



# THE USMC AND NPS

## QUARTERLY RESEARCH UPDATE

1 November 2005

### SPOTLIGHT: U.S. MARINE CORPS PROJECTS AT MOVES INSTITUTE

NPS's MOVES Institute (for modeling, virtual environments, and simulation) has worked with the USMC's TECCOM and PMTRASYS commands to achieve outstanding results in research and academic programs, focusing on providing benefit to the Corps and full usage of Military Operations Specialty 9625. A frequent transition partner for MOVES projects, the USMC has become the client known for asking hard questions and pressing for real answers. This suits MOVES fine, according to the MOVES program officer, CDR Joe Sullivan, USN, who claims the Marine Corps as his favorite customer and collaborator. Some noteworthy USMC/MOVES projects are below.

**FOPCSim** The "Forward Observer" PC simulator (FOPCSim) project began in 2002, when Marine LtCol Dave Brannon and Maj. Mike Villandre recognized a dire need for training aid for the Corp's critical call-for-fire missions. They believed emerging PC technology could solve the problem. Backed by NPS faculty experts in human factors, instructional-systems design, and computer-graphics engineering, Brannon and Villandre examined the nature of mission and critical-training elements and matched it with the capacities of modern PCs. Their robust prototype was field tested with the target audience in Camp Pendleton.

The system gained instant acceptance and popularity. Unfortunately, the cost of the software engine used to build the training application prohibited wide distribution: each CD delivered would carry a \$500-per-seat license fee. Following the USN/USMC tradition of building solutions from what's on

hand, the NPS team sidestepped the problem by building their own software engine—one without the license fees that limit distribution.

In 2005, Marine Maj. J.P. McDonough and Capt. Mark Strom picked up where FOPCSim One left off. Their work included rebuilding the game using the new engine and running it through rigorous evaluation at TBS. The results established that their PC-based training was as effective as existing training and much more easily maintained and distributed. McDonough and Strom's system is scheduled to replace the current system and FOPCSim has transitioned to a program of record. It is now a standard application in use at various schoolhouses in the Marine Corps, such as squad-leader's course to train Marines to call for fire at SOI-East.

Maj. McDonough is currently putting his NPS education to the test, serving the Marine Corps Modeling and Simulation Management Office. He is the USMC's primary representative to the Defense Modeling and Simulation Office. As big a win as FOPCSim has been, the real return on the Marine Corps' investment will be from the programs and policies that Maj. McDonough and other graduates control.

**ChrAVE** The Chromakey-augmented virtual environment (ChRAVE) was originally prototyped by USMC H-53 pilot Mark Lennerton as a cheap and portable way to turn any vehicle into an interactive trainer. Combining a PC running a navigational application with a head-mounted display and a bluescreen, ChrAVE was field tested at HMM(T)-164 and validated for providing an effective overland navigation training system, a test platform for NVG simulation, and a realistic out-the-window view in a deployable, immersive system.



**Forward Air Traffic Controller (Airborne)** The FAC(A) program, dubbed “Cleared Hot,” is investigating the feasibility of an open-source PC-based FAC(A) simulation, leveraging existing work at NPS (such as FOPCSim). The current training syllabus takes students from classroom lessons directly to the aircraft—PC training could provide an intermediate step that provides an immersive, inexpensive, risk-free first go. Status: in development with Maj. Charles Lakey and Maj. Greg King; scheduled for study at Marine Aviation Weapons and Tactics Squadron in March 2006.



*Virtual Environment CQB*

**TECOM and TTECG Baseline Study—the “Rosetta Stone of Training Validation”** MOVES’ unglamorous but enormously valuable and unprecedented study of fundamental training and simulation data has provided baseline measurements from which questions regarding the effectiveness, efficiency, and value of training simulations can be answered with quantified certainty. These benchmarks will allow the USMC to improve training in artillery, air, and ground units and let MOVES researchers understand exactly what works and why. The study contributes towards building the VIRTE conceptual framework and support areas where the VIRTE mission is currently focused. PI: Amela Sadagic. Status: bulk of preparation completed, data collection in process.

**Virtual Environment CQB** MOVES and the USMC have developed a prototype deployable CQB training system and investigated the feasibility of integrating instrumented weapon and HMD for immersive, individual combatant training.

## NPS JOINT CLOSE AIR SUPPORT

JFCOM has been delegated responsibility for developing the Joint Battle Management Command-and-Control Integrated Architecture and requested help from AFIT and NPS in building the conceptual basis of the JBMC2 integrated architecture.

Initial efforts focus on joint close air support and extension to include joint fires. Marine interest in this project is indicated by the MCCDC’s acting as executive agent for development of the close-air-support “Initial Capabilities” document when Gen. Pace was VJCS and JROC chairman.

