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TUAV training for the US Army,

Technology moves forward for UAVs

Jim Perillat and Sue McClung report on a cutting-edge system

Unmanned aerial vehicles (UAVs) play an important role in the modern battlefield. The U.S. Army's Shadow Tactical UAV (RQ-7A) is being developed for ground manoeuvre brigade commanders to conduct military operations of reconnaissance, surveillance, target acquisition and battle damage assessment.

The Army is currently fielding tactical UAV (TUAV) systems worldwide. Critical to the successful fielding and operation of the TUAV is the introductory, crew and sustainment training provided. The Unmanned Aerial Vehicle Systems (UAVS) Project Office, the combat developer of the TUAV system, is leveraging advances in simulation technology and is using the expertise of the Joint Technology Center/Systems Integration Laboratory (JTC/SIL) to build TUAV trainers or institutional mission simulators (IMS). JTC/SIL personnel designed, fabricated and fielded the IMS systems used to support TUAV training to the U.S. Army TUAV Training Facility.

Recently, the JTC/SIL has expanded its area of expertise to include unmanned ground vehicles as well as intelligence, surveillance and reconnaissance training systems. JTC/SIL development, prototyping and integration activities include the Hunter UAV downsized ground control station prototype, TUAV ground control shelter, TUAV interim trainer, the tactical control system (TCS) land based shelter configuration and TCS trainer.

In 2000, the UAVS Project Office requested JTC/SIL to design and develop an TUAV system institutional trainer. The IMS was developed to stimulate the TUAV UAV control station hardware and software, simulate specific AV and payload parameters, allow instructors to introduce system faults and errors, and to support training during all system flight control modes to include tactical automated landing system (TALS) operations. A key component of the IMS is the multiple unified simulation environment (MUSE) that was developed by the JTC/SIL.

The IMS comprises a MUSE driver (MD) - an air vehicle and datalink simulation that stimulates the tactical ground control station (GCS) hardware/software, a payload scene visualisation system, an instructor console and the student air vehicle operator/mission payload operator (AVO/MPO) workstation. The AVO/MPO) station contains the vehicle control station (VCS) tactical hardware and software. The MUSE Driver is an air vehicle and datalink simulation that stimulates a tactical control station such as the VCS or a surrogate control station. It can simulate a wide variety of manned and unmanned air vehicles and uses a generic six degree of freedom (6DOF) model to simulate air vehicle performance in autopilot flight mode.

Air vehicle performance parameters are represented by data files easily tailored to build new or modify existing air vehicles. Data file parameters include engine performance, aerodynamic properties, size and weight of air vehicle structural components, etc. The MD also utilises a higher fidelity 6DOF model in the joint modeling and simulation system (JMASS) architecture for the Shadow 200 TUAV and a generic vertical takeoff and landing model. JMASS provides a standard digital modeling architecture that allows for engineering analysis to be conducted on operational flight algorithms of the aircraft being simulated.

Modifications were made to the MD for the Shadow TUAV IMS. The JTC/SIL developed a new 6DOF air vehicle model, a TUAV tactical message protocol interface, ground data terminal and air data terminal simulations, and simulated the TALS. All of the errors, warnings and failure messages of the system were implemented. This allows instructors to train pilots to monitor and act on critical warning and failure modes better preparing them to handle the emergency during flight. The MD handles all system flight and control modes and can communicate the AV's location to external constructive simulations via distributed interactive simulation (DIS) or high level architecture (HLA) protocols.

The VCS is the hardware and software that make up the two operator workstations inside the tactical shelter - for the AVO and the MPO. The AVO performs flight operations, mission planning, monitors and responds to AV warnings and errors; the MPO controls the sensor on the AV and searches for and detects targets on the battlefield. The IMS uses the same AVO, MPO hardware and software as in the tactical shelter.

The TUAV trainer instructor can control the MD and payload visualisation system at a specially designed instructor's station. The instructor can monitor each simulated TUAV being flown; take control and override specific AV settings and controls; inject system warnings and failures for each AV being flown and monitor each student's responses; the station also has a C4I common message processor workstation that can receive and log tactical messages generated by students during training. C4I messages can be used in after-action review to determine if students were able to detect and report on hostile ground targets visible in the EO/IR payload display.

The IMS MUSE system uses a COTS visualisation system, the Virtual Reality Scene Generator (VRSG™), developed by MetaVR Inc., that produces the electro-optical (EO)/infra-red (IR) payload video scene with textual and graphical overlays for the platform being flown. The VRSG has been integrated into MUSE to provide both EO and IR UAV scene generation and fixed-frame imagery for theatre and national collectors. MetaVR is DIS compliant, and is interoperable with external DIS or HLA constructive and virtual simulations. Terrain databases are derivable from compact terrain data base format, MultiGen OpenFlight, or user definable sources. MPOs can dynamically change infra-red (white or black being thermally hot), and daylight television mode (Day TV) views.

Visual databases are developed at the JTC/SIL in the database and model development lab. The visual databases are highly realistic when five metre pixel resolution or better source imagery is used. Targets can be statically or dynamically placed on the synthetic 3-D terrain locally by the instructors or the MUSE visualisation system can receive an 'entity' feed of target model (tanks, trucks, aircraft, etc.) from external semi-automated forces simulations such as the OneSAF Testbed.

The TUAV Schoolhouse classroom has eight AVO/MPO student stations allowing for simultaneous training of 16 students. UAV operators typically become flight qualified in 118 days of training of which 40 are spent using the simulators. Each TUAV GCS also has an embedded MUSE simulation so operators can train at their home station, participate in command and staff training exercises locally or distributed if desired. During tactical deployments operators can conduct mission rehearsals or maintain system proficiency by running the simulator.

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