Microstructure Development of Granular System during Compaction

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ABSTRACT

Granular materials is the second most manipulated material in the industry today. They are easy to transport and more and more newly developed materials cannot stand the process of traditional casting, like energetic materials and bio-materials, but will survive the powder compaction process. Having a better understanding of the microstructure development of granular systems during compaction process, especially for particles that will heavily deform under loading, will give an insight of how to better process the powders to produce materials with overall better performance comparing to bulk materials. The main theory and mechanism applied are Hertz law and nonlocal contact formulation. Hertz law considers contact forces as completely local, which means the contact forces are independent. Nonlocal contact formulation removes this assumption and considers the effect of all the forces acting on one single particle, which extends the theory to granular systems at high relative density. Simulated results using both Hertz theory and nonlocal contact formulation are expected to differ more and more as the relative density increase, or with lower material modulus and higher Poisson ratio and the results from nonlocal contact formulation are expected to better match the experimental data. Hertz theory does not hold when the material is heavily deform since contacts are not independent anymore. When investigating into a granular system of soft particles, nonlocal contact formulation is a more precise model. Further research may focus on the influence of particle size on the behavior of granular systems during compaction, especially when it reaches nano-scale.

KEYWORDS

granular system, powder compaction, Hertz law, nonlocal contact formulation, simulation

REFERENCES