Keeping Up Appearances: New Trends in Active Decoys

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In Washington, DC, things are rarely what they seem. Off-the-cuff remarks to the media are, in fact, carefully worded and planned well in advance. Set-in-stone policies are often portrayed as trial balloons. Successful defense programs are cut by the Pentagon so that Congress can play the hero and restore the funding, giving the Pentagon what it wanted in the first place. In Washington, deception is an art.

On the battlefield, radars perform automatic target recognition, commanders rely on semi-automated imagery analysis, overtasked pilots depend on computer-managed electronic countermeasures. Thus, the opportunity for fooling machines rather than operators is growing. For electronic warfare (EW), active decoys are proving to be an even more effective means for deceiving threat radars. With the first generation of these systems entering production in the US, a new class of fiber-optic decoys is entering development, prompting the rest of the world to take notice.

LISTEN TO THE MUSIC

The ultimate goal of an active decoy is to dupe an enemy radar or missile into thinking that *it* is the legitimate target, thus protecting the platform that deployed it. In the past, self-protection jammers and passive expendables such as chaff took care of air defenses (acquisition, tracking and fire-control radars and the missile) quite well. With a bit of jinking to maximize his beam coverage, a pilot could jam a threat radar before it could develop a firing solution, or, if that was not successful and a missile *was* launched, he could certainly jam the missile's semi-active seeker. He could also deploy chaff and coordinate that with his jamming. When compared with the latest generation of threats, however, those were the "good ol' days." Today's radar-guided missiles have the ability to counter jamming by switching into a receive-only, home-on-jam mode that allows them to continue their attack in the presence of jamming, in effect turning electronic countermeasures into electronic guidance. In response to this advance in threat seekers, the EW community searched for a new element to add to the countermeasures suite and developed the active RF decoy. The job of the decoy is simple: if jamming cannot prevent missile launch then the decoy will lure the missile away by advertising itself as the target.

"We're talking about something where an amplifier is used to create a large signature target," said Frank Klemm, branch head for off-board countermeasures at the Naval Research Laboratory. With active decoys, operators are able to specifically control what type of signature is transmitted. The concept is similar to how a radio works. If you like pop music, for example, the music can be inputted into a transmitter at a radio station and then broadcast, Klemm explained. "If you want to listen to reggae we can send you reggae," he said. The same can be done with decoys by generating signatures that look ship- or aircraft-like and are specific to the threat that is guiding it. The higher the power level, the better the signature and the more attractive the decoy appears to the threat. According to Klemm, active decoys are preferred in this case when compared to passive decoys, because passive decoys are limited in terms of the signature or radar cross section (RCS) they can produce.

THE TOOLBOX

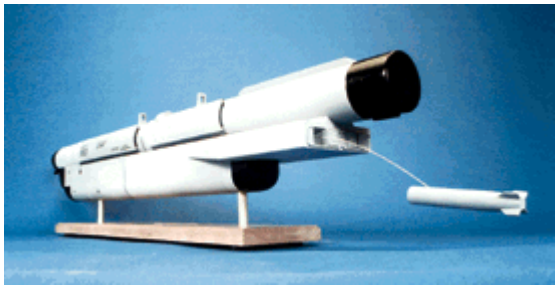
Despite all the fanfare, active decoys are not a replacement for such passive expendables as chaff, and the Air Force and Navy are not about to rip ALE-47 dispensers out of their aircraft or Mk 36 launchers off their ships. According to CDR Robert Boyd, EW program manager for the Office of Naval Research, the Navy believes that advanced RF missile seekers will soon rely on discriminants to distinguish between chaff and the target. But chaff still serves a useful purpose against a wide range of RF threats. It is not an "either/or," Boyd said of passive and active decoys. "One is not better than the other," he stressed. In fact, active decoys can be more effective when deployed just *after* a few rounds of chaff have been dispensed. In this type of scenario, chaff can temporarily confuse the missile's RF seeker, and when the missile re-acquires the target, it is in fact tracking the decoy.

Active decoys do, however, have definite advantages over passive countermeasures, Robert Evans, an EW program officer for ONR, said. "Obviously the best decoy you could have for a ship would be another ship," he said. With an active decoy, a better representation is transmitted for the enemy to see than with a passive device, he explained. "In some ways, active decoys can even be better than another ship because the decoy can look *even larger*." Typically, a missile will detect a target presenting the biggest RCS, therefore it is ideal to make an active decoy that appears to have a tremendously large RCS (even larger than a ship). "You can really fool a dumb enemy," Evans said.

