

**DOTTORATO in Ingegneria e Scienze Applicate**  
**Dipartimento di Ingegneria e Scienze Applicate, Dalmine (BG)**

## **ACTIVE VIBRATION CONTROL**

**Short Doctoral Course: 3-5 November 2014**

**Prof. Maryam Ghandchi Tehrani**

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### **Abstract**

In this course, an overview of active vibration control will be presented. Both feedback and feedforward strategies will be introduced.

In feedback control, receptance method will be introduced and implemented to assign the eigenvalues of the system. This problem is known as “pole placement”. Experimental results will be shown on a T-plate, where the natural frequencies and damping ratios of the plate are modified as a result of feedback gains. Stability analysis using Nyquist criteria will be presented. The receptance method will also be extended to partial pole placement and robust control. Experimental results on an H-rig structure show how these techniques in active control work. An application of pole placement will be demonstrated on an Agusta-Westland W30 helicopter. Vibration suppression is achieved using both velocity and displacement feedback by assigning the poles of the helicopter to avoid blade passing frequency.

In feedforward control, Least Mean Square (LMS) algorithm will be considered. A secondary signal will be generated to cancel the vibrations from primary (disturbance) source. Examples such as active noise control of a duct and active vibration control of an aircraft wing will be provided. The feedforward control will also be applied to nonlinear systems. The performance of linear with nonlinear control will be compared. The course also includes three computer tutorials. The first tutorial is to simulate a feedback control based on measured data. In the second tutorial, feedforward control using LMS algorithm will be practiced. In the third tutorial, active control in a duct will be considered.

### **Short Bio**

Prof. Maryam Ghandchi Tehrani is currently appointed as Lecturer at the Institute of Sound and Vibration Research, University of Southampton. She has earned a PhD on Passive Modification and Active Control for Structural Vibration Suppression 2004-2007 and a MSc (Eng) in Mechanical System Engineering 2003-2004 at the University of Liverpool and a BSc in Mechanical Engineering at the Iran University of Science & Technology, 1998-2002. She has been already Visiting Professor ITALYR at the Dept. of Engineering (Dalmine) in 2013. She is a research expert in nonlinear dynamics, active vibration control of linear and nonlinear systems and energy harvesting.

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# ACTIVE VIBRATION CONTROL

## Time Schedule

### Day 1 – Monday, 3 November 2014

#### Morning: Room 22

09:30–10:30 Introduction to active control

10:30–11:30 Feedback control and stability analysis

11:30–12:30 Pole placement by the receptance method; Application of feedback control on helicopters

#### Afternoon: Computer lab – Room 11

15:00–18:00 Laboratory 1: Feedback Control

### Day 2 – Tuesday, 4 November 2014

#### Afternoon: Computer lab – Room 11

15:00–18:00 Laboratories 2 and 3

Construction of FRF from measurements, LMS algorithm

Active noise control

### Day 3 – Wednesday, 5 November 2014

#### Afternoon: Room 22

15:00–16:00 Digital control

16:00–17:00 Feedforward control in a duct, nonlinear control

17:00–18:00 Application of feedforward control on an aeroplane wing