Stress-Density Model Validation for Liquefaction Analysis

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Motivation

- Numerical modelling has become an increasingly valuable tool for liquefaction analyses in geotechnical research as well as industry rather than conducting centrifuge or full-scale tests.
- What are the capabilities/limitations of mathematical (constitutive) models used in these numerical modellings?
- How does a constitutive model which has been recently implemented in a widely used software (i.e., FLAC) work?
- Validation of the Stress-Density model \([1,2]\) in FLAC is an attempt to fulfill the mentioned motivations.

Method

- Centrifuge tests can reproduce two characteristics which the behaviour of sand significantly depends on: 1) relative density, 2) in-situ confining stresses.
- Results of a well-conducted centrifuge test (~140 sensors, 55g in a 9 meters radius machine) is used for validation.
- Comparison between the centrifuge and 1D FLAC model was made for the free-field case.

Preliminary Results

- Stress-Density model has three main parts. The parameters for sands used in the centrifuge test for two parts are introduced into FLAC. Preliminary results are promising, as sometimes models cannot even predict the overall trend of pore pressure generation or amplification of acceleration.
- Acceleration response is partially captured at the current stage.
- Admitting the differences between FLAC and centrifuge results, the pore water pressure build-up pattern shows a good agreement in Figure 5
- Long-term simulations are still needed to compare the dissipation patterns.

Conclusion

- Preliminary validation of the Stress-Density model indicated that it can simulate pore water pressures and accelerations.
- According to the current stage of validation, potential uncertainties regarding the input parameters may have caused bias in predicting the acceleration response by model.
- Using other comprehensive experimental data (e.g., torsional simple shear test results) can enhance the accuracy of input parameters to FLAC, which in turn improves the Stress-Density model performance.
- Further Validation with structures present in the model are required to evaluate the model in terms of the soil-structure interaction. This will be done in the near future.

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References