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Strain Energy-Based Modeling of Soil Liquefaction Using Data-Driven Techniques

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- S. Raj Athira (1) Email author (athirasraj1995@gmail.com)
- S. Adarsh (2)

1. Department of Civil Engineering, College of Engineering, , Trivandrum, India
2. Department of Civil Engineering, TKM College of Engineering, , Kollam, India

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Abstract

This paper presents the application of Gaussian Process Regression (GPR) and M5 Model Tree as two alternative data-driven modeling practices for prediction of soil liquefaction. The initial effective mean confining pressure (σ'_{mean}), initial relative density after consolidation (D_r), percentage of fines content (FC), uniformity coefficient (C_u), Coefficient of curvature (C_c), mean grain size (D_{50}), etc. are used as model inputs to predict strain energy density (W) required for triggering the liquefaction. The performance evaluation criteria like mean absolute relative error (MARE), coefficient of correlation (R), root mean square error (RMSE) for the validation datasets are found to be 6.381, 0.849, 0.266, respectively. Use of multiple statistical criteria and graphical plots confirmed the superiority of PuK Kernel-based Gaussian Process Regression (GPR) model over five different empirical models, two linear genetic programming (LGP)-based expressions, artificial neural network (ANN) and M5 Model Tree-based predictions. Further, a parametric sensitivity analysis performed on input parameters showed that σ'_{mean} is the most influencing predictor to explain the variations of the capacity energy than other input parameters.

Keywords

Liquefaction Strain energy Kernel GPR Data-driven techniques