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T&E FOR RAPID ACQUISITIONS

INVITED ARTICLE

The Joint Test and Evaluation Program: Quick Reaction Tests (QRTs) for the Joint Warfighter

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FEATURED CAPABILITY

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TECHNICAL PAPER ABSTRACTS:

Test and Evaluation to Support Rapid Acquisition for the Warfighter

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The U.S. Army Evaluation Center (AEC), Aberdeen Proving Ground, Maryland, identified the need to transform the evaluation processes to provide Army and Department of Defense decision makers, along with warfighters, with accurate and rapid evaluations of materiel. Operations Enduring Freedom and Iraqi Freedom quickened the pace of materiel development and acquisition, thereby requiring transformation of the processes for testing and evaluation (T&E) that support those acquisitions. This article briefly sketches those transformations and additions to the T&E processes by addressing the following factors: the importance of striking a balance between the need for rapid fielding and the complexity/risk of the item under test; the Army Test and Evaluation Command's (ATEC's) and AEC's early involvement with materiel developers; and the ATEC/AEC Rapid T&E process.

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Training and Testing: A Complex and Uneasy Relationship

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Effective test player training is essential to valid operational testing. Inadequate test player preparation invariably results in a flawed test and undermines the validity of data essential to system improvement and acquisition decision making. This article begins by discussing the reasons for ineffective pre-test training, and then addresses the impact of inadequate test player preparation on test events to follow. It also explores two questions central to effective test player training in the emerging warfighting environment: "Why is training increasingly critical to good testing?" and "Why is that training more difficult now?" A set of pre-test training actions that must occur if test players are to be properly prepared to participate in meaningful operational testing are is presented and discussed. These actions fall into three categories: (1) Establishing a stable performance platform prior to testing; (2) Pre-test training conduct; (2) and Pre-test training evaluation.

Science and Technology Needs for Modeling and Simulation

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Modeling and simulation (M&S) provides a unique capability for humans to put either themselves or systems into an environment, a place and/or a time to which they otherwise cannot go. Over the last 15 years, M&S has grown considerably in capability and importance, especially for military purposes. In fact, decisions about all aspects of the military enterprise are commonly assisted with simulation. Strategy documents throughout the Department of Defense (DoD) often mention the power of computer simulation to portray alternative futures and to assist decision makers. For the same 15 years, each of the military Services conducted many studies to evaluate M&S deficiencies, nominate areas for science and technology (S&T) investigations, justify solutions and program remedies. One can fairly characterize the S&T needs for M&S across DoD as: shared needs, minimal collaboration, unsteady or nonexistent funding and little progress. Delay in funding the S&T research to improve M&S tools will continue degradation of important M&S capabilities. This article proposes areas where S&T investments are needed to improve M&S capabilities.

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An OEF/OIF Study of Close Combat Missions Using Small Unmanned Aircraft Systems

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The Small Unmanned Aircraft System (SUAS) is a rucksack-portable aerial observation vehicle designed to supplement reconnaissance, surveillance and target acquisition tasks of an infantry company. The Raven, an earlier version of the SUAS, is an urgent material release acquisition and has been used for the past two years by selected Army units in Operations Enduring Freedom and Iraqi Freedom (OEF/OIF). Army Test and Evaluation Command-led surveys were used to assess the capabilities and limitations of the Raven in OEF/OIF. Results and analyses of the surveys indicate that Raven enhances situational awareness of a small unit in urban areas and in selected close combat missions. Users of the Raven state that it is easy to use, although there are major issues with frequency de-confliction, airspace management, short endurance and sensor performance. The SUAS is a program of record and completed developmental and operational testing in preparation for full-rate production. This article addresses the SUAS effectiveness, suitability and survivability evaluation strategy based on actual testing of the system.

Developmental Test and Evaluation for Advanced Maritime Technology Integration

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Since September 11, 2001, the combatant craft community has been especially challenged to hasten improvements on weapons, communications, propulsion and hull designs, leading to new technology for craft and related systems. A discussion of these topics is provided herein, especially those challenges related to high-speed combatant craft within the research, development, test and evaluation construct of the Combatant Craft Division, a detachment of the Naval Surface Warfare Center, Carderock.

