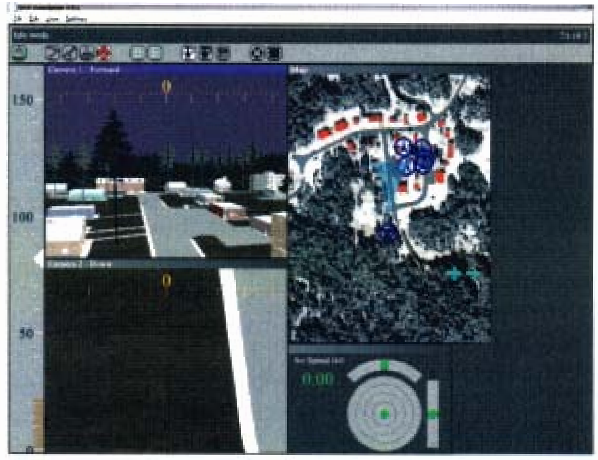
INSTITUTE for SIMULATION & TRAINING

Intuitive Means for Robotic Control (IMROC)



What is IMROC?

IMROC (Intuitive Means of Robotic Control) is a research simulation environment intended for the investigation of training issues relevant to the introduction of robotic/unmanned elements into Army operations. The research will be concerned with the cognitive challenges of robotic operation and employment, as opposed to the physical challenges. Consequently, details of portability and ergonomics are not addressed by IMROC. Development of IMROC has been supported by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) from their Simulation Systems Research Unit (SSRU) and RDECOM-STTC through a contract to the Institute for Simulation and Training (IST) at the University of Central Florida.

The initial focus of IMROC has been to develop a research environment to study operator control training for an operator of an unmanned ducted fan, vertical-lift micro-aerial vehicle (MAV). The Army is considering fielding a MAV as the Class I unmanned aerial vehicle (UAV). It is expected that the Class I UAV will be an organic infantry platoon asset operated by Soldiers without any prior traditional pilot training. The Army desires that operators be "designated" not "dedicated." That is, operator training should be achievable relatively rapidly and not require specialization on the part of the operator. As the design of the operator control unit (OCU) directly impacts training ease or difficulty, IMROC's OCU was designed to be re-configurable, so that the impact of various display configurations and/or MAV capabilities on operator training and performance can be investigated. For example, reconfiguration of the OCU allows for simulation of a MAV with fixed vs. zoom/pan cameras. Possible OCU configurations are virtually limitless, because IST has written the code, and can modify it as requirements demand. The Figure above illustrates the OCU in one of its possible configurations.

The key components of the IMROC testbed are the reconfigurable OCU, OTB v2.0, and DIVAARS (Dismounted Infantry Virtual After Action Review System). DIVAARS is used to capture training session events. OTB is used to provide target entities and objects into the synthetic environment. OTB can provide SAF entities that can play parts in interactive scenarios. IST has customized both DIVAARS and the OCU to meet experimental data collection requirements (e.g., human-computer interaction data). A simple model of MAV flight dynamics is a component of the OCU. Similar to other features of the OCU, the model can be altered to change the simulated MAV's flight characteristics. The OCU communicates with OTB and DIVAARS via DIS packets.

Current IMROC-OCU Capabilities

The capabilities of the IMROC-OCU are based on ARI's investigation of existing UAV OCUs, particularly those for small UAVs intended to be controlled by one operator once airborne. The essential elements of the OCU consist of a situation awareness map, sensor displays, manual (teleoperation) control inputs, mission planning/editing tools for semi-autonomous missions, and status indicators (e.g., altitude, velocity). The operator can interact with the OCU via a mouse. While actual prototype OCUs tend to use touch-screen inputs, we opted for the traditional mouse to minimize cost (considering that the ergonomics of OCU usage were not our main concern). Scenarios are written in OTB and are played out within a synthetic environment modeled on Shughart-Gordon at Fort Polk. Hardware requirements are 3 PCs: one for the OCU, one for OTB, and one for DIVAARS. The DIVAARS PC requires a hardware accelerated graphics card.

As mentioned above, several aspects of the OCU are configurable. This includes the appearance of the OCU itself as well as environmental factors (e.g., time of day), and MAV capabilities (e.g., number of cameras and their properties). The MAV can be set up as having one, two, or three cameras. Independently, the number of camera views displayed simultaneously can be selected. For example in a planned experiment, we will configure the MAV to have two fixed cameras and manipulate whether both camera views are displayed simultaneously vs. only one view at a time (current setup of prototype OCUs ARI has examined). This will allow for investigation of how the need to switch between views may affect operator performance, workload, and situation awareness.

Three input schemes for manual control have been implemented. Two use the mouse to select MAV movements, but using different displays and input-response mappings (see below). A third method uses a game pad controller. In a planned experiment we will determine which configuration operators find the easiest to master.

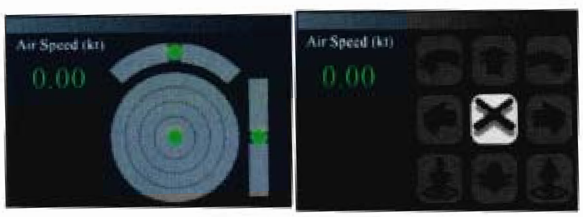


Figure 1: Two input schemes for manual control of the simulated MAV. The analog scheme (left) controls lateral movement via the center circle, altitude via the bar on the right, and rotation by the arc at the top. The digital scheme (right) uses the different buttons to control the MAV.

Essentially any aspect of operator-OCU interaction can be measured and logged. Data collection can be customized according to the needs of the research. Targets can be placed in the synthetic environment via OTB scenarios. Target detection can be logged either when the operator snaps its picture, or lases a target (lasing allows a target icon to be placed on the situation awareness map). Collisions with environmental objects can be recorded, as can variance of travel from designated routes. DIVAARS allows for playback of a previously run mission, to allow for research analysis or AAR (after action review).

Plans for the Future

The information gained from an unmanned sensor is of no use if it doesn't get passed on to the "consumer" who needs to know about it. Our plans for expansion of IMROC involve adding a Command and Control (C2) node. The intention is to investigate the communication and information exchange requirements between the C2 node and the MAV operator. What are the best modes of information transfer for 1) MAV operator to inform the C2 of information so that it is quickly and easily understood, 2) the C2 node to assign a MAV mission, and 3) the C2 node and the MAV operator to collaborate in mission planning. What training with respect to the employment of the MAV is required at the C2 node?

To answer these questions, we also plan to give the C2 node assets to control (such as dismounted infantry). These assets can either be SAF, played by researchers via OTB inputs, or live players via dismounted soldier simulation systems such as SVS. When these elements are added, IMROC will be able to study questions of MAV employment and TTPs in simulation. Other possible future modifications include the addition of a ground robotic element

ARI is interested in discussing other possible extensions and configurations that could be of benefit to military research and training development. **We invite anyone interested in providing input to contact one of the people below.**

For more information, contact:

Glenn A. Martin
University of Central Florida / IST
3280 Progress Drive
Orlando, FL 32826
Phone: (407) 882-1349
E-mail: martin@ist.ucf.edu

Paula J. Durlach, Ph.D.
US Army Research Institute
12350 Research Parkway
Orlando, FL 32826-3276
Phone: (407) 384-3983
E-mail: Paula.Durlach@peostri.army.mil