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

# Mechanical Engineering Seminar

**Sinniah Ilanko**
**Professor**
**The University of Waikato**
**New Zealand**

## Lecture Title: Negative Stiffness and Negative Mass in Modeling Essential Constraints

Friday, October 9, 2009, 11:00 AM, Room 173 Light Engineering

**Abstract**

In 1943, Courant introduced the concept of artificial stiffness in modeling constraints. The idea was to replace rigid supports and connections with elastic springs of high stiffness. This was subsequently generalized and became known as the penalty method. The main drawback of the method was that it was not possible to estimate the error due to any violation of the constraints and the choice of penalty parameter or stiffness was made on a trial and error basis, by finding a suitable number that was large enough to effect a constraint and yet not too large as to cause numerical problems such as ill-conditioning. However, recent work by the speaker and his colleagues has paved the way for tackling this using both positive and negative stiffness or in vibration problems using positive and negative mass as penalty values. Their use has been justified through several theorems and numerical experiments. The use of positive and negative penalty mass in vibration analysis has also led to interesting alternative procedures for solving engineering problems such as heat transfer using a distribution of pseudo inertia to obtain an equivalent vibration problem. The modes of vibration yield characteristic functions which can then be used to solve the actual problem.

**Biography**

The speaker Dr. Sinniah Ilanko joined in University of Waikato, New Zealand, as an Associate Professor in 2006. He was an Associate Professor of Mechanical Engineering at the University of Canterbury. He completed his B.Sc. and MSc in Civil Engineering at the University of Manchester in British and his PhD in Mechanical Engineering at the University of Western Ontario in Canada. Dr. Sinniah Ilanko is a Subject Editor for Journal of Sound and Vibration for Analytical Methods for Linear Vibration.

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