A Marine student at NPS is identifying and examining doctrine and CONOPS for current and future joint close-air-support targeting-and-delivery systems. A supporting wargaming program has been developed in collaboration with TRA-DOC, AFIT, and JFCOM.

- The current joint-close-air-support project will involve optimizing selected targeting-and-delivery architectures and their implications for associated tactics and doctrines. The results will be vetted through the wargaming process with TRA-DOC, AFIT, and JFCOM.

## TNT TACTICAL REMOTE-SENSOR SYSTEM

The tactical-network topology (TNT) program of quarterly field experiments develops and demonstrates new technologies supporting the near-term needs of the warfighter. Emphasis is on wireless networks, autonomous vehicles, sensor networks, situational awareness, and target tracking and identification—measures of performance of technologies and operators are also addressed.

**Deployable Network Operations Center** Under the TNT aegis, Marine Corps students Maj. Thiry and Lt. Johnson recently designed, built, and implemented a deployable network operations center (DNOC) at Camp Roberts, CA for the U.S. Special Operations Command. In collaboration with TNT director of networking Alex Bordetsky and field-experimentation coordinator David Netzer, Thiry and Johnson created a man-packable network-operations center.

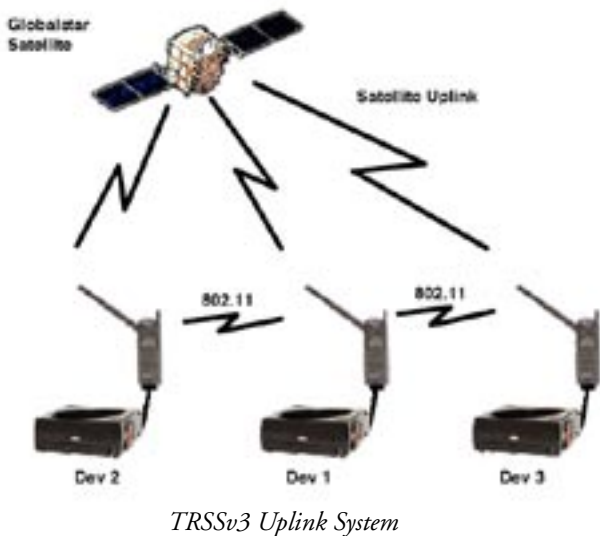
Users participate over an experimental test-bed of hybrid wireless



*MOVES’ FOPCSim transitioned from student thesis to Marine program of record*

technologies (links) and manned/unmanned mobile platforms (nodes), allowing them to connect into the wireless backbone network, the Internet, and a remotely operated audiovisual suite that displays their PC monitors to the group. The plug-and-play DNOC liberates TNT researchers from cumbersome setup and allows them to concentrate on the intellectual challenges at hand.

The primary objectives were to demonstrate shared situational and network awareness by improving the information-management processes and to enhance the geodistributed tactical warfighters' ability to self-synchronize over a robust network topology—which means increased collaboration and flexibility, faster decision making, minimized logistics, and improved interoperability.



**TRSSv3** Research conducted in spring 2005 at the TNT 05-3 experiment at Camp Roberts served as an extension of thesis work by Marine captains Brian Dixon and William Felts.

The USMC uses a tactical remote-sensor system named TRSS. As a part of thesis research, a second version, TRSSv2 was developed, and TRSSv3 followed by adding improved performance through hardware upgrades.

TRSSv2 was a wireless sensor network built on handheld mobile devices, developed to utilize capabilities discovery, load sharing, and resource aggregation for overall performance. TRSSv2 also made use of capabilities discovery to evaluate network devices. It utilizes load sharing to distribute images collected by an individual sensor to other devices on the network, and resource aggregation to exploit the resources of all devices in the network. Satellite communications provided internet connectivity from

remote locations. The software package was written in C Sharp (C#), uses the .NET compact framework, and worked under the Pocket PC 2002 operating system, using 802.11b wireless technology for ad-hoc network connectivity. TRSSv2 was designed to deliver high quality images from any area within satellite coverage to any computer connected to the internet.

TRSSv2 worked well, but was snail's paced due to limitations of the PDA's architecture. To improve performance, the sensor system was migrated to a Pentium 4-based miniPC, and named TRSSv3. This provided the processing power, memory, and storage the sensor system needed to operate correctly. In addition to hardware upgrades, TRSSv3 employed the CrossBow sensor system. This system augmented TRSSv3's software-based motion detection with hardware-based motion detection. Several small motes were deployed, which provided motion detection based on changes in IR spectrum as well as the magnetic field.