Decoys prompted advances in other portions of the generic EW suite as well. Good situational awareness from radar warning receivers is vital to deploying a decoy effectively. "You need situational awareness to know where the missile is coming from," explained Evans. Then the operator can maneuver the plane or

ship into a position where it won't be the second target (i.e., he won't line up the decoy between the missile and the platform) in a case where a missile could fly past a decoy and acquire the aircraft or ship that deployed it. "Some [decoys], like the untethered [ones], could be programmed to maneuver in such a position that you don't have that issue," he said. Situational awareness gives a pilot the knowledge to know when to deploy and with what countermeasure, Klemm explained. Only then can a warfighter reach into his toolbox and pull out the right countermeasure.

A MIXED BAG OF TRICKS



The ALQ-184(V)9 jammer/decoy combination offers a synergistic countermeasures solution. (Raytheon E-Systems photo)

A decoy is used to make an enemy believe he is looking at a target, a more viably attackable target than the aircraft or ship that deployed it. But platform self-protection cannot be performed by decoys alone. "You want to hide what you want to protect and *then* give the enemy something to hit," Klemm explained. For this reason, the Air Force is tapping the synergy generated between decoys and jammers in its ALQ-184(V)9 configuration, which marries the Raytheon E-Systems (Goleta, CA) ALE-50 dispenser with the company's ALQ-184 jammer. The concept behind this pairing, explained a Raytheon source, is to use the ALQ-184 to jam acquisition radars in the lower bands. However, if the jammer cannot defeat an acquisition radar and prevent it from handing off target information to a tracking radar and ultimately to a fire-control radar which can direct a missile, then a decoy can be deployed to seduce the missile away from the aircraft. The Air Force is currently performing tests to determine the possibilities of using jammers and decoys together. One question that must be answered is when to stop jamming and deploy the decoy, said the source. Another possibility is to deploy the decoy and then continue to use the -184 to perform "blinking jamming," (where the jammer is turned on and off) against the tracking and fire-control radars. This maximizes the effectiveness of the decoy since the jammer can break lock on the radar temporarily and lead the radar or missile to acquire the decoy instead of the aircraft.

The first generation of active decoys, represented by the ALE-50, consists of "repeater" decoys. The ALE-50 system comprises two main elements. A launcher/controller subsystem houses the decoy before it is deployed and provides power to the decoy after it is launched. The decoy body contains a receiver and transmitter and

is a self-contained system except for the power supply. According to the Raytheon source, the ALE-50 does one thing and one thing only. When it receives a signal from a threat radar, it amplifies it and retransmits it, making it look like an aircraft that has reflected the original radar signal. Of course the radar receives two signals — one bounced off the aircraft and a stronger identical signal coming from the decoy. Unable to distinguish between the two signals, the radar or missile seeker assumes that the *stronger* of the two is the target. In addition to the repeated signal, the ALE-50 also adds a small modulation to mimic the aircraft's engine signature to fool radars that look for such discriminants. Because of its simplicity, the ALE-50 cannot be saturated by too many radar signals. It repeats everything in the environment, said the source.

As always, the threat is evolving and some next-generation radars will likely use a man-in-the-loop process. These radars are associated with command-guided threats and, unlike their predecessors, can discriminate between the two signals (the aircraft reflection and the repeater decoy), easily determining which target is in front and deducing that one to be the plane or ship that is towing the decoy. But sophisticated threats call for a sophisticated response. To counter this type of threat, the US has led the way with the development of the Integrated Defensive Electronic Countermeasures (IDECM) system. Unlike repeater decoys, which contain both receiver and transmitter, the IDECM will use the aircraft's threat warning receiver to identify the threat and deliver its information to an on-board techniques generator (functioning much like a jammer) to send a modulated jamming signal down a fiber-optic towline to the decoy. With the countermeasures technique being generated on board the aircraft, the decoy will contain only a power source and an antenna.

Ironically, the IDECM system is much more advanced than a simple repeater decoy, but the fiber-optic decoy itself is in fact much dumber, housing only the transmit equipment. The IDECM techniques generator is manufactured by ITT Avionics (Clifton, NJ) and is based on the company's ALQ-165 jammer. The system's fiber-optic towed decoy, nomenclatured the ALE-55, is manufactured by Sanders, a Lockheed Martin Company (Nashua, NH), and will be deployed from a member of the ALE-50 family of launchers. In addition to the decoy signal, the techniques generator can create a cover pulse, delivered by the decoy, that hides the aircraft from

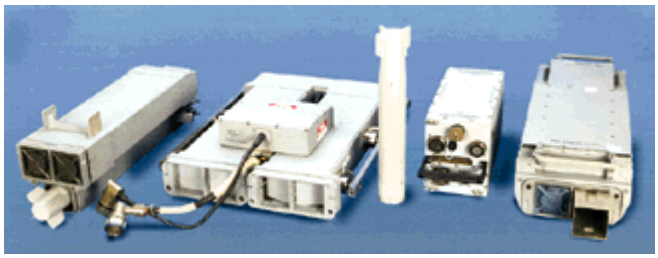
The IDECM's ALE-55 is a pioneer among fiber-optic towed decoys and is slated for use on multiple aircraft. (Sanders photo)

the radar. "If the man is in the loop and can command guide his missile and can see two targets, and he knows we have things like decoys, he's going to know the target in front is the one he wants to hit," said an industry source. "For those instances where you have a man in the loop, you want the fiber-optic decoy, because it hides most of your plane and makes sure the missile, if it is launched, goes for the decoy."

