Active Control of Aerospace Structures

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Overview

Aerospace vehicles are composed on hundreds and thousands of interconnected structural components which are designed to perform under varying flight conditions and to withstand mechanical and aerodynamic loads during its flight envelop. Performance of an aircraft depends on its designed shape, material selection, weight or weight distribution and connectivity of its structural components. Design of a safe, reliable and high performing aircraft involves the investigation of multidisciplinary aeroservoelastic (ASE) interaction among the structures, aerodynamic loads and flight control systems (FCS). Constraints on the material, weight and sizing of the structural components, necessitates the development of active control strategies such that the performance of the aircraft can adapt to changes during its flight envelope based on the measurements available from embedded sensors. Next generation aerospace structures involve active control technologies for gust load alleviation to achieve aircraft stability and reduced weight, flutter suppression to alleviate airspeed restrictions, and flow control for enhanced aerodynamic performance.

In this course, various aspects of active control design of aerospace structure are introduced. This includes: (i) review of the feedback control and classification of different controller types, (ii) state of the art model based state space modeling for different types of controller design, (iii) aeroservoelastic modeling of aircraft wings and implementation of control for flutter suppression, and (iv) recently developed model independent receptance based aeroservoelastic control method. Practical aspects such as incorporating actuator dynamics in control loop, effect of time delay in the feedback loop, strategies to control a small number of prescribed modes by partial pole placement and effect of nonlinearities in control will also be addressed. Each lecture is supported by hands-on tutorial session, in which numerical simulations using MATLAB will be carried out to demonstrate the modeling and performance of the controller design.

Objectives

The primary objectives of the course are as follows:

- Facilitating tutorial review on the fundamentals of feedback control to the participants.
- Developing skills of the participants in state-of-the-art modeling, active control design and numerical simulations of open and closed loop systems.
- Providing hands-on exposure to the participants in aeroservoelastic modeling techniques and associated active control design.
- Exposing participants to practical aspects of the controller design and their solution strategies, such as handling of time delay in feedback loop, strategies for model reduction, utilization of measurement for controller design and selection of actuators, through various numerical examples and demonstrations.
- Enhancing the knowledge base of the participants through the introduction of some recent advancements and techniques for active control (receptance based control, partial pole assignment etc.) so they can select suitable controller design strategies for aerospace systems.

Dates	**15 July to 20 July 2019**
Place	Department of Electrical Engineering, National Institute of Technology, Silchar, Assam, India.
Modules	• Fundamentals of Feedback Control • Control for Large Dimensional Aerospace Systems • State of the Art Aero servo elastic Modeling and Control • Aero servo elastic Control using Method of Receptances • Control for selected modes (Partial Pole Assignment) • Advanced topics in Aerospace Control
Who can Participate	• Interested graduate students. • Some undergraduate students who took before the course "Introduction in Control". • Researchers in the fields of control engineering, applied mathematics, Mechanical and Aerospace Engineering. • The teachers/professors who wish to obtain the complementary material for their graduate courses in Control Applications to Aerospace Engineering. • Participation from outside NIT Silchar will be given preferences. **NUMBER OF PARTICIPANTS FOR THE COURSE WILL BE LIMITED TO FIFTY (50)**
Fees	• Participants from abroad: USD 500 • Industry/ Research Organizations: Rs. 10000/- For Academic Institutions • **Faculty: Rs. 5000/-** • **External Students: Rs. 1000/-** • **Internal PG & PhD Students: Rs. 1000/-** • **Internal UG Students: Nil** The above registration fee is towards instructional materials, computer use for tutorials, 24 hr free internet facility, light refreshments etc. The outstation participants will be provided twin sharing accommodation on payment basis in Institute Guest House if available.

