



QUADROTOR DESIGN COURSE

Description:

This technical course is designed to meet the needs of UAV VTOL multi-rotors engineers, UAV aircraft designers, UAV industry managers, educators, and research and development engineers. The course provides an introduction to the fundamental principles of multi-rotor design. The course is intended as a first course that provides in-depth understanding of state-of-the-art quad-rotor issues; including airframe design, propulsion options, cycle analysis, principles of operation, systems, components, performance and efficiency calculations, aerodynamics, flight stability, and control. Alternative power and propulsion management is also discussed. This course is available online.

Instructor: Dr. Emaid A. Abdul-Retha

Dr. Emaid A. Abdul-Retha holds BSc, MSc, PhD and DSc degrees in aeronautical engineering. His research areas include jet engine automatic control systems and modeling of gas turbine engines. He has over 34 years of aviation experience including 20 years' experience with UAVs. He has been a chief engineer for ten years working on modifications to the MiG-21 and MiG 29 jet fighter aircraft. Dr. Abdul-Retha has supervised several research centers and projects related to aviation and unmanned aircraft. He has performed research on many different types of aircraft (fighter, transport, helicopter, agriculture, light, general aviation, etc.). He led a development effort to modify the MiG 29 jet fighter with drop fuel tanks and an inflight refueling system. His research efforts have also led to an increase in helicopter engine power in hot climates. He has also conducted research in air defense operations and fighter tactics against attacking missiles and UAV's. His research related to UAVs includes the design, manufacture, integration and testing of many different types (fixed wing, VTOL, jet powered). He has also led research activities in unmanned ground vehicles (UGVs) and unmanned surface vehicles (USVs). In 2003 he was a research fellow for UAV automatic control systems at the National Aerospace University in Kharkov, Ukraine. He returned to the university in 2007 as an advisor to the small unmanned aircraft vehicle research program. From 2008 to 2010 he provided consulting services for the King Abdullah Design and Development Bureau (KADDB) in Jordan where he managed a VTOL UAV research program. He is presently the R&D Director at Jordan Aerospace industries (JAI) and has established a comprehensive UAV program in Jordan. He is a member of the board of directors at Jordan Advance Remote Systems (JARS), a company that specializes in UAV's.

What You Will Learn:

- Fundamentals of quad-rotors.
- Classify quad-rotors by type and mission.
- Understand quad-rotor UAV operation.
- Design and applications of different quad-rotor types.
- Quad-rotor selection and matching.
- Quad-rotor assist devices.
- Explain quad-rotor propeller types.
- Principles of quad-rotor engine control and regulation.
- Quad-rotor power resources and alternatives.
- Novel quad-rotor concepts.
- Quad-rotors dynamics and mathematical modeling.
- Trade studies and costs
- Maintenance, repair and overhaul (MRO)

Training Day 1

Welcome

Introductions

Motivations

Multi-rotors review

Course contributions

Training Day 2

Multi-rotors

General concept

Quad-rotor design

Quad-rotor mathematical modeling

Quad-rotor applications

Training Day 3

Quad-rotor novel concepts

Electro-mechanical quad-rotor

Multi rotor with variable pitch propeller

Multi rotor with servo thrust vectoring

Flap thrust vectoring

Variable pitch quad-rotor

Quad-rotor thrust-vectoring

Quad-tilt-rotor design

Quad-tilt-rotor modeling and control

Flap thrust vectoring

Conclusions

Course references