## INDIVIDUAL IDENTITY, FRIEND OR FOE (IIFF)

With increasing reliance on night operations and close-quarters combat (CQC), an improved tool is urgently needed to minimize fratricide. This longstanding issue becomes even more critical with the growing density of night-vision devices (NVDs) among individual soldiers, marines and special-forces operators and the parallel proliferation of NVDs around the world. *(cont.)*



*LCDR Bradley and his individual IFF. The American flag patch emits infra-red light (inset) when activated by a remote optical transmitter. Marine Corps funding will help develop field-testable units.*

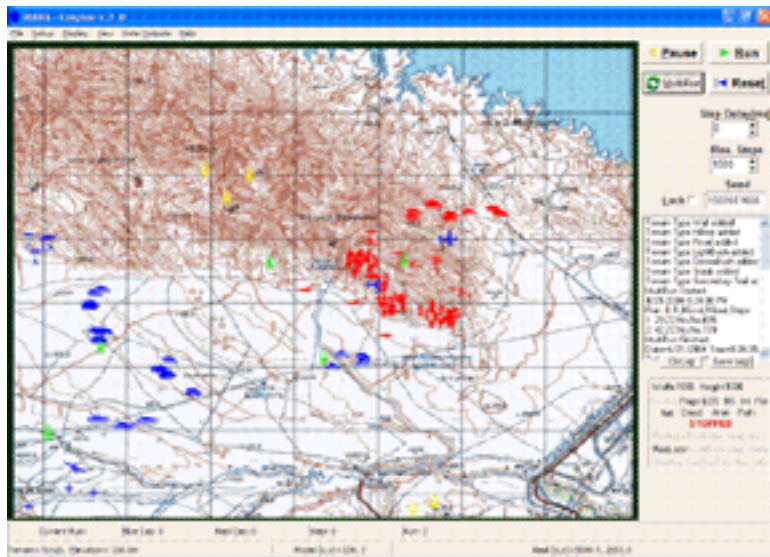
With support from the Marine Warfighting Laboratory (Maj. Jeffrey Dunn, MCWL), LCDR Frank Bradley and professor Nancy Haegel of the NPS physics department are developing a IIFF device based on new polymer light-emitting materials. The work is being performed in collaboration with Add-Vision, Inc. of Scotts Valley, CA.

An optical transmitter will be incorporated into the aiming device of each operator's weapon. It will interrogate and trigger emission from a small, lightweight patch that will identify individual friendly forces. The interrogator is directional and can be encoded so that enemy personnel cannot activate the patches, eliminating a common problem with existing IIFF. The system has been designed so as not to add significant weight or complexity for the warfighter, to integrate into existing SOPs, and to take advantage of the latest technologies. The polymer emission and printing process will allow for a relatively low-cost device, meaning that the patches can be issued and worn as multiples by operators to allow for 360° exposure. The program anticipates delivery of twenty prototype devices in December 2005 for initial testing and evaluation.

## COMMAND AND CONTROL IN NETWORK FORCES

Nations around the globe are increasingly using information-age technologies to transform the tools of warfare and the way fighting forces are organized and employed. Distributed sensors and networks provide battlefield entities with unprecedented levels of information. The ability of networked forces to act rapidly and decisively on that information depends heavily on having the right command-and-control (C2) systems and processes. Of course, what is "right" is affected by the mission, enemy,

terrain, and many other factors—that is, forces will always have to adapt to the situation. As with all revolutionary advances in military capabilities, there is much to learn; substantial cost and time benefits will result if these lessons are learned via experimentation rather than on the battlefield.



Screen shot of a future force company attacking an embedded red force implemented in the agent-based simulation environment Map Aware Non-uniform Automata (MANA).

This research, which is part of the broader "Project Albert" program, has developed new algorithms that enhance an analyst's ability to quickly conduct and analyze high-dimensional computational experiments. Project Albert is a Marine Corps-led international collaboration that is transforming how analysts support military decision makers by harnessing high-performance computing, new modeling environments, and innovative analysis techniques. These new capabilities are enabling small teams of experts and analysts to rapidly generate models and provide insight into problems that have historically been deemed too hard. Over a score of thesis students have applied Project Albert techniques to analyzing issues such as degrade communications in future forces, logistical support to a distributed-operations platoon, UAV survivability, convoy protection, village-search operations, and peacekeeping—see <http://diana.cs.nps.navy.mil/SeedLab/>.

Principal investigators are professors Susan Sanchez and Tom Lucas, NPS operations research.



C2 in network forces: decision graph of the most significant three communication factors, in order of importance, top to bottom, for minimizing future force blue casualties in a battalion-level combined-arms attack in the Caspian Sea area of operations (from the master's thesis of Captain Joe Lindquist, USA, 2004). Colors indicate the MOE category: good (green), moderate (yellow), or poor (red).