UNIVERSITY TRANSPORTATION CENTER

RESEARCH BRIEF

Informing Predictions from Above with Data from Below: AI-Driven Seismic Ground-Failure Model for Rapid Response and Scenario Planning

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Background

Soil liquefaction is a significant threat to post-earthquake mobility across all modes of transportation. Reliable predictions of this phenomenon are thus needed, both prior to an earthquake for efficient planning and mitigation, and immediately following an earthquake for response and recovery. Such predictions would ideally be made: (i) rapidly (e.g., in near-real-time after an event); (ii) at high resolution (e.g., commensurate with the scale of individual assets); and (iii) over the regional scope of transportation networks. Problematically, state-of-practice models for predicting liquefaction rely on subsurface geotechnical measurements. Given the infeasibility of this testing across vast areas, regional-scale predictions of liquefaction typically rely on geologic maps, from which generic areal classifications of susceptibility are assumed. This type of approach is simple and inexpensive but also crude, resulting in predictions so uncertain that their utility is unclear. Given the growth of community geotechnical datasets, remote sensing, and machine learning, it is time for a more accurate, data-driven solution.

Research Project

The goal of this project is to develop an AI-informed, open source, high-resolution model to probabilistically predict liquefaction regionally - at no cost to the user - both in future scenario earthquakes (to inform mitigation and planning) or immediately following an event (to inform response and recovery). This model will: (i) predict subsurface soil properties using an array of predictor variables obtained from satellite remote sensing (i.e., predict below-ground traits using above-ground information; (ii) utilize machine- and/or deep-learning algorithms; (iii) be anchored to a mechanics-based framework for predicting liquefaction via subsurface soil properties, thus physically constraining the predictions; and (iv) have rapid capabilities, providing regional predictions minutes after an earthquake. The model will first be implemented in PacTrans Region 10 using Pacific Northwest data, but will be scalable to a larger study, and transferrable globally. In addition to providing the model to the transportation industry, the project will use the model to simulate Region 10 events. These will include ruptures on the Cascadia and Aleutian Subduction Zones, as well as crustal faults in the Puget-Willamette Lowlands.

ABOUT THE AUTHORS

The research team consisted of Brett Maurer of the University of Washington.

ABOUT THE FUNDERS

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EXPECTED DATE OF COMPLETION

August 2022

FOR MORE INFORMATION

http://depts.washington.edu/pactrans/research/projects/informing-predictions-from-above-with-data-and-below-ai-driven-seismic-ground-failure-model-for-rapid-response-and-scenario-planning/