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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

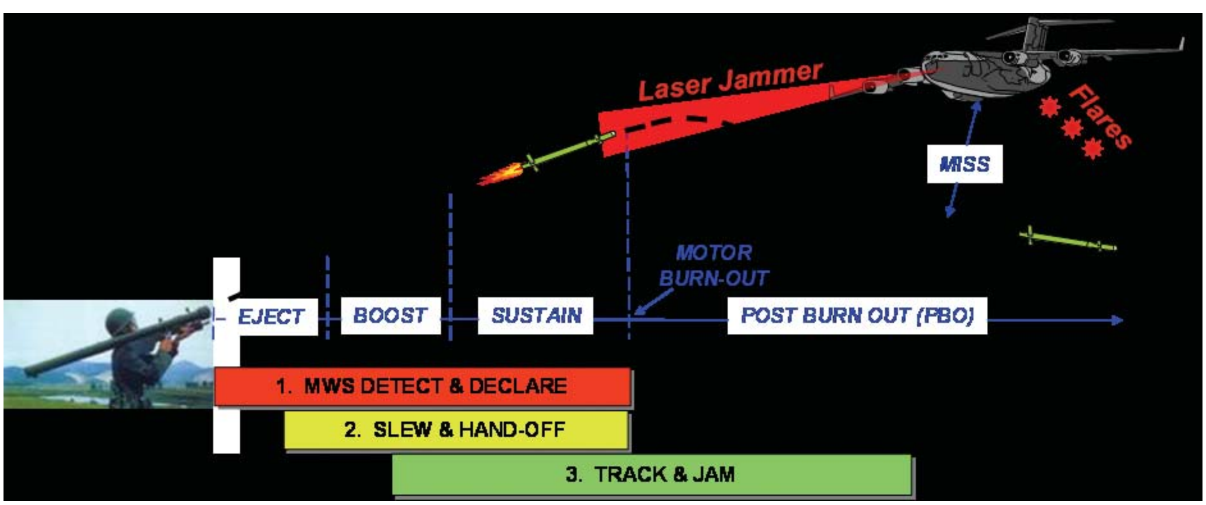

Figure 1. Infrared Countermeasure (IRCM) systems are being developed to defeat both surface-to-air and air-to-air missiles by using technology to detect UV or IR radiation from the missiles' plumes.

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.

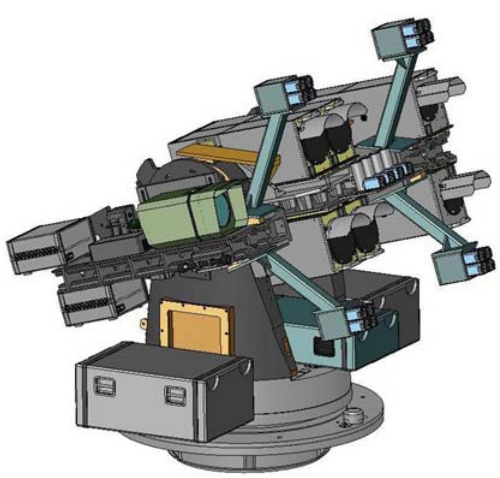

Figure 2. The Joint Mobile IRCM Test System (JMITS).

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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