

# AEROSPACE

## SHORT COURSES

## Flight Testing Unmanned Aircraft Systems – Unique Challenges (AERO0300)

Instructor: George Cusimano

### Course Description

Unmanned Aircraft Systems (UAS) are comprised of an unmanned vehicle (UAV), a manned control element(s), and various data and control links. Although unmanned, the vehicle is still an aircraft and must be tested with the same rigor and precision as manned systems. However, being "unmanned" and being part of an integrated system, UAVs demand unique flight test approaches that present corresponding challenges.

### Course Highlights

- Fundamentals of flight test—review the purpose of flight test and evaluation and discuss the flight test and evaluation process as it applies to UAS testing.
- Typical test requirements—review both typical user requirements and certifying airworthiness requirements.
- UAV Flight Operations—review the current regulations for conducting UAV flight operations within both the National Airspace System and on national test ranges. Discuss the present state of sense and avoid requirements and technology, and the resulting impacts to flight test operations.
- Typical UAS architectures—review the system concept and understand why it is necessary to know typical UAS architectures in order to assure a successful flight test program.
- UAV software and modeling—examine the level and complexity of UAS software testing and appreciate the need for systems level flight test.
- UAV design characteristics—appreciate the basis for UAV designs with emphasis on those features that create development and test challenges.
- Typical UAV ground and flight-testing—review the most problematic areas of UAV ground and flight test.
- Risk analysis and management—review the risk management process and how it applies to UAV testing.
- Cause-Effect/Effect-Response method to mitigate flight test challenges—introduce a new methodology designed to help mitigate UAV flight test problems.
- Human factors considerations—discuss the application of human factors principles to UAS command and control design and test.
- First flight(s) planning—discuss the unique aspects of UAV first flight(s).

- Lessons learned in UAV flight testing—share UAV lessons learned.
- Summary of UAV unique challenges— Review the top 20 flight test challenges presented in the course.

### **Who Should Attend?**

The course is designed for practicing flight test engineers, test pilots, test managers, aircraft engineers, aircraft designers and educators who already possess a fundamental understanding of flight test principles and practices. The course content is appropriate for civilian, military and academic researchers.

### **Learning Objectives**

- Fundamental flight test and evaluation principles.
- How modern, complex, highly integrated, and software intensive UAS designs contribute to flight test challenges.
- How and why the current restrictions to UAS flight operations exacerbate flight test challenges.
- Risk management principles as they apply to UAV flight test.
- The Cause-Effect / Effect-Response (CE-ER) method to mitigate potential UAV flight test problems.
- Human factors principle and why they are important to UAS command and control.
- The unique challenges of UAV first flight(s).
- The methods, processes, and/or procedures required to minimize the effects of UAS challenges on program cost, schedule and risk of the challenges presented.
- Share UAV flight test lessons learned.

### **Course Outline**

#### **Day One**

- Introduction and history
- Fundamentals of flight test
- Typical requirements
- UAV Flight Operations
- Typical UAS architectures
- Software and models

#### **Day Two**

- UAV design characteristics (1)
- Mass properties and structures
- Aerodynamics
- Flight controls
- Propulsion systems
- UAV design characteristics (2)
- Data and control links
- Health monitoring
- Mission planning

- Human factors considerations for UAS command and control
- Classroom exercise

### **Day Three**

- Risk management
- Test Hazard Analysis
- Cause-Effect / Effect-Response
- Typical ground and flight tests
- Taxi and ground control
- Take-off and landing
- Cruise and climb performance
- Stability and control
- Closed loop handling qualities
- First flight(s) planning
- Lessons learned in UAV flight testing
- Summary of test challenges
- Classroom exercise

### **Classroom hours / CEUs**

21 classroom hours

2.1CEUs

### **Certificate Tracks**

Flight Tests and Aircraft Performance

Unmanned Aircraft

### **Course Fees**

Early registration course fee: \$1,995 if you register and pay by the early registration deadline (45 days out).

Regular registration course fee: \$2,095 if you register and pay after the early registration deadline.

### **Course Materials**

Course materials, including outlines, presentation copies, and supplementary materials, will be accessible through Canvas, KU's online learning system. Instructions to access Canvas will be provided upon completed registration. Students are required to bring a computer or other electronic device with PDF-viewing capabilities with them to class each day. If you require accommodation contact us at [professionalprograms@ku.edu](mailto:professionalprograms@ku.edu) and we will work with you on an accessible solution.

### **U.S. Federal Employee Discount**

This course is available to U.S. federal employees at 10% off the registration fee. To receive the federal employee discount, you must enter the code **FGVT116** during the checkout process.

Please note that you must validate your eligibility to receive this discount by entering your U.S. government email address (ending in .gov or .mil) when creating your online registration profile. This discount is available for both the early registration and regular registration fees.

### **Canada Department of National Defence Discount**

This course is available to Canada DND employees at 10% off the registration fee. Please contact the DND Procurement Authority (DAP 2-3) for details. Please note that you cannot register using our online system when requesting this discount. This discount is available for both the early registration and regular registration fees.

### **Instructor Bio**

George Cusimano is the co-founder and Chief Operating Officer of Vector LLC aviation consulting services. He is a flight test engineer and educator with more than 40 years of experience in research, development, and test of important leading edge technologies. He has flight-tested complex systems, such as the F-117, B-2, X-33 (single stage to orbit prototype), DarkStar UAV and X-35 (Joint Strike Fighter prototype). In addition to multiple postings as a flight test engineer, George was: the Director of Test and Evaluation for the F-117 System Program Office; the Chief of Flight Test Engineering for the B-2 Combined Test Force; the Deputy Director of the Joint STARS Combined Test Force; and the Director of Flight Test at the Lockheed Martin Skunk Works. George has also taught at the National Test Pilot School and has served as a Technical Advisor to the United States Air Force. He retired from the United States Air Force as a colonel after 24 years of service. George holds a B.S. in mechanical engineering and an M.S. in industrial engineering from Arizona State University. He is a graduate of the USAF Test Pilot School and a Fellow of the Society of Flight Test Engineers.

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