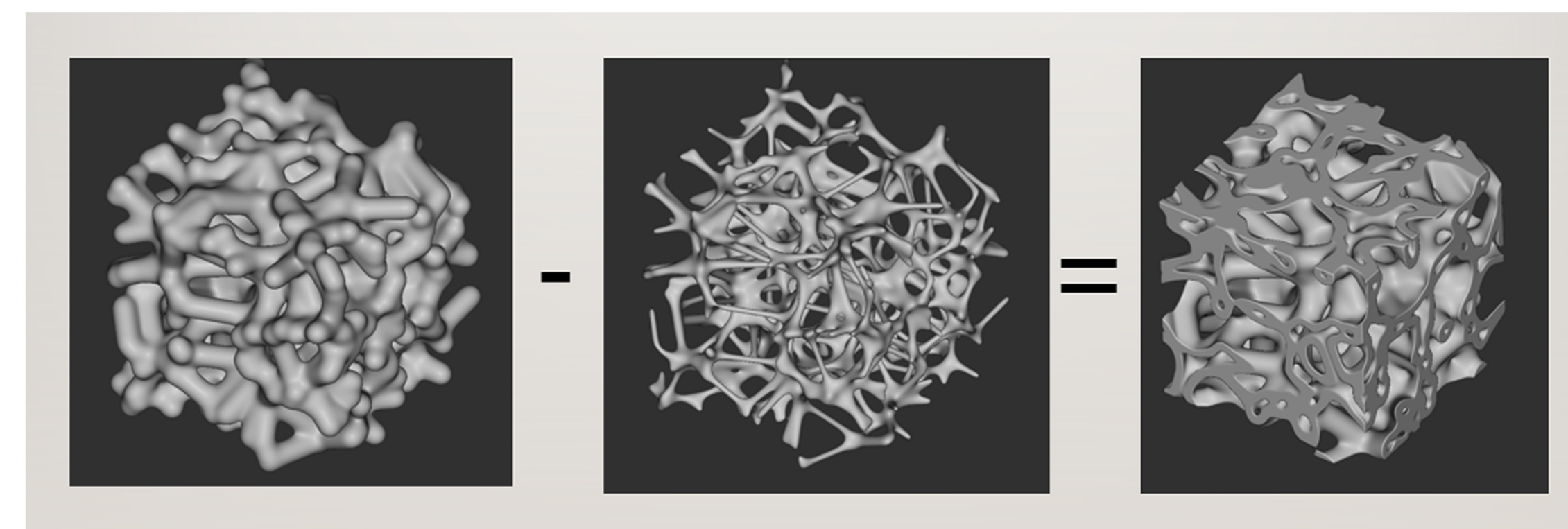
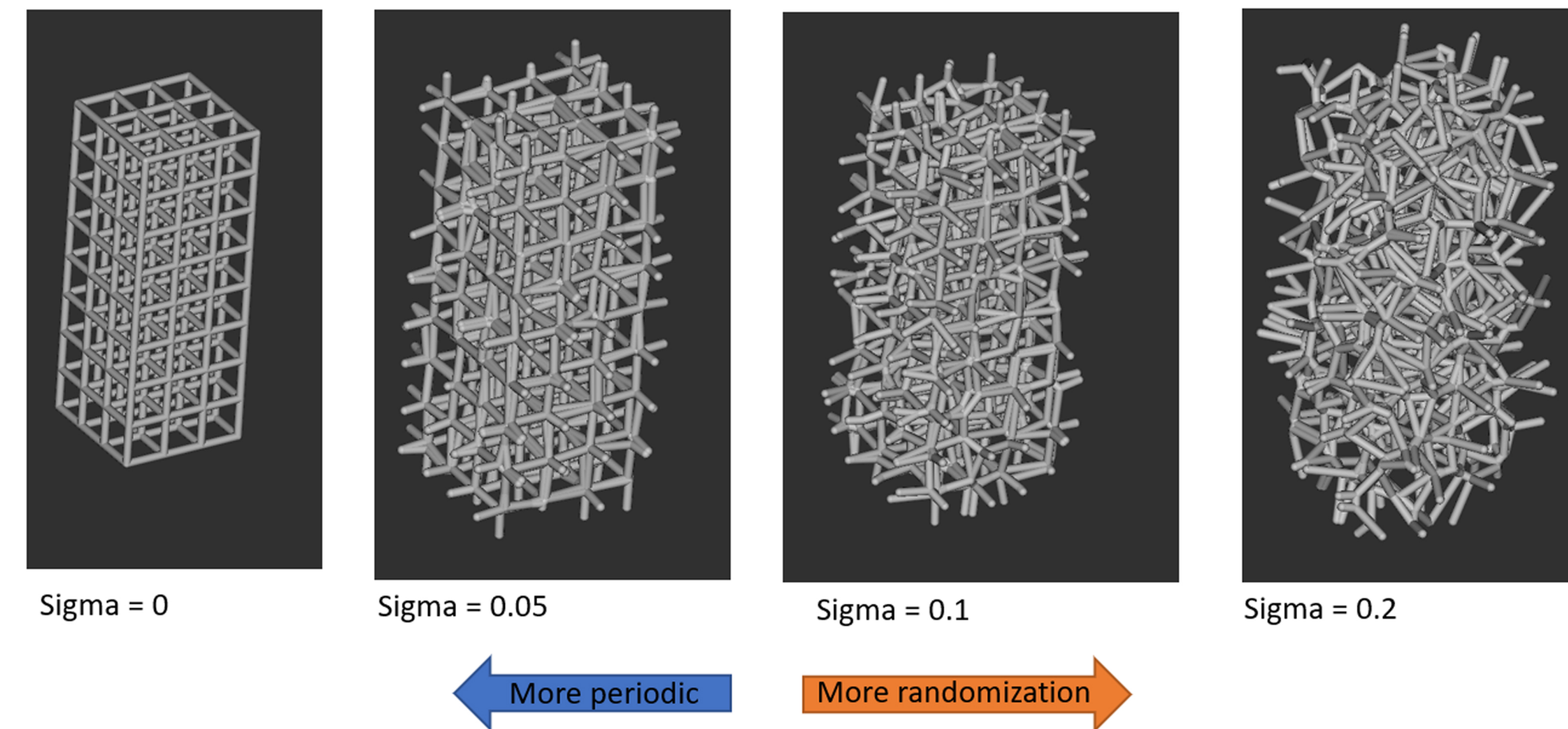
2D Version - Honeycombs

