Conceptualization of Adaptable Light Weighting Methodology for Material Extrusion Processes

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Efficient light weighting methods can make 3D printing more affordable while conserving model strength; its exploration brings this technology one-step closer to everyday use.

The biggest feat in creating these models was making them adaptable and simple to understand.

Three base models were developed from metallic crystal structures, which take primitive, body-center cubic, and face center cubic orientations. To create models that could be changed within instants the Grasshopper graphical add-on program was utilized to relate all the variables.

The variables kept constant within this testing were the subject dimensions, the shell width, and the material used (which is polycarbonate for the testing presented). Varying variables include the spherical hole radius (either 4mm or 2mm), the hole distributions (primitive, FCC, or BCC), and the hole counts in the X,Y,Z directions. The models explored are ‘loose’ or have less pores (3 holes in X,Y,Z for radius of 2mm or 2 in XYZ for r=4mm) or deemed ‘compact’ or with more voids (4 holes in XZ & 8 Y for r=2mm or 2 in XZ and 4 in Y for r=4mm). Compressive models were 26.8x26.8x57.2 mm³ in dimension.

Once the base model designs are established, three copies of each model are printed and then tested, using compressive and tensile testing methods.

Future impacts of this research includes first of all the exploration of further light weighting options. One in particular which includes offset internal support rods which are slightly fused together.

Due to the significant findings in this research which revolve around the tool path taken during the printing process, different tool paths are being explored. This will require the creation of a whole new algorithm, computer program, and possibly a different nozzle head or the development of a whole new 3D printer.

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