Structural Engineering Seminar Series
CEE 595 S

AI-Augmented Shape Sensing and Assembly Optimization for Prefabricated Bridge Construction

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Abstract:
Prefabricated bridge construction assembles major structural components off-site, offering a distinct alternative to conventional cast-in-place methods. It shortens construction time and improves quality, making it particularly attractive for replacing aging urban bridges with minimal traffic disruption. Because the method relies on assembling pre-made components, however, precise fabrication and accurate on-site alignment are critical yet difficult to achieve in practice. Reliable construction therefore requires accurate shape and position information for both individual and assembled components, and broader field adoption requires that such information be obtained automatically and efficiently. Drone-captured imagery combined with AI-based image processing offers a practical route to this capability. This study proposes a method that integrates neural radiance fields (NeRF) with a zero-shot segmentation model to sense the shape and position of target components—such as bearings, girders, and shear connectors—without retraining the segmentation model. The sensed geometry is then used to optimize the assembly: deviations between the as-fabricated and design geometries are quantified and translated into placement adjustments for the components to be erected, so that accumulated fit-up errors are minimized before assembly. The method was validated at an operating prefabricated bridge construction site, where it captured component shape and position with sufficient accuracy to guide assembly decisions in the field.

Bio:
Sung-Han Sim is a Professor in the School of Civil, Architectural Engineering and Landscape Architecture at Sungkyunkwan University, Korea. He received his B.S. and M.S. degrees in Civil Engineering from KAIST in 2000 and 2002, and his Ph.D. in Civil Engineering from the University of Illinois at Urbana-Champaign in 2011. Before joining Sungkyunkwan University in 2019, he was on the faculty of UNIST from 2011 to 2019, first as an Assistant Professor and then as an Associate Professor.

His research integrates advanced sensing and computing technologies into civil infrastructure systems, with a focus on smart construction, structural health monitoring, damage detection, and system identification. He also works on applications of artificial intelligence, machine learning, and computer vision to civil engineering, including automated inspection, data-driven decision-making for structural safety, and AI-based disaster management. He received the 2021 Takuji Kobori Prize from the International Association for Structural Control and Monitoring.

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1310 Yeh Student Center