CROSS-PROPERTY CONNECTION BETWEEN HEAT AND FORCE NETWORKS IN THERMALLY-ASSISTED COMPACTION OF GRANULAR MATERIALS

Gülşad Küçük[1], **Marcial Gonzalez**[2] **and Alberto M. Cuitiño** [3]

[1]Department of Mechanical and Aerospace Engineering, Rutgers University,
Piscataway, NJ, 08854, USA,
gulsad@gmail.com
[2]School of Mechanical Engineering Purdue University 585 Purdue Mall
West Lafayette, IN 47907-2088,
marcialgonzalez@purdue.edu
[3]Department of Mechanical and Aerospace Engineering, Rutgers University,
Piscataway, NJ, 08854, USA,
cuitino@jove.rutgers.edu

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Unlike the continuum media, granular materials host inhomogeneous distribution of contact networks, which results in uneven distribution of loads in the dense particulate assemblies. These structural arrangements play a critical role in determining the preferred paths of heat transport, due to the fact that thermal contact conductance is a function of normal force between the particles. In spite of the recent experimental and theoretical studies on the evolution of force chains, the formation of heat chains and the correlation between theses two networks still remain unclear. In this regard, a two dimensional discrete model based on particle mechanics approach is developed to unveil the short and large range relations of these networks' formation, and the effect of thermo-mechanical coupling on cross-property connection. Understanding the evolution of heat and force chains, and their influence on hot zone relations in the formation of these networks, represents a fundamental goal of granular mechanics, in terms of optimizing their collective behavior on macroscopic material properties.

For a particular loading condition that is mostly used in conventional engineering applications, numerical simulations are demonstrated to unveil some of the fundamental concepts in thermally-assisted compaction of granular materials. These are: (i) formation of force and heat chains (ii) alterations in force and heat distributions with respect to compaction parameters, (iii) cross-property relation between normal force and heat transferred at the contact surfaces.