Data-Driven Mechanics Laboratory

Master thesis/Semester project

Experimental Investigation of Architected Granular Materials

Description: Architected materials can achieve properties not found in natural materials, such as negative Poisson's ratios, programmable stiffness, or tunable energy absorption. This project will explore the emerging field of architected granular materials — ensembles of particles whose shape, surface properties, and packing arrangement are deliberately designed to control macroscopic mechanical behavior. Students will design and 3D-print custom particle geometries, assemble granular packings with controlled structure, and perform static and dynamic mechanical tests using the lab's experimental facilities. Experimental campaigns will be complemented by high-resolution imaging and digital image correlation to capture evolving material characteristics. Data analysis will focus on linking microscale properties and interactions to macroscale response, revealing design principles for granular systems with tailored stiffness or energy absorption. The project combines additive manufacturing, experimental mechanics, and data-driven algorithms, contributing to the fundamental understanding and engineering design of new classes of programmable granular materials.

Prerequisites:

- Background in experimental mechanics, 3D-printing
- Coding skills (Python)

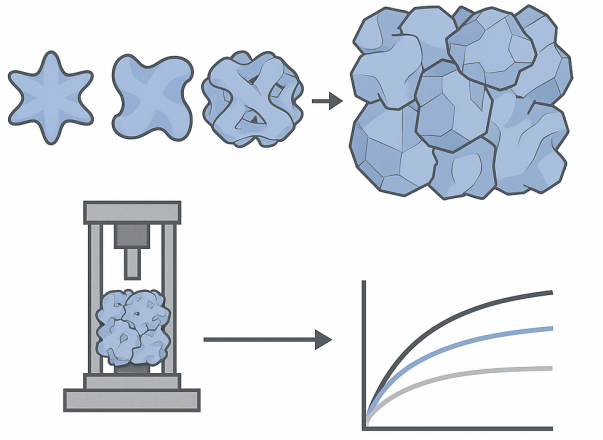

Figure 1: Overview of the design and experimental testing of architected granular materials.

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