# Numerical simulations of Ultimate state of Granular Materials using DEM

Tang-Tat Ng

Department of Civil Engineering,
University of New Mexico
Albuquerque, NM 87131
tang@unm.edu

The ultimate state of granular material was investigated by the discrete element method. Samples of different densities were loaded along three different stress paths. The stress paths are axial compression, lateral extension, and constant mean stress compression. For all numerical tests, the principal stress direction is vertical. The immediate principal is adjusted such that the b parameter [$b = (\sigma_2-\sigma_3)/(\sigma_1-\sigma_3)$] is constant. The numerical samples consisted of two different kinds of ellipsoids. The ellipsoids were mixed in the proportions 50:50 by weight. The samples were generated by deposition under gravity. The gravity is removed and the samples were consolidated isotropically. Then, they were sheared along the prescribed stress path until the deviator stress and void ratio did not change anymore. The ultimate friction angle and void ratio were determined. In this paper, we presented the effect of mean stress and the b parameters. When samples of different densities were sheared along the same loading path, a unique ultimate state was found. The initial density does not affect the ultimate state.

**Keywords**: discrete elements, granular materials