School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Application instructions:
Detailed instructions are available at :
https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Dr Vasiliki Dimitriadi (Email: v.dimitriadi@napier.ac.uk)
- 2ND SUPERVISOR: Dr Daniel Barreto

Subject Group: Built Environment

Research Areas: Geotechnical Engineering

Project Title: Exploring the mechanisms of shear wave propagation in granular materials using DEM

Project description:

Shear wave propagation and associated velocity Vs, are fundamental in characterising the small-strain response of soils. In addition, the shear wave velocity is essential input information in the characterisation of soils under static and dynamic conditions and eventually, in the design of geotechnical structures.

The present study aims in exploring the mechanisms of wave propagation in dry and (ultimately) saturated granular materials on an interparticle level through the use of DEM. In particular, the first attempt to capture the problem with the use of DEM is going to be based on simple assumptions, which will gradually increase in complexity to incorporate more information with regards to the micro- and the macro- mechanics of the problem at hand, and link to actual soil conditions. The initial simulations will consist of cylindrical and/or

cubical samples of granular materials, which will be subjected to a shearing excitation at one end. The shear wave velocity will be measured by means of the time required for the excitation to arrive at the other end of the specimen of known length. In this initial exercise, the granular material will consist of spherical smooth particles of standard size (single fraction in PSD curve terms). Dry conditions will be considered initially, and the effect of different levels of confining stress will be investigated. Depending on the associated computational time and numerical-related challenges (e.g., appropriate selection of boundary type, etc), the parametric investigation will be extended into considering the effects of particle shape, roughness (rough spherical particles), particle size (smaller and larger particles) and void ratio (loose and dense state) upon the magnitude of the shear wave velocity.

The ultimate long-term purpose of the present work, which does not fall withing the scope of the present paper, is to continue increasing the complexity of the DEM simulations and expanding the research in order to fully understand wave propagation in granular materials. In particular, exploring how the shear wave velocity is affected under a liquefaction regime and identifying the controlling parameters in this condition is of interest. Being able to evaluate the shear wave velocity of the liquefied soil by means of DEM simulations and under various soil and excitation conditions is going to provide valuable insight into the behaviour of liquefied soils and allow us to potentially revisit some of the provisions of the existing design codes with regards to the considered shear wave velocity.

Candidate characteristics

Education:

Minimum 2:1 degree in the following subject areas – Civil Engineering

Subject knowledge:

Soil Mechanics

Essential attributes:

- Experience of fundamental concepts in information science research and/or participatory democracy or community groups
- Competent in mixed research techniques including interviewing, document analysis, focus groups, and surveys
- Knowledge of and interest in community groups and how they operate
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

- The ability to work comfortably with people with a range of ages and backgrounds.