Stadiums, pedestrian bridges, dance floors, and concert halls are distinct from other civil engineering structures due to several challenges in their design and dynamic behavior. These challenges originate from human interactions in the form of loading on the structure coupled with the flexible inherent nature of these structures. The investigations in past literature on this topic clearly state that stadia designs are in urgent need of more reliable load quantification and modeling strategies, a deeper understanding of structural response, generation of simple and efficient human-structure interaction models and more accurate criteria for acceptance of vibration levels. Regarding the aforementioned issues, this dissertation aims to solve three specific problems: the quantification of the loading due to individuals or crowds, structural identification under non-stationary narrowband disturbances and measurement of excessive vibration levels for human comfort. For load quantification, a computer vision based approach capable of tracking both individual and crowd motion is used. For structural identification, an improved Multivariate Empirical Mode Decomposition (MEMD) algorithm is incorporated into the operational modal analysis. The assessment of vibration levels is accomplished through computer vision based tracking in combination with empirical mode decomposition, which provides a more convenient means for measurement and computation. All the proposed methods are tested in the laboratory environment utilizing a grandstand simulator and in the field on a pedestrian bridge and a football stadium. Findings and interpretations from the experimental results are presented. The dissertation is concluded by highlighting the critical findings and the future work that needs to be conducted.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2009, Istanbul Technical University
Master's of Structural Engineering, MS, 2011, Istanbul Technical University

Committee in Charge:
F. Necati Catbas, Chair, CECE
Hae-Bum Yun, Associate Professor of CECE
Nicos Makris, Professor of CECE
Jeffrey L. Kauffman, Assistant Professor of MAE

Approved for distribution by F. Necati Catbas, Committee Chair, on October 17, 2017.

The public is welcome to attend.