Soldier at Aviation Technical Test Center Recalls First Use of TOW Missile System in Combat Theater

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A former Army aviator now serving as a civilian experimental flight test pilot at the U.S. Army's Aviation Technical Test Center (ATTC), Fort Rucker, Alabama, discusses the initial use of the tube-launched, optically tracked, wire-guided (TOW) missile system in combat theater. This article highlights some of the experiences of Alvyn Chapman, who flew missions during Vietnam in which helicopters used missiles to attack tanks and other ground targets. The article leads into his current responsibilities at ATTC, where, he notes, new equipment or aircraft are acquired early on for testing, even before any other government personnel have seen or even heard of it.

PRESIDENT'S CORNER

Let me introduce myself. My name is Tom Macdonald. It is indeed an honor to serve the test and evaluation (T&E) community as President of ITEA. We have an exciting year ahead of us, with a lot of work to do. Before I address the upcoming year, it would seem appropriate to tell you a little about myself. I was born, raised and educated in the Boston area. I have more than 35 years of Department of Defense (DoD) experience in the development and analysis of navigation, surveillance and radio frequency (RF) communication systems. I went out on my own in 1998 as a consultant to the Central Test and Evaluation Investment Program (CTEIP), within the Office of the Secretary of Defense (OSD). My particular focus has been on the use of the Global Positioning System (GPS) and advanced datalinks for national test and training range applications. This work experience includes 27 years with the test and training communities. T&E is my life…

I began my association with ITEA in the early 1990s as president of the New England Chapter, moving on to serve as a Regional Vice President, and then to ITEA's Board of Directors. I have ITEA experience with running/chairing conferences; teaching short courses and tutorials; writing articles for the *ITEA Journal*; speaking at chapter meetings; directing committees; and administering as a Board Member and on the Executive Committee as ITEA's Vice President. I believe in ITEA…

Over the years, I have been actively involved with a number of volunteer organizations. I am particularly proud of my Board of Directors involvement with Angel Flight, a non-profit organization that provides free air transport to needy families requiring medical care. I believe in volunteerism… For more than 23 years, I was an instructor with the Graduate School of Engineering at Northeastern University. In addition, I have taught T&E courses around the world. Education is *very* important to me…

So, I come to you with a strong background in T&E, and a firm commitment to ITEA. I want to take this already excellent professional organization and help shape it into something even better. *We need to attract more young members, reach out to non-DoD organizations, and become a voice for major T&E concerns.*

We have already begun to take the necessary steps to make this transformation happen. At our September 21, 2006, meeting, the Board of Directors made an important change to the strategic direction of the Association. The Board reached a consensus to encourage increased participation from under-represented segments of the T&E community, with a specific emphasis on T&E in the aerospace and transportation industries. This new direction will help this Association grow by providing a diverse T&E community where we can each learn through exposure to alternative T&E cultures. This new direction will require ITEA to explore benefits, education and other offerings that will attract this expanded membership.

Thomas J. Macdonald

For the first time, ITEA is developing a plan of action, referred to as the business plan, to implement the Association's strategic goals. This business plan, chaired by our exceptionally well-qualified ITEA Executive Director, Ms. Lori Tremmel Freeman, is shaping our operation to take maximum advantage of the Association's expansive base of extraordinarily talented and committed volunteers, while focusing the efforts of ITEA's many committees to achieve common, high-priority organizational goals. The new planning paradigm engages committee members at every level, focusing on establishing rapport between committee chairs, leadership and staff. To date, four committees have developed draft plans, which include the establishment of measurable, relevant goal setting. I will continue to communicate our progress on this effort through 2007.

