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Understanding soil liquefaction case histories using interpretable machine learning

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ABSTRACT

Soil liquefaction is one of the most common earthquake effects that can cause severe damage to structures and lifelines. Several liquefaction triggering procedures and predictive models have been developed throughout the years. However, the development and application of powerful tools like artificial intelligence and the addition of recent liquefaction occurrences challenge the existing triggering procedures to level up. Moreover, liquefaction prediction highly depends on various factors and the complexity of the relationships among these factors makes it a hot topic to research. Thus, the present study uncovers the connections among the most significant factors in soil liquefaction triggering using an interpretable machine learning based on rough set theory. Rough set-based machine learning (RSML) was used to analyze data from the 230 available liquefaction case histories. RSML generated rules, which are interpretable, that can describe the liquefaction to non-liquefaction cases. The interpretation and significance of some rules were discussed as well as the statistical validation and parametric analyses. Insightful results were produced after the rule-based predictive model was used to classify a new set of case histories that were not part of the training set. This study can help engineers and researchers in understanding the soil behavior under various conditions that can lead to a more efficient design of geotechnical structures and a more directed disaster risk reduction management. Limitations of the proposed approach and recommendations for further studies were also provided.

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