The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar

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Lecture Title: Self-Sensing of Laminated CFRP Structures Using Electrical Resistance Change

Friday, September 24, 2010, 2PM, Room 173 Light Engineering

Abstract

Since laminated carbon fiber reinforced polymer (CFRP) composites have high specific strength and stiffness, they can be effectively used to reduce the weights of aeronautical structural components. It is difficult to detect internal damage to a laminated CFRP structure such as delamination or matrix cracking because such damage is not visible at the exterior of the structure. The inability to inspect CFRP structures visually demands the development of automatic monitoring or damage-detection systems. Carbon fiber is an excellent electrical conductor and has been used as a strain sensor in several decades ago. One possible damage/strain sensing method for CFRP composites is self-sensing using carbon fibers as sensors. In the present presentation, the self-sensing of CFRP composites is reviewed. In the strain sensing, there is a controversial issue. The present review shows the significant effect of the reliability of electrical contact at electrodes on the well-known four-probe method. Recent research on self-sensing has achieved identification of the damage location and dimensions through measurement of changes in the electrical resistance at multiple points within target CFRP structures. Matrix crack monitoring at cryogenic temperature is also shown here. Recent research revealed the effect of dent on the electrical resistance changes. The present review shows the effect of the dent with comparing the effect for thin CFRP and thick CFRP laminates. The present review shows the Time-Domain Reflectometry method for damage detect of CFRP laminate.

Biography

Professor Todoroki is the Chairman of Department of Mechanical Sciences and Engineering at Tokyo Institute of Technology and a leading expert in sensors for composite materials. He has received his Doctor of Engineering degree in 1990 and a faculty member from Tokyo Institute of Technology since 1988. During 1986-88, he was a research staff at Mitsubishi Heavy Industry in Nagoya Aircraft Work. He was also a visiting researcher in University of Florida during 1995-96. Dr. Todoroki's recent research topics are electrical resistance change method for delamination monitoring of graphite/epoxy composites, wireless strain monitoring of tire, damage monitoring of transparent composites with electric luminescent device, statistic diagnostic method for delamination monitoring and optimizations of composite structures. He has received many awards including Hayashi Award of Japan Society of Composite Materials (JSCM), Young Engineers Award of Japan Society of Mechanical Engineering (JSME), Computational Mechanics Achievement Award of JSME and various Best Paper Awards from JSCM, JSME and JSMS (The Japan Society of Materials Science).

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