Unmanned Aircraft Systems Fundamentals
Design, Airspace Integration, Futures

April 19 - 21, Kona Kai Resort & Spa, San Diego, CA

At a Glimpse: This 3-Day classroom instructional program is designed to meet the needs of engineers, researchers and operators. The participants will gain a working knowledge of UAS system classification, payloads, sensors, communications and data links. You will learn the current regulation for small UAS operation.

The principles of UAS conceptual design and human factors design considerations are described. The requirements and airspace issues for integrating UAS into civilian National Airspace is covered in detail. The need to improve reliability using fault tolerant control systems is discussed. Multiple roadmaps from all services are used to illustrate future UAS missions. Alternative propulsion systems with solar and fuel cell energy sources and multiple UAS swarming are presented as special topics.

What You Will Gain & Learn:

- Definitions, Concepts & General UAS Principles
- Types, Classification and Civilian Roles
- Characteristics of UAS Sensors and Payloads
- UAS Communications and Data Links
- NATO Standardization Agreement (STANAG) 4586
- Alternatives to GPS and INS Navigation
- Need for Regulation and Problems with Airspace Integration
- Ground and Airborne Sense & Avoid Systems
- Lost Link and ATC Communication/Management Procedures
- Mission Planning System Concept & Components
- Improving Reliability with Fault Tolerant Control Systems
- Human Factors & Human Machine Interface
- Future Capabilities Including Space Transport, Hypersonic, Refueling, UCAS, Pseudolites and Swarming

UNMANNED VEHICLE UNIVERSITY
UNMANNED EDUCATION AND TECHNICAL TRAINING

Instructor

Dr. (Col Ret) Jerry LeMieux
Subject Matter Expert

Dr. (Col Ret) Jerry LeMieux is a pilot and engineering PhD with over 40 years and 10,000 hours of aviation experience. Dr LeMieux entered the US Air Force in 1980 and was a combat ready fighter pilot, instructor pilot , and commander.

He has over 20 years of experience in program management, systems engineering and test and evaluation for AEW, fighter and tactical data link acquisition programs. As the Network Centric Systems Wing Commander he led 1,300 personnel and managed 100 network and data link acquisition programs with a portfolio valued at more than $22 billion. He served at the numbered Air Force Level, responsible for the development, acquisition and sustainment of over 300 information superiority, combat ops and combat support programs that assure integrated battlespace dominance for the Air Force, DoD, US agencies, and Allied forces.

He competed for a position as a NASA astronaut and is a graduate of the Air War College and Defense Acquisition University with certifications in program management, systems engineering and test and evaluation. In civilian life he has consulted on numerous airspace issues for the US Federal Aviation Administration, Air Force, Army, Navy, NASA, DARPA and all major defense contractors. He has over 20 years experience directing R&D programs and lecturing at major Universities including MIT, Boston University, University of Maryland, Daniel Webster College and Embry Riddle Aeronautical University.

Dr LeMieux is also a National expert on sense and avoid systems for UAS and is currently working with the FAA and RTCA to integrate UAS into US National Airspace.

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Training Day 1

Welcome and Introductions

Definitions & Concepts

- Definition
- Attributes
- Manned vs Unmanned
- Design Considerations
- Acquisition & Life Cycle Costs
- UAS Architecture
- UAS Components
- Air Vehicle
- Payload
- Data Lin
- GCS

UAS Types & Roles

- Categories/Classification
- Micro UAS
- Small UAS
- MALE
- HALE
- Law Enforcement Usage
- Example Civilian UAS Roles
- Other Civil Roles

UAV Sensors & Characteristics

- Sensor Acquisition
- Optical (EO)
- Infrared (IR)
- Multi Spectral Imaging (MSI)
- Hyper Spectral Imaging (HSI)
- Light Detection & Ranging (LIDAR)
- Synthetic Aperture Radar (SAR)
- Small UAV Sensors
- Atmospheric & Weather Effects
- Sensor Data Rates
- Future Sensor Trends

Case Study: Alternative Propulsion System Design Considerations

- The Need for Alternative Propulsion for UAS
- Alternative Power Trends & Forecast
- Solar Cells & Solar Energy
- Solar Aircraft Challenges
- Solar Wing Design
- Past Solar Designs
- Energy Storage Methods & Density
- Fuel Cell Basics & UAS Integration
- Fuel Cells Used in Current
- Small UAS
- Hybrid Power
- Future HALE Designs

Training Day 2

Communications & Data Links

- Current State of Data Links
- Future Needs of Data Links
- Multi UAS Control
- Line of Sight Fundamentals
- Beyond Line of Sight Fundamentals
- UAS Communications Failure
- Link Enhancements
- STANAG 4586

UAS Conceptual Design

- UAS Design Process
- Airframe Design Considerations
- Launch & Recovery Methods
- Propulsion Considerations
- Communications
- Control & Stability
- Ground Control System
- Support Equipment
- Transportation

Human Machine Interface

- Human Factors Engineering Explained
- Heron Tour at Suffield, Canada
- Human Machine Interface
- Computer Trends
- Voice Recognition & Control
- Haptic Feedback
- Spatial Audio (3D Audio)
- AFRL MIIRO
- Synthetic Vision
- Brain Computer Interface
- CRM

Sense and Avoid Systems

- Sense and Avoid Function
- Needs for Sense and Avoid
- TCAS
- TCAS on UAS
- ADS-B
- Non Cooperative FOV & Detection Requirements
- Optical Sensors
- Acoustic Sensors
- Microwave Sensors
- Multiple Sensors

UAS Civil Airspace Issues

- Current State
- UAS Worldwide Demand
- UAS Regulation & Airspace Problems
- Existing Federal UAS Regulation
- Equivalent Level of Safety
- Airspace Categories
- AFRL/JPDO Workshop Results
- Collision Avoidance & Sense and Avoid
- Recommendations

Training Day 3

Civil Airspace Integration Efforts

- Civil UAS News
- FAA Civil UAS Roadmap
- UAS Certificate of Authorization Process
- UAPO Interim Operational Approval Guidance (8-01)
- 14 CFR 107 Rule: Small UAS
- NASA UAS R&D Plan
- NASA Study Results
- RTCA SC 203
- UAS R&D Plan
- FAA Reauthorization Bill
- Six Test Sites

UAS Navigation

- UAV Navigation
- Satellite Navigation
- Inertial Navigation
- Sensor Fusion for Navigation
- Image Navigation (Skysys)
- Satellite/INS/Video (NAVSYS)
- Image Aided INS (NAVSYS)
- Locata

Autonomous Control

- Vision
- Definitions
- Automatic Control
- Automatic Air to Air Refueling
- Autonomy
- Advanced AI Applications
- Intelligent Control Techniques

Case Study: UAS Swarming

- UAS Swarming Concept
- History of Military Swarming
- Battle of the Leyte Gulf
- Battle of Britain
- Naval Swarming in the Battle of the Atlantic
- Modern Military Swarming
- Single Operator Multiple UAS Control
- Swarming Characteristics
- Swarming Concepts
- Emergent Behavior Characteristics
- Swarming Algorithms
- Swarm Communications

Future UAS Designs & Roles

- Goals & Operational Issues
- Space
- Hypersonic
- Submarine Launched
- UCAS
- Pseudo Satellites
- BAMS
- Future Military Missions
- Technology Roadmap
- Potential Future Conflicts