Unboxing the Black Box: Data, Machine Learning, and Artificial Intelligence in Geotechnical Engineering

With the technological advancements in data collection and applications of geotechnical asset management and specialized design geotechnical data has been growing in size and diversity to include a wide range of sources from laboratory testing, in-situ testing, remote sensing, engineering models, and historical records. With this growth, there is a need to improve data management, data governance, and data interpretation to extract useful information that can support improved decisions in design and management of these geotechnical assets. In this webinar, we will discuss some of advancements in geotechnical data collection and the challenges faced with data management and governance. The webinar will discuss some of the procedures to handle the variability in data sources and observations and the uncertainties in decision making associated with that variability and unobserved data or missing data records. The discussion will focus on applications related to design and the recent efforts to establish geotechnical asset management programs by agencies. In the second half of the webinar, we will discuss the role of probabilistic modeling and updating schemes using statistical models and machine learning and artificial intelligence (ML/AI) in geotechnical engineering applications to estimate geomaterial characteristics, improve reliability-based design, and predict geotechnical and foundational assets performance. Moreover, the webinar will summarize the current challenges and limitations faced in practice leading to misuse and misapplication of ML/AI as "black box" tools. Finally, the webinar will discuss an example of Bayesian Networks implementation for the design and predicting the performance of bridge foundations affected by scour and several other limit states within a geotechnical resilience-based design (GRBD) framework.