



EE Department
The Hong Kong Polytechnic University



Lasers and Electrooptics Soc.
IEEE Hong Kong Section

Technical Seminar

Structural monitoring – combining fibre optics with ultrasound

by

Prof. Brian Culshaw
(University of Strathclyde)

Date : 20 May 2006 (Friday)

Time : 10:30p.m. - 12:00p.m.

Venue : Room BC402

The Hong Kong Polytechnic University, Hung Hom, Kowloon

ABSTRACT

Fibre optic sensing systems, especially but not exclusively Bragg gratings, have demonstrated significant potential in structural monitoring, usually as sensors of slowly varying strain fields observed in response to external load history.

Ultrasonic testing in contrast has predominantly focussed on imaging systems and has technologically been predominantly dependent on piezoceramic element, frequently PZTs. This talk will discuss the prospects of combined ultrasonic and optical systems for structural assessment.

Fibre Bragg gratings and simple fibre interferometers and polarimeters can all be used as effective ultrasonic detectors, each with different detection properties. In particular these detection properties contrast significantly with those of PZT in both frequency and directional responses. Furthermore, optical generation of ultrasound also has significant potential, again because of its unique spatial and temporal frequency responses.

We shall review the detection process involving fibre systems and present some experimental results on frequency responses and polar properties. We shall also demonstrate the use of these properties in damage detection.

Finally we shall examine the use of laser generated ultrasound to create very broadband ultrasound and use this to create signatures from which the properties of the sample under test can be derived. Consequently these tests promise a new approach to damage and deterioration monitoring in a wide range of mechanical systems

ABOUT THE SPEAKER

Brian Culshaw is Professor of Optoelectronics at the University of Strathclyde. In the University he has acted as Head of Department and as Vice Dean of the Engineering Faculty. His research, spanning over 30 years has encompassed microwaves, optics and ultrasonics, both at device and system level, and in the context of applications in communications and sensing, measurement and instrumentation. He has published seven research level textbooks in microwave semi-conductors, fibre optic sensing and measurement and smart structures and in excess of 400 journal and conference contributions including many invited. He has also taken an active part in Professional Society development for including two periods as a Director of SPIE, of which he is currently President Elect and as an Editor of Applied Optics. He is a founder director of OptoSci limited, specialists in high performance fibre optic equipment and of Solus Sensors.. He has also chaired numerous technical conferences in the UK and further afield in the areas of optical fibre sensors and smart structures

His recent research activities have been concentrated in two areas, namely advanced spectroscopic systems for optic fibre measurement and structural interrogation using appropriate combinations of ultrasound, optics and signal processing with particular attention to damage detection protocols using signature recognition. He has also been involved with other structural assessment programmes, applied into topics as diverse as assessing the structural deterioration of high performance marine ropes to observing hydrocarbon fuel leaks from storage tanks and pipelines.

Prior to joining Strathclyde in 1983, he was on the academic staff at University College London and had one year visiting appointments at Cornell (1970) and Stanford (1982) Universities. He also spent three years as a member of Technical Staff at Bell Northern Research Ottawa, Canada. He was educated at UCL with a BSc in Physics and a PhD in Electrical Engineering

ALL ARE WELCOME

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