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MECHANICS & PHYSICS OF GRANULAR MATTER ACROSS SCALES

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ABSTRACT

Granular matter exhibits fascinating yet complex mechanical and physical behaviors across length and time scales, with relevance to geophysical, biological, and industrial processes. These behaviors emerge from the collective dynamics of many interacting particles and are governed typically by contact mechanics, friction, shape, as well as by other types of interparticle interactions, including cohesion, adhesion, capillarity, and fluid- or temperature-mediated interactions.

Open questions involve: How do these small-scale details transfer across the scales to meso-structures, correlations, or transfer probabilities between states? or even up to the macro- or continuum-scale for large scale modeling and applications? What determines the macroscopic state (solid-like, fluid-like, or gas-like) of a given granular material, and how to model these states and the transitions between them with meso- or macro-models?

Understanding, predicting, and ultimately controlling the behavior of granular matter requires a multidisciplinary approach that brings together mechanics, tribology, physics, applied mathematics, materials science, and computational science. This minisymposium invites contributions that advance the study of granular systems across scales, from particle-contact level interactions via mesoscale structures to continuum descriptions and macroscopic response, and in particular contributions that connect observations, models, and data across these scales.

Topics of interest include, but are not limited to:

- discrete and particle-based methods;
- novel multiscale mechanics and physics methods;
- continuum and micro-physics-informed continuum models;
- coarse-graining and homogenization approaches;
- experimental characterization and imaging across scales;
- granular matter by design at the intersection of metamaterials, architected materials, and complex fluids;
- data-driven or machine-learning-augmented modeling, discovery, and control of many-particle systems.