

Seminar Series

**Using Non-linearity to Improve the Performance of  
Vibrating Systems**

**Prof. Mike Brennan**

**Institute of Sound and Vibration Research**

**University of Southampton, UK**

**Date: December 8, 2009 (Tuesday)**

**Time: 10:00am (Tea Reception at 9:30am -  
10:00am)**

**Venue: Room B5308, 5/F, Academic Building (Near  
Lift 4)**

**ABSTRACT**

Nonlinearity is often perceived as being undesirable in many vibrating systems and attempts are usually made to avoid it. This generally occurs because nonlinearity can cause unpredictable or large changes to the dynamic behaviour, which can be troublesome if the vibration levels increase suddenly.

In this presentation several applications, in which nonlinearity is used to good effect, will be discussed. The first of these is a biological application, where the flight motor of an insect exploits a nonlinear stiffness mechanism (a "click" mechanism) to change the waveform of the flapping wings so that large velocities can be achieved for a sinusoidal input and a given maximum displacement amplitude. This same mechanism is then investigated for an energy harvesting device which scavenges energy from ambient vibration. It is shown that under a limited set of circumstances, particularly if the vibration is at very low frequency, then this type of non-linearity offers some advantages over a linear resonant system. The final application considered is vibration isolation. By combining positive and negative stiffness elements in an isolator, a low dynamic stiffness can be achieved without compromising the load bearing capacity of the isolator. Thus the performance of a vibration isolator can be improved significantly.

## **BIOGRAPHY**

### **Professor Michael Brennan**

Professor of Engineering Dynamics, Dynamics Group

Michael Brennan holds a personal chair in Engineering Dynamics and is Chairman of the Dynamics Research Group. He has been at the ISVR since 1995 after leaving the Royal Navy where he enjoyed a career, first as an engineer and then as an academic, spanning a total of 23 years. He graduated from the Open University with first class honours in 1987, received his MSc in Sound and Vibration Studies in 1991 and his PhD in 1995, both from the Institute of Sound and Vibration Research at the University of Southampton.

Michael Brennan has a wide-range of interests in acoustics and vibration including the vibrations of rotating machinery, non-linear vibrations, vibroacoustics, active and passive control of sound and vibration, energy harvesting and biomimetics. Additionally he has been a consultant for several companies in the UK and overseas, advising on vibration and acoustic testing methods, control measures and design. Michael Brennan currently teaches on the BEng undergraduate course in Acoustical Engineering, the MSc course in Sound and Vibration Studies. He has also designed, co-written and co-presented several short courses for industry in the UK and abroad. He is a past President of the European Association of Structural Dynamics, Associate Editor of the Transactions of the ASME Journal of Vibration and Acoustics, Guest Professor at Harbin Engineering University in China and Visiting Professor at UNESP in Brazil. He has published over 100 papers in peer reviewed journal and has presented over 140 papers in international conferences.

Enquiry: 2788 8420

***All are welcome!***