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College of Engineering
MARQUETTE UNIVERSITY

Department of Civil, Construction and Environmental Engineering

SPECIAL SEMINAR

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A Nexus for Remodeled Cities: Infusing Community Resilience from a Multi-Hazards Perspective through Tunable DC-IEPM Skins

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Abstract

A Nexus for Remodeling Cities through Community Resiliency and Sustainable Smart Systems is predicated on three pillars: Assessment (diagnosis), Prediction (prognosis), and Rehabilitation (management). Applications include ageing steel or concrete coastal infrastructures and railways, self-healing roads, green-building designs or recyclable building materials/adhesives, and establishing centralized education and health facilities for sustainable communities.

At its core, new multi-functional self-diagnosing/self-healing materials and health monitoring strategies are developed. Formulated on chemical-materials-structural solutions, by elucidating nanoscale changes of adaptable interfacial polymeric chemistries of dynamic covalent interfacial epoxy-polyurea matrices, molecular vibrational properties of thin DC-IEPM "skins" are dialed-in and linked to tailorable bulk properties. By embedding self-diagnosing/self-healing, thermal or mechanical resiliency, and energy harvest capability, large-scale structures become durable against environmental agents (ageing, marine-salt, or environmental pollutants) and resilient against natural (earthquakes, hurricanes, tornados, flooding) and anthropogenic hazards (ballistics, blast loads).

The assessment and management pillars include "MRI" non-destructive evaluation through optimal radio inductive frequency testing (RFIT). RFIT evaluates the bond strength and overall health of DC-IEPM-skin-structures using low-frequency resonant magnetic fields, facilitating discrete measurement of deep sub-surface structural damage or moisture changes. Penetration depth and resolution may be enhanced using certain metamaterials.

Biography

Dr. Thomas Attard is an associate professor of structural engineering and mechanics at University of Alabama at Birmingham. He earned his doctorate degree from Arizona State University in 2003. During his career, he has authored 30 peer-reviewed journal-articles and 47 conference-articles, and he has six pending domestic and international patent applications related to IEPM. He has taught 21 different courses, including developing new courses, and he has procured research projects funded by NCHRP, DHS, NSF, DOE, Alabama and California DOTs, and industry. From 2006-2009, he designed and directed a large-scale seismic testing facility and later developed a large-scale steel loading frame. He is currently associate editor for ASCE, Journal of Architectural Engineering, and he previously served as editor/guest editor for two other journals. From 2013-2017, he served as Head of Civil Engineering Unit for Athens Institute for Education & Research, chairing its structural engineering conferences, and in 2008 and 2010, he served as chairman of Pan American Congress of Applied Mechanics.