Application of AI-enabled Nondestructive Evaluation for Equitable Access to Safe Infrastructure

- Rebecca Napolitano, College of Engineering
- Wesley Reinhart, College of Earth and Mineral Sciences

Abstract: One of the National Academy of Engineering Grand Challenges is restoring and improving urban infrastructure, which currently scores a D+ on the American Society of Civil Engineer's report card. One prominent barrier to restoring and improving buildings is that the state of materials inside the building envelope is unknown. Radar methods such as Ground-Penetrating Radar (GPR) have been developed to detect embedded elements such as rebar and plumbing. However, these techniques can only provide qualitative information about inhomogeneities such as voids or moisture in the insulation. The proposed work will use a hybrid physics-based simulation and artificial intelligence approach to infer the geometry and material properties inside an existing building envelope based on scattered radar signals. In this seedling project, we plan to explicitly study how the contents of training data sets influence the accuracy of resulting diagnostics and efficacy of resulting interventions in different constructions archetypes. Laboratory experiments will provide a high-quality validation data set to test the simulation protocol and scattering inversion capability of a physics-informed neural network model. Effort will also be directed towards benchmarking the method to provide bounds on various figures of merit related to deployment in the field, making future grant proposals more competitive by measuring the technological and societal impact beyond academic model tuning.