Project Title: Fluid-impregnation of 3D architectured solid structures

3D architectured solid structures has offered extremal and meta-material responses through elaborate design of shape, size, density, distribution and conformity of generated 3D unit cells. These structures have already been used to enhanced energy absorption, vibration modulation, acoustic control and many other structural duties. Such arrangements, especially open cell foams/lattices, present the option of fluid impregnation to construct multi-stable, multifunctional lightweight structures. Fluid impregnation of lattice structures can happen in the void space (open cell space), through the struts/structural elements that make up the cellular solid or a combination of the two. A process such as this has significant implications towards mechanical, vibration and thermal properties of the overall structures. Multi-stable and multi-functional responses can be enhanced by choice of impregnation fluid such as Magnetorheological (MR), Electrorheological (ER) or other non-Newtonian (NN) Fluids. The project will involve the design of such structure through multi-physics solid/fluid interactions to establish a design perimeter, one concerning the optimal fluid impregnation degree (0-100% impregnation). The project is intended for energy absorption and vibration modulation structures under high loading frames/strain rates and possibility for field responsive lattice structures.

Project Deliverables: Computational analyses on the effect of multifunctional liquid phase impregnation on cellular lattice structures and being able to predict vibrational and mechanical responses with experimental validations.