

DISEG SEMINAR SERIES

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Aula Albenga



Wave propagation in granular soils: discrete element simulations for a micromechanical perspective

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Abstract: Dense granular materials behave differently from classical fluids or solids, due to the strong relation between the macro-scale behavior and smaller-scale kinematics.

Here the propagation of waves in granular soils is addressed and, as related to it, the very small strain (elastic) regime. Elastic wave propagation provides a noninvasive way to examine polydisperse, frictional granular materials. The discrete element method (DEM) allows for a micromechanical interpretation of the acoustic response. Using experimentally measured granular microstructures as input, we numerically perform both static and dynamic probing to deduce elastic moduli/wave velocities from small-strain modulus degradation and time/frequency-domain signals. Static probing allows to understand the path dependency of the elastic moduli, i.e., the stress response to small strain increments, as well as their degradation behavior, for medium-to-large probing strains. Complementarily, dynamic probing provides insights into the acoustic properties (dispersion relations) at different wavelengths, for various probing characteristics.

Finally, the study is extended to the case of saturated granular media via a hydro-micromechanical model based on the coupling of lattice Boltzmann method (LBM) and discrete element method (DEM). The pressure and shear wave velocities predicted by the numerical model at various effective confining pressures are found to be in excellent agreement with Biot analytical solutions, including his prediction for slow compressional waves.

Short bio: Dr. Vanessa Magnanimo is Associate Professor in the Multiscale Mechanics group within the Engineering Technology faculty at University of Twente, Netherlands. Before joining the UTwente as postdoc in 2010, she received a PhD in Continuum Mechanics from Politecnico of Bari, Italy and worked as consultant in a structural engineering firm. She was a visiting scientist at the City College of New York, Cornell University and 3SR Lab in Grenoble and part of the editorial board for Géotechnique, Powder Technology and Granular Matter. Dr Magnanimo is currently principal investigator in several EU- and industrially-funded projects. Her broad research interests are primarily in the area of theoretical analysis and modern simulation techniques applied to wave propagation and constitutive modeling of materials with an internal micro-structure such as soils, powders and emulsions. She is interested in the numerical optimization of tunable soft materials for soil improvement and mitigation of natural hazards.

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