The Publications Committee plan calls for the *ITEA Journal* to be more representative of the membership and, to that end, has established a new feature, "Invited Article." This feature, which stands as a new vehicle for unique/different voices in the T&E community, will appear only as we identify authors and topics we want to highlight, rather than being a standing quarterly feature. In this edition on page 9, James H. Thompson of DOT&E provides the inaugural article.

I will be devoting my coverage in future "President's Corner" columns to the following two areas: (1) Providing a status report on ITEA's progress in becoming more beneficial to its members; and (2) Presenting issues that are of paramount importance to T&E.

I would encourage you to contact the ITEA office or any member of the Board of Directors with your concerns and ideas for improving ITEA. In addition, I would ask you to consider sharing your time and talents in ***our*** professional Association.

Armor Testing, An Example of T&E for Rapid Acquisitions

COL John P. Rooney, USA

U.S. Army Aberdeen Test Center,
Aberdeen Proving Ground, Maryland

Testing in support of rapid acquisition is a process that sometimes comes without fully defined requirements and represents the Army's daily adaptation to battlefield realities. It is characterized by a responsive test process, streamlined decision making, and the need for test resources to already be in place to allow for rapid execution. Effort must be spent to fully characterize significant aspects of the operational environment and to continuously examine them to ensure that they remain relevant. The results must be repeatable and capable of withstanding intense scrutiny. In the fervor to provide something immediately, caution must be exercised to ensure that the solution is not worse than the problem, that is, *something* isn't always better than *nothing*.

COL John P. Rooney, USA

My involvement with rapid acquisition can be traced to August 2003 when MG Robert Armbruster, USA, then-commander of the Army Test and Evaluation Command (ATEC), Alexandria, Virginia, called a meeting to address armor protection systems. This was about two months into my assignment as chief of staff of the Developmental Test Command (DTC), Aberdeen Proving Ground (APG), Maryland, and I was the DTC representative to the meeting, which also included the Army Evaluation Center (AEC), Program Managers (PMs), Army G-3 (operations) and G-8 (analysis), as well as the National Ground Intelligence Center (NGIC). Fewer than 300 of the high-mobility multipurpose wheeled vehicles (HMMWVs) in theater were up armored. With improvised explosive devices (IEDs) and other threats, the imperative was to get them up armored immediately. The purpose of the meeting was to define the threat; develop ideas for how to protect the vehicles; and define the required level of protection. Two issues were addressed: (1) Protection against the appropriate threats in theater; and (2) Automotive performance consequences of up armoring these vehicles.

The outcome from the meeting was a test concept describing what could be accomplished immediately that would add value to the acquisition process. It was briefed to MG Armbruster, who subsequently approved the idea and assigned me as the action officer, and then chair of the ATEC Systems Team (AST) for Characterization of Armor Protection Initiative for Vehicles. This enabled me, as someone onsite where all the armor testing was taking place, to rapidly provide emerging results of armor testing to senior leadership in support of acquisition decisions.

A data call was issued for armor protection with ATEC tasked to test the ideas. The approach was to perform rapid screening ballistic testing on 2-foot x 2-foot material coupons. The coupons were exposed to bullets and fragments to characterize performance. The results provided a comparative basis for choosing those with protection potential. Once suitable materials were identified, suppliers were requested to deliver two complete kits (HMMWV only at first): a ballistic test kit and an automotive test kit, for determining capabilities and limitations to permit a go/no-go decision to be made. Candidates passing these tests were then used for exploitation—testing seams, bolts and so forth—where potential weaknesses could occur. There were also full-up live fire shots using the appropriate threats to assess the integration of the solution on the vehicle.

In parallel with these tests, automotive performance was examined to assess changes in vehicle performance due to up armoring, for example, steering and handling, side slope, braking and limited reliability-availability-maintainability (RAM). These tests established the new handling characteristics and the capacity of the chassis to support the additional weight.

Keep in mind that there was little experience in the Department of Defense (DoD) with putting armor on tactical wheeled vehicles. The M1114 was designed primarily for a very different threat than was present in Iraq and Afghanistan. Testing had to be conducted on a relative comparison basis—there was no other choice. All samples were exposed to identical threats.

