Abstract Submitted
for the CUWIP21 Meeting of
The American Physical Society

Controllability of Granular Packings SAMANTHA SIMON, ERIN TEICH, DANIELLE BASSETT, University of Pennsylvania — Granular packings are disordered, athermal systems common in our everyday lives. Following perturbation, their evolution depends on the force chain network, a mesoscale stress-distributing structure. Yet, it is unknown how force chain networks change under applied stress. Here we tackle this knowledge gap using network control theory (NCT). NCT is a branch of systems engineering and statistical physics developed to understand and control the activity of networked systems in technology, robotics, and many other structures. It considers the network of connectivity between units, modeling the nature of the systems dynamics as being constrained by that connectivity. A powerful technique revolutionizing other fields, NCT is a promising approach to study force chain networks both conceptually and mathematically. We use NCT to estimate the control energy needed for a packing to transition between contact states. Our preliminary results indicate that control energy increases with system size and jamming, providing physical intuition for characterizing force chain architecture evolution. More broadly, our findings can inform design principles by determining how changing the physical features of a granular packing impacts the system's force chain network architecture and stress behavior.

Samantha Simon
University of Pennsylvania

Date submitted: 22 Dec 2020 Electronic form version 1.4