The voronoi node pattern is designed using a periodic pattern, positions are perturbed by adding a random vector to each node which controls the randomness of the resulting structure

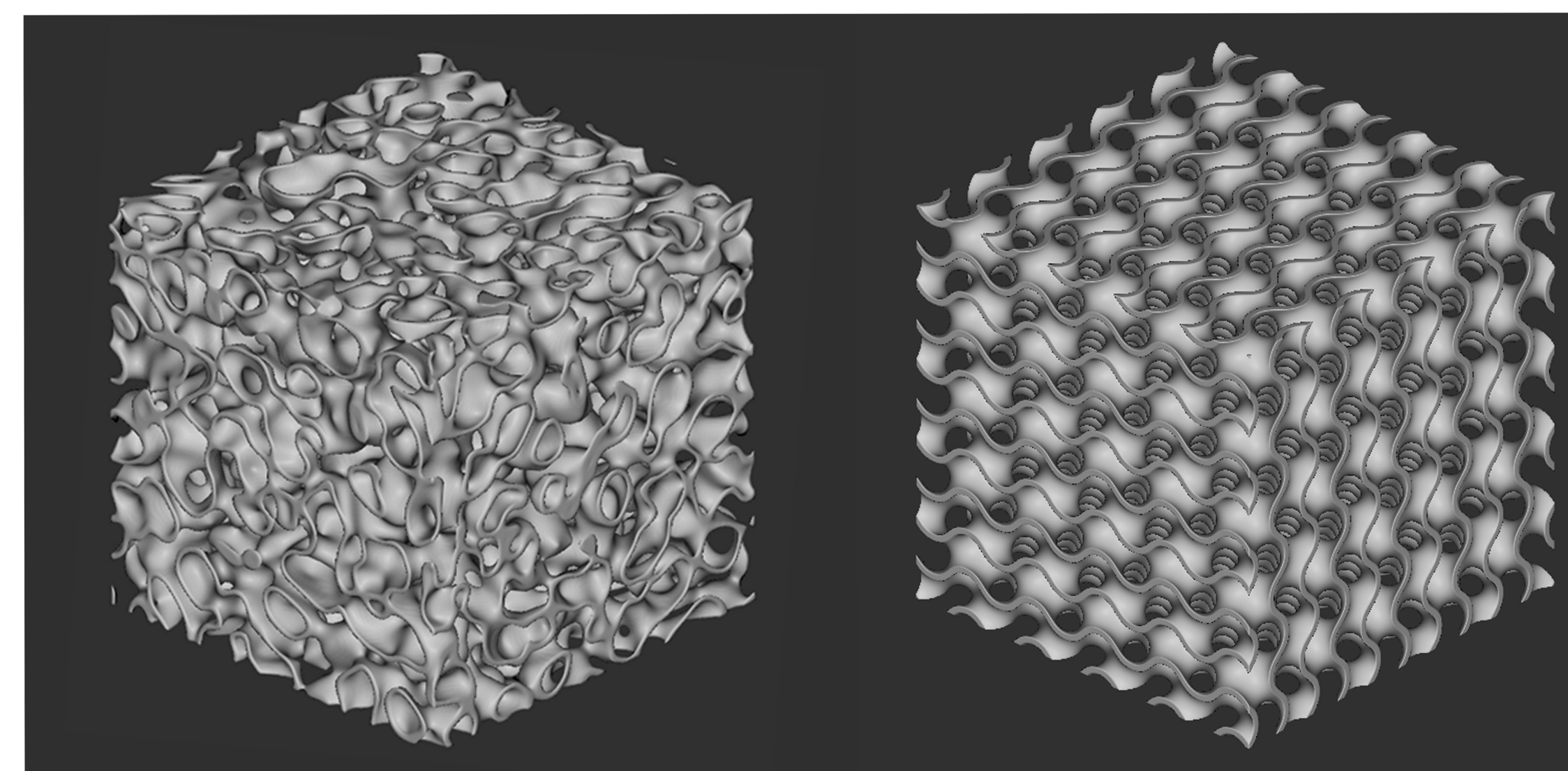


Resulting 2D designs using different perturbation levels

3D Version - Lattices



Shelling using boolean operations



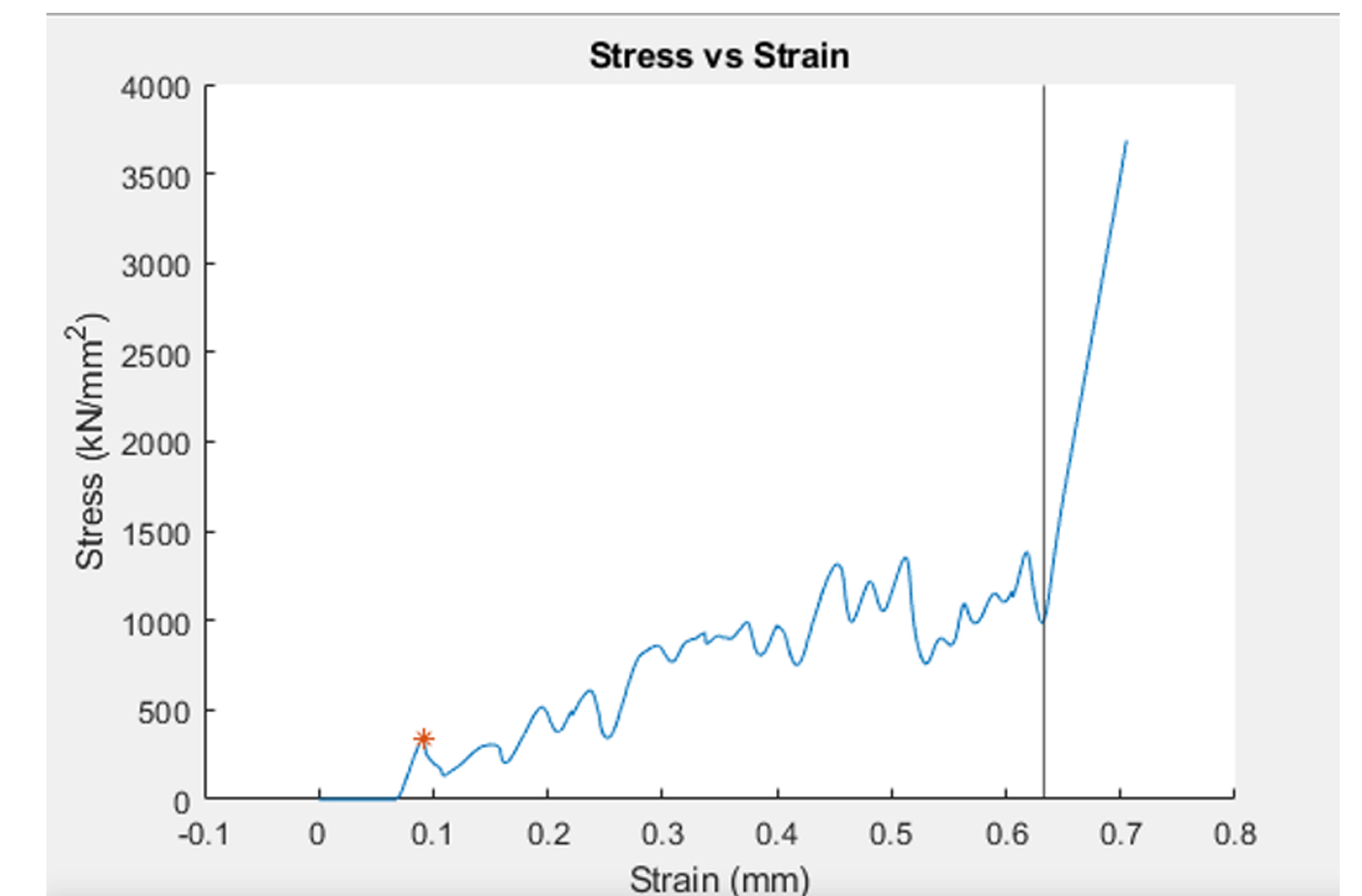
Aperiodic Surface

Traditional TPMS Gyroid Surface

Experimental Design - 90 specimens

- 2 wall thicknesses
- 6 Different Shapes
- 4 Perturbation Levels
- 3 Crush directions

Specimens are 3D Printed out of nylon and compressed using Instron machine
- Compression curves are then compared to measure metrics relating to energy absorbing behavior



Future Work

- This method can be used to design biomimetic structures
- Structural optimization by node placement, allows for complex structures to be described using less data
- Multi-functional design since surface-based structures contain multiple non-intersecting channels, they could be used to exchange heat between two fluids while still providing a structural function