

AICTE QIP SHORT TERM TRAINING PROGRAMME

On

Unmanned Aircraft Systems: Road to Autonomy

March 21 to 26, 2022

Coordinators

Dr. Devaprakash Muniraj

Dr. Satadal Ghosh

Prof. Nandan Kumar Sinha

Sponsored by

All India Council for Technical Education



Organized by

**Department of Aerospace Engineering
Indian Institute of Technology Madras**

BACKGROUND

Owing to their enormous potential, unmanned aircraft systems (UAS) that are capable of autonomous beyond visual line-of-sight flight are deployed in diverse applications ranging from search and rescue, package delivery, traffic monitoring, infrastructure inspection, reconnaissance and so on. Currently, most of these missions are accomplished with a remote operator; however, recent advances in sensing and actuation technologies, computing and communication technologies, motion planning and collision avoidance algorithms, and control design methods have enabled autonomous operations that require minimal human intervention.

A host of challenges need to be addressed to facilitate autonomous operations of UAS. The foremost task of an autonomous system is to acquire knowledge about itself and its environment. Efficient perception and navigation systems are therefore critical for autonomous operations. Based on situational awareness, computationally efficient task planning and motion planning algorithms are required to continually update the plan in near real-time to achieve the mission goals while ensuring the safety of the system. Another important challenge is to design controllers, which ensure that the UAS tracks the reference commands despite significant atmospheric disturbances and sensor noise. When UAS are deployed in safety-critical applications, where collateral damage due to incorrect operation or purposeful attacks by malicious agents might lead to human casualties, the designer needs to put systems in place that would ensure that the deployed UAS safely executes its intended function.

The short-term course aims to provide the participants with an overview of the state-of-the-art developments in unmanned aircraft systems with a focus on autonomous operations. The course will start with an introduction to autonomous systems and then cover topics in flight dynamics modeling and model-based controller design, navigation systems, motion planning and collision-avoidance algorithms, security-aware design of UAS, and verification and validation.

COURSE CONTENTS

- Introduction to autonomous systems
- Model development for 6DoF motion simulation of aerospace vehicles
- Open-loop dynamics simulation (modal and maneuver)
- Model-based open-loop control (stability augmentation, maneuver/recovery)
- Offline motion planning
- Guidance algorithms
- Online reactive motion planning
- Integrated guidance and control for 6DoF vehicles
- Security threats to unmanned aircraft systems
- Attack detection systems (estimation-based detectors, active detectors, and runtime monitors)
- Design for security, resilient hardware design
- Verified design, verification and validation of unmanned aircraft systems

RESOURCE PERSONS

The lectures will be delivered by faculty from the Department of Aerospace Engineering at IIT Madras and by prominent experts from other universities and research organizations.

COURSE DURATION & VENUE

The duration of the course is six days from **March 21st to March 26th 2022**. **Lectures will be delivered in online mode only.**

ELIGIBILITY

The course is open to faculty in aerospace engineering, mechanical engineering, electrical engineering, and other relevant disciplines from AICTE-approved engineering colleges and other higher educational institutions. Scientists and practicing engineers from research organizations and industries are also eligible to apply. Applicants with some familiarity in dynamics and control would be preferred. Selected applicants will be informed over email.

Fee Structure

For applicants from AICTE-approved engineering colleges and faculty from other higher educational institutions, a course fee of Rs. 1000 would be charged. For all other applicants, a course fee of Rs. 5000 will be charged. However, the course fee would be refunded for the first 30 applicants to register from AICTE-approved engineering colleges.

Center for Continuing Education, IIT Madras

<http://www.cce.iitm.ac.in/>

Department of Aerospace Engineering, IIT Madras

<https://ae.iitm.ac.in/>

Contact Information for Correspondence:

Dr. Devaprakash Muniraj

Assistant Professor

Department of Aerospace Engineering

IIT Madras, Chennai - 600036

Email: deva@iitm.ac.in

Website: <https://sites.google.com/view/rasas-lab/home>