By mid-October 2003, the first shots were completed, leading to development of two up armor kits: one from the Army Research Laboratory (ARL) and the other from ARL and the Army Tank-Automotive and Armament Research, Development and Engineering Center (TARDEC). By late October 2003, about 2,000 ARL and ARL-TARDEC kits were shipped to theater. From then on, the work was constant, examining new ideas and adapting to changing threats. Throughout 2004 and 2005, this same process was followed, and the full range of trucks was tested, in addition to continually upgrading the up armor kits as the threats changed. There have been in excess of 460 options tested to date (December 2006) from 76 vendors.

In 2005, I was assigned command of the Aberdeen Test Center (ATC), APG, which has primary responsibility for testing the up armor concepts. ATC is the DoD lead test center for automotive testing, manned and unmanned ground vehicles, guns and munitions (direct fire and small arms) testing, and live fire vulnerability and lethality testing. Along with colleagues at ARL, AEC and DTC (all at Aberdeen Proving Ground) these are the vulnerability, ballistics and survivability experts for the Army .

Once the initial kits were developed and shipped, and with the morphing threat, the natural question became: "Were our tests duplicating what was really happening in theater with the evolving IED threat?" In April 2004, BG Joseph L. Votel, USA, and I went to Iraq with the IED Task Force and Coalition Explosives Exploitation Cell to examine data on what was really happening and to determine how to adapt the testing to be more representative. Only small changes to the test scenarios were required based on information gathered from the trip.

Rapid acquisition by its very nature does not follow the path of a traditional test program. Operational concepts are often developed concurrently with fielding; there may be limited time for formal operational testing; and evaluation must identify the capabilities and limitations of the solution. To mitigate the risk, ATEC established Forward Operational Assessment (FOA) teams, which consisted initially of military operational testers and evaluators and have recently added civilian developmental testers. The team members are subject matter experts that have the ability to conduct limited tests and operational assessments in theater with a direct line of support for testing and follow up at the test centers.

One example of such a limited test was conducted on tactical vehicles to assess how they are being used in theater compared to how they were tested against the military standards. Twenty tactical vehicles were instrumented, and we learned that in theater, they are accumulating more miles at high speed and are experiencing more idle time. We now have black boxes on deployed vehicles taking data continuously—almost a million miles of data thus far. ATC subject matter experts have been deployed eight times for specific issues. We are learning more about the effects of armoring tactical vehicles. It is neither the ideal way to learn nor the one we prefer, but it has provided critical information.

In another example of test support to rapid acquisition, the Joint Experimentation Range Complex (JERC) was established at the Yuma Proving Ground in late 2003 and early 2004. Its role (see "Featured Capability" in this edition, page 21) is to provide as realistic a representation as possible, portions of Afghanistan and Iraq, and to conduct rapid turnaround testing. Fourteen days after start of construction, sufficient roads and features were ready for testing to begin. The site currently encompasses more than 14 miles of roads and more than 240 buildings representing a wide range of urban and rural environmental features. It has supported the evaluation of more than 150 technologies that address the IED threat.

Adding rocket-propelled grenade (RPG) protection to the Stryker vehicles also required rapid response from the test and evaluation community. The slat armor concept was proposed, developed and tested for the Stryker over a single weekend by a team of ARL, DTC and ATC experts. ARL and ATC then worked for seven straight days and produced the first prototype. The process was to develop an idea, characterize the slat armor performance, brief Pentagon decision makers, obtain a go-decision, and proceed to test, develop and deploy. The first 25 kits were produced at ATC, and the PM subsequently sent the designs to the Lima tank plant to mass produce the variants for the different versions of the Stryker.

Rapid acquisition has been conducted in another way that differs from traditional testing. Initially for testing of armor proposals, instead of having a procurement action for every purchase and separate funding lines and contracts for every contractor, we created a standing budget to test proposals. When an idea came in the door from a vendor, we had immediate resources allowing the ideas to be documented and tested without establishing individual test programs and budgets for each test, ensuring very quick response. Initially that method allowed us to provide the quickest response.

