

NDE and structural health monitoring at the University of Pittsburgh, including: “Leaky guided ultrasonic waves for the inspection of immersed structures”

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ABSTRACT

Structures containing or surrounded by water are ubiquitous in the modern world. They can be arbitrarily clustered into the following groups: oil or natural gas offshore structures, communication cables, pipelines, naval vessels, waterfront facilities, water mains and pipes, and sea wind farms. The economic and strategic impact of these structures is enormous but, owing to the operational conditions, they are vulnerable to corrosion, ship anchors, and seismic movements of the sea bed. As such, the periodic inspection or the permanent monitoring of structures surrounded or containing water is necessary.

This seminar presents the results of experimental and numerical studies where guided ultrasonic waves are used for the structural health monitoring / non-destructive evaluation of an immersed plate. Leaky Lamb waves were generated by means of a pulsed laser and detected by an array of immersion transducers. The signals are processed using continuous wavelet transform to extract few damage-sensitive features that are fed to an unsupervised learning algorithm based on outlier analysis. Moreover the features are used to create an image of the structure. The experimental setup is simulated numerically using commercial finite element software to predict the time of arrival of the propagating modes. In this presentation we show the capability of the monitoring system to detect four defects artificially devised on an aluminium plate prior to the immersion in water. We find that the non-contact probing system and the signal processing enable the detection of cracks and simulated corrosion.



Dr. Piervincenzo Rizzo earned his Laurea (M.S. equivalent) in Aeronautical Engineering at the University of Palermo, Italy in 1998. After serving in the Italian Army Corps of Engineering, Dr. Rizzo moved to the U.S.A. where he earned a Master (2002) and a Ph.D. (2004) in Structural Engineering at the University of California, San Diego. In September 2006 he became assistant professor at the Department of Civil and Environmental Engineering at the University of Pittsburgh and promoted to Associate Professor with tenure in 2012. Dr. Rizzo's research interests are nondestructive evaluation and structural health monitoring using techniques such as ultrasound, acoustic emission, solitary waves, infrared thermography, and electromechanical impedance. His current and past researches have been supported by the Pennsylvania Department of Transportation, the National Science Foundation, the Federal Railroad Administration, the American Society for Nondestructive Testing, and various Pitt's seed funding mechanisms. He is the recipient of the 2002 Fellowship Research Award and the 2007 Faculty Grant Award from the

American Society for Nondestructive Testing, and the 2012 Achenbach Medal, which recognizes every year a young individual who has made an outstanding contribution to the advancement of the field of Structural Health Monitoring. Dr. Rizzo is the author of 8 book chapters, 76 peer-reviewed journal papers, and ~130 conference papers and presentations. For more information, visit Dr. Rizzo's home page <http://www.pitt.edu/~pir3/>.