



Towards a new paradigm for the evaluation of liquefaction risk: the Next-Generation Liquefaction Project



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Abstract

In the last 50 years, the cost associated with damage produced by natural disasters increased by an order of magnitude, going from \$14 billion in the 1976-1985 period to \$140 billion in the 2005-2014 decade. A substantial portion of such damage is caused by earthquakes. Notably, earthquake-induced liquefaction is one of the dominant earthquake-related effect. Despite the relevance of liquefaction-related damage, current models to predict earthquake-induced liquefaction susceptibility, triggering, and related consequences are largely based on relatively data-scarce pre-2000 datasets and lack transparency in modeling choices. As a result, they are not ideal in accurately predicting liquefaction-induced effects. Since 2000 many earthquakes around the world generated hundreds of new liquefaction case histories. Furthermore, many of them were documented with modern reconnaissance tools and represent high-quality data points. To fill the existing gap in the liquefaction modeling state-of-the-art, in 2016 the Next-Generation Liquefaction (NGL) project was launched. This project has two main scopes: (1) create a global, open-source, and transparent database of liquefaction case histories, and (2) use this data to generate novel semi-empirical, data-informed liquefaction susceptibility, triggering, and consequences models. This presentation will present the NGL database (Zimmaro et al., 2019 and Ulmer, Zimmaro et al., 2023; <https://www.doi.org/10.21222/C2J040>), main features of recent liquefaction case histories, new techniques to analyze liquefaction data leveraging big data and advanced data analytics tools, and present, for the first time, the on-going development of a novel semi-empirical liquefaction prediction model. This model is being developed to distinguish explicitly between liquefaction triggering and surface manifestation of liquefaction within a Bayesian framework and will represent a transformational shift from years of past practices.

Biosketch

Dr. Paolo Zimmaro is currently an Assistant Professor in Geotechnical Engineering (ICAR/07) at the University of Calabria in Italy. He also holds an appointment as a Visiting Project Scientist at the University of California, Los Angeles (UCLA). He obtained his Master's degree in Civil Engineering (Specialization in Geotechnical Engineering) at the University of Calabria (summa cum laude) in 2010 and his PhD in Geotechnical Engineering at the University "Mediterranea" of Reggio Calabria in 2015. Between 2015 and 2020 he worked as postdoc first (2015-2017) and as a Lecturer and Academic Researcher (2017-2020) at UCLA in the research group coordinated by Professor Jonathan P. Stewart. His current research interests include: (1) ground failure hazard characterization (including liquefaction and landslides) at the site-specific and regional scales, (2) system reliability of geotechnical systems (e.g., earth dams and levees), distributed infrastructure, and lifelines, (3) advanced geotechnical characterization involving analysis of the spatial variability of geomaterials, (4) site response analysis within probabilistic frameworks using non-ergodic approaches, (5) probabilistic seismic hazard and risk analysis, (6) data analytics in geotechnical engineering, and (7) advanced tools for geotechnical post-disaster reconnaissance, recovery, and resilience. Since 2016 Dr. Zimmaro has collaborated with the Italian government, the Presidency of the Council of Ministers of Italy, and the "Casa Italia" department on the plans for sustainable reconstruction of the Central Italy area hit by the 2016 earthquake sequence. His research received funding by various federal and state agencies in Italy and the USA, including NASA, the U.S. Nuclear Regulatory Commission, and the Pacific Earthquake Engineering Research Center. Dr. Zimmaro currently serves as the Chair of the Professional Development Committee of the Earthquake Engineering Research Institute (EERI). He is a member of various international professional associations including EERI, the American Society of Civil Engineers (ASCE), and the Italian Geotechnical Society (Associazione Geotecnica Italiana, AGI). Dr. Zimmaro is the recipient of various awards including the 2018 Earthquake Spectra Outstanding Paper Award and the 2018 UCLA Non-senate faculty Professional Development Award. More recently, in 2020, he ranked first in the Italian National Program for Young Researchers "Rita Levi Montalcini" in the Civil Engineering and Architecture field.