MEMS Modelling and Nonlinear Dynamic Based Analysis.

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Overview

MEMS are micron sized devices typically used as sensors and actuators, which function by bridging the gap between traditionally separate physical domains and can provide superior performance over traditional circuits through innovative design. Time scale and resources involved with fabricating these devices warrant a thorough analytical study before actual fabrication and testing. However this involves simulating multi-physics phenomena and developing nonlinear models even for simplest cases. Using Finite Elements would be prohibitively expensive, especially for long time period based parametric study hence requiring reduced order modeling strategies. This course through case study of many state of the art MEMS devices would introduce the complexities of modeling such systems and demonstrate methodologies of generating highly accurate and efficient models for the same. Nonlinear dynamics based methods would also be introduced and demonstrated for understanding the underlying dynamics and hence to optimize their design. This course is organized in two modules that should be taken together. The topics in Module A will expose the participants to the modeling of simpler nonlinear MEMS devices analytically and various methodologies for analyzing their complex dynamics. In Module B, more complicated MEMS geometries and reduced order model generation for the same would be discussed that would involve using Multiphysics based Finite Element study.

Course participants will learn these topics through lectures and hands-on experiments. Also case studies and assignments will be shared to stimulate research motivation of participants.

Dates for the Course	**7th December, 2016 to 21st December, 2016**
Host Institute	**IIT Madras**
No. of Credits	**2**
Maximum No. of Participants	**50**
You Should Attend If…	▪ You are an Engineer or research scientist interested in designing optimized MEMS device, Even if your work is primarily in fabrication. ▪ You are a student or faculty from academic institution interested in learning how state of the art MEMS devices can be designed and analyzed. ▪ If you are just interested in learning nonlinear dynamics principles or performing multi-physics analysis, which can be used to study various macro-scale systems as well.
Course Registration Fees	The participation fees for taking the course is as follows: **Student Participants:** Rs.2000 **Faculty Participants:** Rs.6000 **Government Research Organization Participants**: Rs.10000 **Industry Participants:** Rs.20000 The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges. **Mode of payment: Demand draft in favour of "Registrar, IIT Madras" payable at Chennai**
Accommodation	The participants may be provided with hostel accommodation, depending on the availability, on payment basis. Request for hostel accommodation may be submitted through the link: http://hosteldine.iitm.ac.in/iitmhostel

Course Faculty

Dr. Mohammad Younis is an Associate Professor of Mechanical Engineering at KAUST and Adjunct Faculty at SUNY Binghamtom,NY. He works on the interface between nonlinear dynamics and vibrations and Micro and Nano systems. His research focus is on the utilization of the knowledge gained from understanding the exceptional mechanical and motion aspects of micro and Nano structures to design, optimize and invent MEMS and NEMS devices of distinctive characteristics and superior performance. Applications range from sensing and actuation for inertia and chemical applications, energy harvesting, health and safety gadgets, and smart switches and devices. Starting with his PhD with Prof. Ali H Nayfeh at Virginia Tech, USA in 1999, he has worked on several engineering problems employing nonlinear dynamic modeling and analysis techniques. He is the recipient of the 2009 NSF CAREER award and has a book published by Springer on 2011 on the topic of dynamics of MEMS, entitled "MEMS Linear and Nonlinear Statics and Dynamics".

Dr. Manoj Pandey is an Assistant Professor in the department of Mechanical Engineering at Indian Institute of Technology, Madras. His research interests are in the computational mechanics and nonlinear dynamics based study of MEMS through multi-physics simulations of these devices based on reduced order nonlinear model generation. Device applications include RF Sensors, Energy Harvesting Self powered MEMS, Surface Acoustic Wave devices etc. He is a member of Center for NEMS and Nano Photonics at IIT Madras and is developing a lab for studying MEMS dynamics. He has been involved in nonlinear dynamics based study of MEMS since 2001 during his PhD and Post Doctoral research(Sonic MEMS lab) both at Cornell University, NY, USA and also holds US patent on developing novel MEMS. He also has extensive experience of FEM based computational modeling during his research as well as during industrial experience in USA for 4 years at Finite Element Company Abaqus and glass manufacturing company Corning. He has offered two elective courses at IIT-Madras on similar topic before.

Course Coordinator

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