

Analysis and Design of Piezoelectric Vibration Energy

Overview:

Vibration energy harvesting is an emerging topic and there are very few courses available in the world. Over the past decade there has been an explosive growth in research activities and most works are available as journal / conference papers only. This course will bring together the latest research by the International Faculty's research group and works by other researchers in the field. The course will introduce the fundamental theoretical concepts of piezoelectric energy harvesting exploiting linear and nonlinear vibration. Practical design and optimisation methods will be discussed using experimental case studies.

Participants will be trained on using Matlab to simulate multiphysical systems involving structural dynamics, smart materials and electrical equations together.

Participants will also be given hands on experience to use smart materials for energy harvesting. Laboratory sessions will include, session on pasting of piezoelectric composite on beams, connecting electrical circuit and use of NI (national instrument) software for voltage measurement. Support excitations will be provided using a shaker and it will be shown to power up electronic sensors.

Dates for the course	<u>30 October 2017 – 3 November 2017</u>
Host Institute	Indian Institute of Technology Madras
No. of Credits	01
Maximum no. of Participants	40
Registration Fees	Students: INR 1000 /- Participants from abroad: USD 500 /- Academic Institutions/ Research Organization: INR 5,000 /- Industry participants: INR 10,000 /- 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 The demand draft is to be sent to the Course Coordinator at the address given
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 Faculties and industry persons would be provided IITM Guest House rooms (twin sharing / single rooms depending on availability). Participants may avail food/meals inside or outside the IITM campus, wherever they prefer, on their own expenses.

Objectives

The proposed course aims to introduce the concepts of piezoelectric vibration energy harvesting using analytical, numerical and experimental approaches. Main objectives are:

1. To develop and explain linear and nonlinear coupled electro mechanical equations governing piezoelectric vibration energy harvesting
2. To explain solution methods of the governing equations with harmonic and random forcing
3. To develop parameter optimisation methods for maximising energy harvesting under different forcing
4. Numerical solutions of coupled mechanical and electrical equation in a multi-physics environment.
5. Hands on training for energy harvesting design and measurement.

Who should Attend the Course?

Anyone interested in addressing future energy challenges by mechanical approaches should attend the course. The course is inherently multidisciplinary in nature and specifically strong background in any particular topic is not necessary. Therefore, attendees with the following backgrounds are encouraged:

- Engineering Graduate and Post-graduate students at all levels (B.Tech/B.E./M.Tech/M.E./MS/Ph.D) with disciplines such as, mechanical, civil, electrical, aerospace, mechatronics, electronics.
- Science Graduate and Post-graduate students at all levels (B.Sc, M.Sc. / Ph.D) with disciplines such as, physics, materials science and mathematics.
- Faculty and/or project staff from academic and technical institutions, and researchers in R&D organizations, interested in and/or working in the fields of energy, structural vibrations, dynamics, autonomous systems, control, smart materials.

Registration Procedure

Please follow the following steps for the registration:

1. Go to GIAN website (<http://www.gian.iitkgp.ac.in/GREGN/index>) First time users need to register and pay a one-time fee of INR 500 /-.
2. Enroll for the course: **Analysis and Design of Piezoelectric Vibration Energy Harvesters**. Once you enroll for the course, an **Enrollment/Application** number will be generated, and the course coordinators will be notified.
3. The selected candidates must pay the applicable fees using Demand Draft (DD) drawn in favour of **“Registrar, INDIAN INSTITUTE OF TECHNOLOGY MADRAS”**. Please write your Name and Enrollment/Application number at the back of the DD, and post/courier it, to reach by **10th October 2017**.

Address of the Course Coordinator:

Dr. Shaikh Faruque ALI
Department of Applied Mechanics
Indian Institute of Technology-Madras (IIT-M)
Chennai 600 036, India
Email: sfali@iitm.ac.in
Telephone: +91-9940473031; +91-44-2257-4054
Fax: +91-44-2257-4052

4. Fill the course registration form in GIAN portal. Email the course registration form to the Course Coordinators and Volunteers by **15th October 2017.**

Volunteers

Queries about the course may be send to:

Mr. M. Rajarathinam - rathinam_kmr@yahoo.co.in, +91-8072340031

Mr. M. Aravindan - aravindradhu@yahoo.co.in, +91-9944347942

The Teaching Faculty



Prof Adhikari (MS, IISc Bangalore; PhD, Cambridge) is the Chair Professor of Aerospace Engineering at the College of Engineering of Swansea University. He Received the Wolfson Research Merit Award from the Royal Society (UK academy of sciences). He was an Engineering and Physical Science Research Council (EPSRC) Advanced Research Fellow and winner of the Philip Leverhulme Prize in Engineering (given to an outstanding scholar under the age of 35). He obtained his Ph.D. in Engineering at the Trinity College of the University of Cambridge. He was a lecturer at the Bristol University and a Junior Research Fellow in Fitzwilliam College, Cambridge. From 2015 he has been a Distinguished Visiting Professor at the University of Johannesburg (South Africa). He was a visiting Professor at the University of Paris East (France), Carleton University (Canada) and a visiting scientist at the Los Alamos National Laboratory (USA).

Professor Adhikari's research stands on three fundamental footings - structural dynamics, probabilistic methods and computational mechanics. His research works use these basic principles to understand cutting edge multiscale and multidisciplinary problems in applied science and engineering. He has published 4 books, 265 peer-reviewed journal papers, and 170 conference papers. He is one of the most cited researchers in his field (over 8500 citations with h-index=50). He has supervised over 15 Ph.D. students and postdocs. Professor Adhikari is a Fellow of Royal Aeronautical Society (FRAeS) and the member of the AIAA Non-Deterministic Approaches Technical Committee (NDA-TC). He is a member of the editorial board of several journals such as: Computers and Structures, Probabilistic Engineering Mechanics and Journal of Sound and Vibration.



Dr. Ali is currently with the faculty of Department of Applied Mechanics, Indian Institute of Technology Madras. He is an associate fellow of INAE and a Newton international alumnus from Royal Academy of Engineering, UK. He is recipient of DAAD research exchange fellowship from DAAD in 2015; Young Engineer Award from INAE in 2014; Newton Fellowship from Royal Society, UK in 2009. Dr. Ali has received his doctorate from Indian Institute of Science-Bangalore and BE from Jadavpur University, Kolkata. His research interests are in structural dynamics, vehicular vibrations, autonomous vehicles, control systems and energy harvesting. He has published 23-research paper and has more than 40 international conferences. He has also published 1 book and 4 book chapters