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24 February 2017 – 02:30 p.m

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**Smart Materials, Structures and Systems:
State of the Art, Perspective & Future Applications**

Abstract:

The concept of adding smartness to any material/structure to enhance its intrinsic value is simply ingenious and the temptation to implement it is extremely appealing. Smart materials, smart structures or smart systems are one of the new fascinating frontiers of research in sciences and engineering.

For the last few years, research has been conducted in the area of sensors, actuators and software. When these sensors and actuators are incorporated with their related software together in a material, structure or device, the system becomes smart. Smart materials, structures and/or systems are defined as systems that have three basic functions. The first function is to sense internal and/or external stimuli; the second is to analyse and decide what to do with them; and the third is to respond to those stimuli in appropriate ways in real or near real time. Moreover, smart systems capable of detecting their flaws in a non-destructive fashion are of increasing importance due to the need of timely repair before it is too late. This in-situ intelligent health monitoring is very beneficial to all fields of engineering including aerospace, mechanical, electrical, chemical and civil.

This added value is also very attractive because the concept of ambient smart systems could potentially result in significant improvement in the design of new geometries and in their performance. All these new developments will have a significant impact not only on the manufacturing technique used but also on the processing of any new material involved. This will certainly lead to an improved health monitoring of a smart system, to a better control of its active or adaptive functions in order to ultimately make its users' lives more comfortable.

The presentation will discuss all these new developments and presents a few smart devices, structures and systems.

Bio:

Dr. George Akhras is currently a Professor of Civil/Mechanical Engineering at the Royal Military College of Canada (RMC) and the Director of the Centre for Smart Materials & Structures. He is a Fellow of ASCE, CSCE and EIC.

Dr. Akhras received his MSc A and PhD from Laval University, Quebec City in Structural Engineering and Computational Analysis. Member of many technical and professional associations, his interests include smart materials, structures and systems, composites, computational engineering and numerical modelling.

After developing software used by the James Bay Corporation for the analysis of the underground cavities of the LG2 and LG4 of James Bay, he joined the Quebec DOT to be in charge of their computing section dealing with road and bridge design and other engineering works related to transportation.

At RMC, Prof. Akhras is in charge of teaching numerical methods and performing research on computational approaches: in the last 25 years, he concentrated on expanding and developing the Finite Strip Method as well as the Finite Layer Method which are variations of the Finite Element Method. All these innovative developments have been published widely.

Since 1997, he has been the elected founding President of Cansmart, the Canadian Smart Materials and Structures Group www.cansmart.com with the objective of promoting research, development and use of innovations dealing with smart materials, structures and systems.

Since its inception in 2005, the Centre for Smart Materials and Structures (CSMS) www.smartmaterials.ca chaired by Dr. Akhras, has been very active in the design and production of sensors and actuators as well as active, adaptive and smart structures using emerging innovative materials in order to produce systems for practical applications.

From 2007 to 2011, George chaired the CSCE Innovation and IT Committee which was and continues to be one of the most active committee of CSCE. In 2013, he received the Whitman Wright Award for significant contribution to the advancement of Innovation and Information Technology in Civil Engineering. In 2015, he was elected VP finance of ISHMII (International Society of Health Monitoring of Intelligent Infrastructures).