The Expert

Prof. Kumar V Singh is currently a full professor in the College of Engineering & Computing, Department of Mechanical & Manufacturing Engineering, Miami University, USA. He graduated from Birla Institute of Technology (BIT), Mesra, Ranchi, India in 1997. He earned Ph.D. in Mechanical Engineering from Louisiana State University, Baton Rouge, LA in 2003. He is an elected Associate Fellow of The American Institute of Aeronautics and Astronautics (AIAA). He joined Miami in 2006, after serving as a post-doctoral research associate at LSU. He has recieved Faculty Fellowship (2010-11, 2012-14, 2016) at the Air Force Research Laboratory (AFRL)-WPAFB, Dayton and currently collaborating with the researchers at their Multidisciplinary Science and Technology Center (MSTC) in the area of aeroelastic control.He was also a senior fellow at the University of Liverpool, UK in Fall of 2009. His research focuses on inverse eigenvalue problems related to multidisciplinary areas of structural vibration and control. The emphasis is in developing technologies which are purely based on measurable vibration data (natural frequencies, mode shapes and frequency response functions) for (i) active control for flutter suppression and optimal design for the next generation aircraft structures; (ii) active/passive dynamic absorption; (iii) parameter estimation and structural health monitoring; and; (iv) dynamic characterization, and design of smart polymeric materials. His research is supported by National Science Foundation (NSF)/TUES, Air Force Research Laboratory (AFRL/DAGSI) and US Department of Agriculture (USDA). He is an author/co-author of more than 60 peer-reviewed international journal and conference articles. He is in the editorial board of Shock and Vibration Journal. He also serves as a reviewer for several international journals such Journal of Sound and Vibration, ASME-Journal of Vibration and Acoustics, Journal of Vibration and Control, and Mechanical Systems & Signal Processing Journal. Currently he is also serving in the AIAA Structural Dynamics Technical Committee (SDTC). He is a registered Professional Engineering (P.E.) Licensee (Mechanical Design) in the state of Louisiana.

Course Coordinator

Dr. Rajeeb Dey is an Assistant Professor in the Department of Electrical Engineering, NIT Silchar Assam India. His research interest includes time-delay system analysis and robust control. He has worked with Dr. Kumar in the past on Partial Eigen value problem in the past and holds joint publication too.

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Registration Guidelines (Step-by-Step):

1. First, 'web register' at GIAN 'Courses Registration Portal': http://www.gian.iitkgp.ac.in/GREGN/index by paying requisite fees. If you're already registered, skip this step.

2. Then, log in, click 'Course Registration' tab on the GIAN Portal, and 'check box' to select this course **(#171031L01) "Active control of Aerospace structure."** from the list. Click 'save' to register, and 'Confirm Course(s)' to confirm.

3. Now, pay the requisite Course Fee online in favour of the Director, NIT Silchar, A/C No: 10521277057, IFSC Code: SBIN0007061, MICR Code: 788002004. OR You can obtain DD in favour of Director NIT Silchar, Assam, India. Keep the payment info (DD details, transaction # & date) handy. You'll need this during the next step. Also, please retain the receipt for on-spot submission..

4. Next, fill out the form given below, sign it. Send the scan copy of the filled in form with scanned copy of course fee transaction slip/DD to the course coordinator e-mail address (rajeeb.iitkgp@gmail.com). This is for the Course Coordinator's record. Now, await the Course Coordinator's confirmation.

P.S: Registering on the GIAN portal does not guarantee participation in the course. Please do not confuse with web registration with course registration. You might have been 'shortlisted' after paying the 500/-, but your selection is subject to paying the requisite course fee to NIT. For successful enrolment, make sure you've made both the payments. Number of participants for the course is limited to 50, and the registration will be open till the seats are filled. For queries and clarifications, write to the Course Coordinator at: rajeeb.iitkgp@gmail.com.

GIAN: Global Initiative of Academic Network

Name of the course: Active Control of Aerospace Structures

(Course ID: 171031L01)

Dates: 15th July – 20th July 2019

Department of Electrical Engineering, NIT Silchar, Assam, India

REGISTRATION FORM

GIAN Portal Application Number:

Full Name: Category (Industry/Academic/Student):

Organization:

Address:

Email Id:

Mobile Number:

Highest Academic qualification:

Payment option and details:

a. **Demand draft:**

Draft No.	Bank	Date	Amount

b. **Online transaction**

Transaction Id/Ref No	Bank	Date	Amount

Accommodation Required: Yes/No (please tick in the applicable field)

Date:

Place:

Signature of Applicant