



Ph.D. DISSERTATION DEFENSE

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Title:	Development and applications of machine learning approaches for prediction, design, and monitoring of civil structures and materials
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ABSTRACT

This dissertation focuses on the application of machine intelligence in civil infrastructure research, design, and application. The conventional methods used for designing and preserving civil infrastructure systems often require vast amounts of human labor and are susceptible to human error. The aim of this study is to provide innovative solutions to minimize human error and efficiently solve civil engineering problems using machine intelligence. The study focuses on three main research topics: (i) automated prediction and optimization of sustainable and high-performance construction materials (ii) automated design of sustainable civil infrastructure systems, and (iii) automated health monitoring of civil structures. The dissertation focuses on five interconnected research objectives. Firstly, a method will be developed to predict and optimize the properties of high-performance fiber-reinforced cementitious composites (HFRCCs), considering multiple design objectives. Secondly, a method will be developed to predict the interfacial behavior of steel-concrete composites, aiming to improve structural performance and durability. Thirdly, a method will be developed to design sustainable complex structures with high efficiency and accuracy, utilizing AI-based optimization techniques. Fourthly, a method will be developed to monitor the conditions of structures using distributed fiber optic sensors through an optimization-based inverse analysis. Lastly, a comprehensive testing program will be developed to validate the proposed AI-based methods through numerical simulations and real-world experiments. This dissertation is expected to contribute to the advancement of civil engineering research and practice by introducing innovative machine intelligence techniques for designing and preserving sustainable civil infrastructure systems, ultimately leading to more efficient, cost-effective, and reliable infrastructure solutions.