In March 2006, another trip was taken to Iraq to look at the current threat and update the leadership on the capabilities and limitations of the existing kits. While in theater, a new armor vulnerability emerged, so an ATC armor expert was sent to theater. Over the period of one week, an interim fragmentation kit was developed, and funding was directed to field the kits—almost 6,000 of them are now installed. Today, more than 40,000 up armored tactical wheeled vehicles are in theater, compared to 300 in October 2003, and the threat is still evolving. ATEC remains ready to support the global war on terrorism in Iraq and Afghanistan or wherever needed.

At ATC, the desire is to make sure that the reality of the war is as close to us as it is to the soldiers in theater—to maintain urgency here for providing solutions there. Interim kits were deployed in March 2006, and report of the first hit on an interim kit was obtained in May—everyone walked away. That is the ultimate success of rapid acquisition. ❑

***COL John P. Rooney, USA**, assumed command of the U.S. Army Aberdeen Test Center, Aberdeen Proving Ground (APG), Maryland, in June 2005. Prior to this assignment, he was chief of staff, U.S. Army Developmental Test Command, APG, Maryland. He was commissioned as a second lieutenant in the Field Artillery upon graduation from the United States Military Academy in 1978. After attending the Field Artillery Officer Basic Course, he was assigned to Battery A, 3rd Battalion, 18th Field Artillery at Fort Sill, Oklahoma, where he served as battery fire direction officer and battery executive officer. He then assumed command of Service Battery, 3rd Battalion, 18th Field Artillery. He then attended the Field Artillery Officer Advanced Course. In 1982, he was assigned to 1st Battalion, 37th Field Artillery at Fort Richardson, Alaska, where he served as the battalion adjutant before assuming command of Battery B, 1st Battalion, 37th Field Artillery. COL Rooney was then assigned as assistant professor of military science at the University of Miami in Coral Gables, Florida, and attended the U.S. Army Command and General Staff College. At Fort Lewis, Washington, he served as the brigade fire support officer for the 199th Infantry Brigade (Motorized) and the 2nd Armored Cavalry Regiment; and as the battalion operations officer for 1st Battalion, 11th Field Artillery. He then reported to the Joint Staff, Washington, D.C., serving as assistant deputy director for operations, National Military Command Center, and subsequently as operations officer, U.S. Central Command Division, Joint Operations Division, J3. On assignment to Hawaii, he joined the 25th Infantry Division (Light), Schofield Barracks, as commander, 3rd Battalion, 7th Field Artillery. He then attended the U.S. Army War College, at Carlisle Barracks, Pennsylvania, and was subsequently assigned as director of the Fire Support Evaluation Directorate, U.S. Army Evaluation Center. He was then deputy chief of staff for operations of U.S. Army Test and Evaluation Command Headquarters, Alexandria, Virginia. COL Rooney's awards and decorations include the Legion of Merit Award, Defense Meritorious Service Medal, Meritorious Service Medal (with five Oak Leaf Clusters), Army Commendation Medal (one Oak Leaf Cluster), Global War on Terrorism Service Medal, Overseas Service Ribbon, Joint Meritorious Unit Award and the Parachutist Badge.*

Infrared Countermeasures Test and Evaluation

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A shadowy figure hides in the brush near a military or civilian airport. A man-portable surface-to-air missile rests on his shoulder as he watches the aircraft take off. When the big jet reaches 3,000 feet, the missile "locks" onto the heat from the aircraft engines, and the gunner pulls the trigger. The 24-pound missile quickly accelerates to Mach 2, reaching its target in less than 5 seconds. The 4-pound warhead, although relatively small, is enough to bring the aircraft down. Over half a million of these relatively inexpensive weapons are available worldwide and are easily obtainable by terrorists, insurgents and other enemy combatants.

