Microscopic origin of macroscopic strength in granular materials

Jerves, Alex, ajerves@caltech.edu; Andrade, Jose, California Institute of Technology, United States

ABSTRACT

This study attempts to develop an analytical study about the behavior of arbitrary shape and size noncohesive two-dimensional granular materials. Several mechanical properties and relations are unraveled by connecting micro- and macroscales in an explicit fashion that, at the same time, provides the basis for an analytical–theoretical multiscale framework. Furthermore, this study is based on three main ideas that are developed and connected progressively, namely, the obtention of explicit expressions that enable us to relate microscale parameters, such as contact forces and fabric, to stress and strain as macro (continuum) physical properties. Then, with these powerful tools, physical connections and relations between the mentioned microparameters and macroconstitutive parameters such as friction angle, dilatancy, and critical state are established.