



Rapid damage assessment in structures using cepstral features

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Abstract:

In this seminar, different methods that can be used for a rapid evaluation of the structural condition of bridges and buildings are discussed and validated using measurements of the dynamic structural response, both from numerical simulations and from field tests. Falling into the category of “data based” methods, such methods only need as input the time histories of the structural response measured at different locations on the structure and, when possible, in the case of seismic ground motion, the time histories of the ground acceleration, without any information on the geometry or mechanical characteristics of the structure.

Special attention will be given to methodologies that can be framed within a statistical pattern recognition framework, ideal for machine learning applications. Such methodologies focus on the recognition of certain patterns in the behavior of damage sensitive features, features that can be easily extracted from the time histories of the structural response. Quite popular in the field of speaker recognition, cepstral coefficients extracted from the time histories of the structural acceleration through simple digital signal processing are used as damage sensitive features, through the use of a Time-Delay Neural Network and of Generalized Autoencoders. These methodologies will be validated using field data from a real bridge (the Z24 bridge) that, before being demolished, went through an extensive monitoring campaign with progressive imposed damage.

Bio:

Professor Raimondo Betti received his Laurea degree magna cum laude in Civil Engineering from the University of Rome “La Sapienza” in 1985 and his Master of Science in Structural Mechanics (1988) and PhD in Civil Engineering (1991) from the University of Southern California. In the fall of 1991, Dr. Betti joined the Department of Civil Engineering and Engineering Mechanics at Columbia University as an Assistant Professor and has been there since, being promoted to Associate Professor (1998) and to Full Professor (2002). As a professor at Columbia, he has received in 1995 the National Science Foundation Young Investigator Award and the 1997 Foreign Specialist Award from the Public Work Research Institute in Japan. For his outstanding teaching, he received, in 1996, the Distinguished Teaching Award from the School of Engineering and Applied Science at Columbia and the Great Teacher Award in 2000. For his work on structural health monitoring of suspension bridges, Dr. Betti was awarded the Aftab Mufti Medal by the International Society for Structural Health Monitoring of Intelligent Infrastructure (2017) and the ASCE Norman Medal (2024). His research interests focus on monitoring the structural health of buildings and bridges, with particular emphasis on rapid damage assessment through dynamic structural response measurements, on vibration-based identification of reliable structural models, and on deterioration mechanisms in structures. His research work has been funded by National Science Foundation, California Department of Transportation, NYC DOT, and Federal Highway Administration. He is the author of three book chapters, over 100 journal and 125 conference publications and has been invited to many national and international conferences. He served as Chair and Vice Chair of the Dynamics Committee of ASCE Engineering Mechanics and as Associate Editor of the ASCE Journal of Engineering Mechanics. He is currently a member of the Board of Governors of the ASCE Engineering Mechanics Institute and an active member of the Dynamics and Structural Health Monitoring Committees of ASCE. Dr. Betti served also as technical advisor for bridge dynamics and monitoring to the Metropolitan Transportation Authority in New York.

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1310 Yeh Student Center