To counter this threat, the U.S. military, as well as the Department of Homeland Security, are developing Infrared Countermeasure (IRCM) systems. These IRCM systems are designed to defeat both surface-to-air and air-to-air missiles by detecting the ultraviolet (UV) or infrared (IR) radiation from the missile plume (the exhaust trail from the missile) and then initiating countermeasures *(Figure 1)*. Countermeasures include both flares, which are designed to give the missile a decoy target; and laser jammers, which cause missile guidance systems to abruptly steer away from the target aircraft.

Examples of IRCM systems currently in development include the Army's Advanced Threat IRCM/Common Missile Warning System (ATIRCM/CMWS); the Air Force's Large Aircraft IRCM (LAIRCM) NexGen; and the Navy's Strike Directional IRCM (DIRCM).

The continuing evolution of better missiles and better IRCM systems leads to the need for an ever-improving IRCM test infrastructure. Newer missiles are faster, more maneuverable and better able to remain locked on to the target aircraft while rejecting countermeasures. To counter this problem, newer IRCM systems search for missiles in all directions with the IR equivalent of multiple high-definition television cameras. These IRCM systems have sufficient processing power to simultaneously track and assess dozens of suspicious radiation sources, correctly identifying real threat missiles while avoiding false alarms. Multi-color, solid-state lasers, aimed with pin-point accuracy even during aircraft maneuvers, disrupt the guidance systems of even the most advanced missiles.

Primary IRCM test and evaluation (T&E) issues include measuring the ability to defeat missiles, rate of false alarms, and suitability (for example, reliability, availability, maintainability and so forth). Performance against

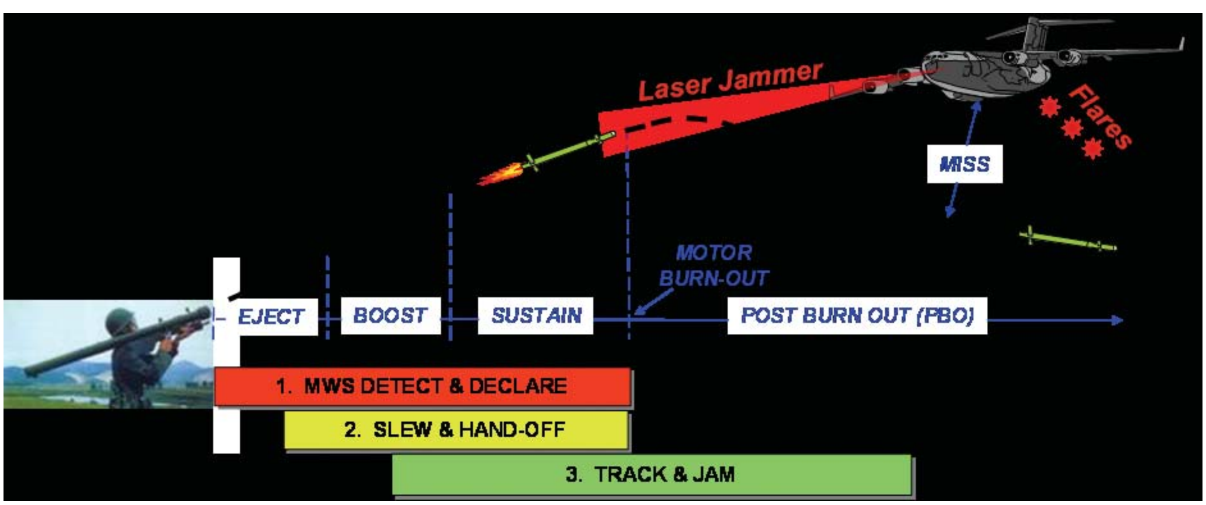

Figure 1. Infrared Countermeasure (IRCM) systems are being developed to defeat both surface-to-air and air-to-air missiles by using technology to detect UV or IR radiation from the missiles' plumes.

missiles must necessarily involve thousands of combinations of missile types, launch ranges, launch azimuths, aircraft speeds/altitudes and weather conditions. To access false alarm performance, IRCM systems must be tested in a variety of geographic locations and background clutter levels, including battlefield radiation sources such as fires and munitions.

