From macro to micro and back: How material microstructure influences macro-scale behavior in avalanching systems

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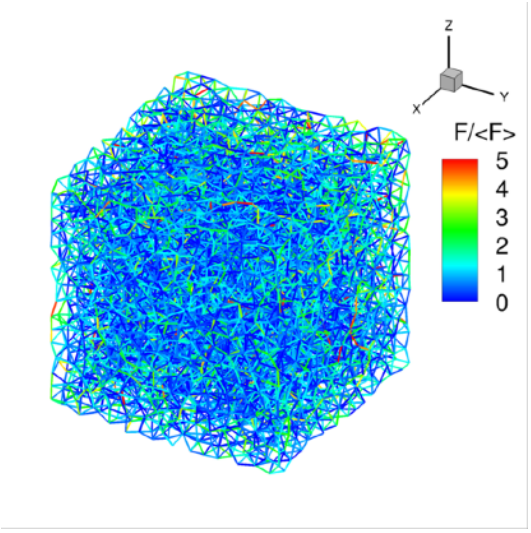
This project focuses on the systems that show avalanching behavior, or so-called intermittent dynamics. The basic system that will be studied involves a collection of soft particles whose interactions are modeled using discrete element/molecular dynamics simulations. These systems form mesoscale features, called force or interaction networks, whose size is large compared to particle scale but small compared to the scale of the system. These networks will be analyzed using topology-based methods and standard statistical mechanics-based approaches. One direction of the planned research involves the development of machine learning algorithms that may have predictive capabilities. Another direction includes the development of effective stochastic methods that could be used to understand the mathematical basis for intermittent types of behavior. The project will be carried out as a joint effort with theoretical groups at U. Oklahoma, and a computational/ modeling group based in Argentina. The participating student will be expected to work and communicate with the researchers from both groups, including travel for work and study visits. The research itself will involve further development of existing computational routines, analytical work on appropriate continuum stochastic models, and collaborative projects with other members of the research group. The figure shows an example of an interaction network spontaneously forming in a compressed granular system.



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