

Development of “true” liquefaction triggering curve



Student: Sneha Upadhyaya

Faculty Advisor: Russell A. Green (rugreen@vt.edu)
Adrian Rodriguez-Marek (adrianrm@vt.edu)
Brett W. Maurer (bwmaurer@uw.edu)

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Motivation

This research is motivated by the need to improve the methodologies that are currently being used to predict liquefaction triggering and the resulting severity of surficial liquefaction manifestations. The existing models that relate liquefaction triggering at depth to the severity of surficial liquefaction manifestation have been developed as add-ons to the semi-empirical procedures that predict liquefaction triggering. However, because the procedures for liquefaction triggering evaluations are developed almost exclusively based on the post-liquefaction surface observations, the mechanisms that influence surface manifestation are intrinsically embedded in the liquefaction triggering curve. Hence, the factors that influence the severity of surficial liquefaction manifestations are likely double-counted in the existing “add-on” models that are used to assess the severity of surficial liquefaction manifestations.

Moreover, interpretations of case histories that are used to develop semi-empirical liquefaction evaluation procedures involve varying judgements and assumptions, which could cause alternative interpretations or even misinterpretations of such case histories. Since the triggering procedures tie the observed response (i.e., “liquefaction” or “no liquefaction”) to a single “critical” layer having determined representative properties, such misinterpretations can affect the position of the liquefaction triggering curves and associated uncertainties. Hence, liquefaction triggering models and manifestation models need to be developed simultaneously within a consistent framework.

Accordingly, the main objectives of this research project are:

- To develop an internally-consistent framework to evaluate liquefaction triggering and severity of surficial liquefaction manifestation using the CPT liquefaction case-history database from the 2010-2016 Canterbury earthquakes (CE) in New Zealand.
- To develop deterministic and probabilistic variants of “true” liquefaction triggering curve.

Research Tasks

1. Add to the existing liquefaction case-history database resulting from the 2010-2016 Canterbury earthquakes in New Zealand. (completed)
2. Develop an internally-consistent framework to evaluate liquefaction triggering and severity of surficial liquefaction manifestations. The outcome of this task will be a deterministic “true” liquefaction triggering curve and an improved model to assess the severity of surficial liquefaction manifestations. (in progress)
3. Develop a probabilistically based “true” liquefaction triggering curve using the Bayesian updating technique in conjunction with the proposed deterministic framework. (in progress)

4. Validate the efficacy of the framework developed above by evaluating a separate database of select global case histories. (in progress)

Development of “true” liquefaction triggering curve within the manifestation model

The approach for deriving the “true” triggering curve can be framed in terms of the following question: *what triggering curve results in the most accurate predictions of the severity of surficial liquefaction manifestation for the liquefaction case histories?* To answer the stated question, the deterministic true liquefaction triggering curve will be derived following the approach illustrated using a flowchart as shown in Figure 1.

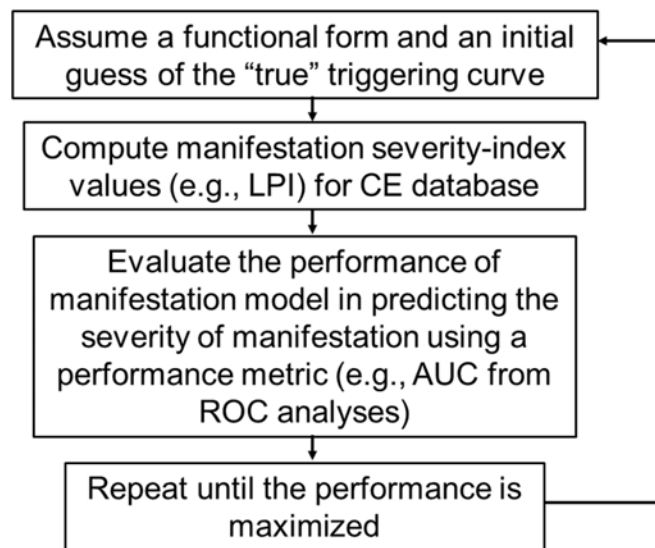


Figure 1. Flowchart showing the approach for deriving a “true” liquefaction triggering curve within the manifestation model.