It is essential that IRCM systems be flight tested on the specific aircraft types for which they will eventually be deployed. The single biggest limitation of IRCM testing is the inability to fire missiles at manned aircraft; even with the warhead removed, a 20-pound missile traveling at Mach 2 is lethal. IRCM systems themselves, when not installed on their intended aircraft platforms, can be tested at live missile firing ranges such as the Aerial Cable Range at White Sands Missile Range, New Mexico. However, such testing is limited to near-static flight velocities and unrealistic simulations of host aircraft platforms. IRCM systems can also be tested on droned surrogate aircraft (such as QF-4s), but at great expense, and only with partial simulation of the actual host platforms.

To flight test IRCM systems on their host aircraft platforms, missile simulators are being developed. An example is the Joint Mobile IRCM Test System (JMITS) currently being developed for the Center for Countermeasures under the Central Test and Evaluation Investment Program (CTEIP). JMITS, shown in *Figure 2,* includes IR and UV beams that illuminate the IRCM system on the aircraft, replicating the signature of the approaching missile and activating the IRCM system. Actual threat missile seekers and jam beam radiometers on JMITS characterize the resulting countermeasure. JMITS has been specially designed for deployment in built-up urban areas corresponding to worst-case background clutter and density of potential false alarm sources.

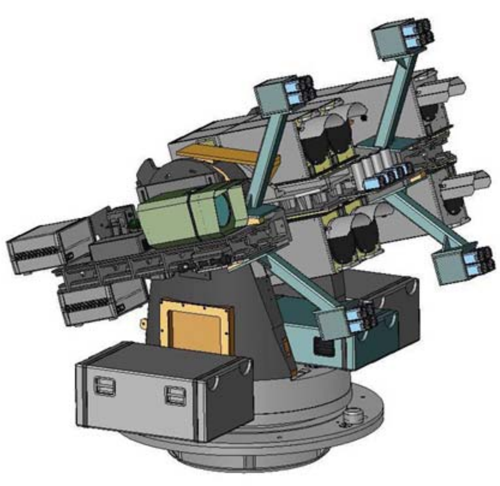

Figure 2. The Joint Mobile IRCM Test System (JMITS).

As IRCM systems become more sophisticated, they will be able to reject fixed ground-based missile simulators such as JMITS. To delay this obsolescence as long as possible, the Test and Evaluation/Science and Technology program is investing in advanced UV light emitting diode (LED) technology. These UV LEDs offer an advanced UV source to systems such as JMITS to provide a more robust UV signature in a compact array. Because the intensity of the UV output can be varied, the IRCM system under test should detect a "moving" target.

Even with these advancements in ground-based simulators, airborne missile simulators such as the Towed Airborne Plume Simulator (TAPS) are required. The TAPS is currently being developed under CTEIP. Eventually, IRCM systems also will reject airborne simulators, at which time it will be necessary to develop surrogate missiles that can be fired at manned aircraft without endangering the aircrew. Such missiles exceed current technology limits.

To test the thousands of missile engagements needed to assess system performance, a broad array of advanced test and simulation tools is needed. Advanced Installed System Test Facilities (ISTFs) are being enhanced for ground testing of IRCM systems when installed on their host aircraft platforms. These very large facilities use UV and IR scene projectors to illuminate the IRCM systems with missile-like radiation. Likewise, individual IRCM components such as missile warning systems and laser jammers can be tested in hardware-in-the-loop (HITL) facilities, which are hybrids of actual IRCM hardware and simulations. The UV and IR scene projectors required to produce realistic scenes in ISTFs and HITLs push the technology limits of both image resolution and frame rate. To feed these projectors, validated missile signature and background scene prediction models must be developed that can run in real time.

In summary, IR threats and IRCM technology are advancing at a rapid pace. The challenge will be to identify and develop adequate T&E infrastructure in time to support the required testing. ❏

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