The simplicity of the ALE-55 should not be overlooked. Because the decoy is not doing anything "smart," it never has to be reprogrammed with threat updates. Updates are performed on the techniques generator. According to Jay Herther, director of RF countermeasures for Sanders, "As your threats change, it is much easier to adapt the system to the changing threat, because all the decoy is doing is transmitting a technique, not doing the processing."

The IDECM system is being developed for the US Navy's F/A-18E/Fs and the Air Force's B-1Bs and F-15C/Es. Additionally, the U-2 and some UAVs may be fitted with portions of the system. Sanders and ITT Avionics were selected in November 1995 to develop the IDECM RF countermeasures (RFCM) subsystem (see *JED*, December 1995). An initial $49.3 million contract provides for the RFCM system development that includes the ALE-55. But the decoy will not be left to perform its job alone. The Navy is expected to eventually develop a low-band jammer to complement the ALE-55, working under the same concept as the ALQ-184(V)9.

UPPING THE POWER



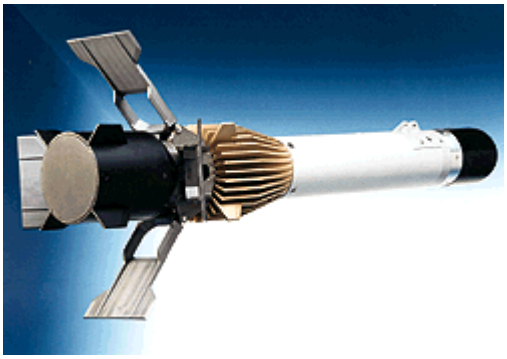
Raytheon has developed a family of ALE-50 launchers that will be used with the IDECM system on aircraft ranging from the B-1B to F-16C/Ds and F-18E/Fs. (Raytheon E-Systems photo)

As the IDECM system makes its way through development, Navy and Air Force planners are looking to use it primarily on smaller tactical aircraft such as the F/A-18 and F-15. An exception to this pattern is the B-1B. Large as it appears, however, the size of the B-1B's RCS is very similar to an F-15, according to Air Force sources. Thus, in terms of the output power needed to cover the B-1B, the existing ALE-55 fits the bill. The next step in fiber-optic decoys, however, is to provide coverage for aircraft that present a large RCS, such as P-3 Orion maritime patrol aircraft and C-130 air frames. In an effort to meet the decoy needs of the large-aircraft market, Raytheon has led the way by winning a contract last year to supply a fiber-optic variant

of its ALE-50 for the UK's Replacement Maritime Patrol Aircraft (RMPA) 2000 program (see "Nimrod DAS Falls Into Place", *JED*, July 1997). The UK's RMPA program seeks to upgrade its fleet of MR.2 Nimrod maritime patrol aircraft with a new mission system and a new self-protection suite. Lockheed Martin Fairchild Systems (Yonkers, NY) is acting as the prime contractor for assembling and integrating a defensive aids suite, which includes Lockheed Martin Fairchild's ALR-56M radar warning receiver, a Racal Radar Defence Systems Ltd. (Chessington, Surrey, UK) techniques generator and the fiber-optic variant of the ALE-50 launched from an ALE-50 launcher. For its part, Raytheon has struck an agreement with Northrop Grumman Electronic Systems and Integration Div. (Rolling Meadows, IL) to use Northrop Grumman's Microwave Power Module (MPM) to supply the fiber-optic decoy's output power. Just as with a jammer, higher power levels are needed to provide coverage for larger platforms. The MPM is capable of providing that power in a small package — small enough to fit in the ALE-50 dispenser. According to a Raytheon source, the company completed its critical design review of the decoy in December 1997 and is in the process of building five pre-production models for delivery beginning in October. Flight tests will take place in mid-1999 and continue through 2001, when the UK will make a production decision.

The US Air Force Special Operations Command (AFSOC) is keeping a close eye on the progress of the Nimrod decoy program and may seek a cooperative development effort as it did with the AAQ-24 Nemesis directed infrared countermeasures system. According to an industry source, the AFSOC is looking to use the ALE-50 fiber-optic variant on its C-130-based platforms such as the AC-130 gunships. If pursued, the AC-130's ALQ-172(V)3 would likely serve double duty as both the aircraft's jammer and as the techniques generator for the decoy. In addition, the Navy is reportedly considering the decoy for its P-3s, which are expected to fly in dense threat environments during littoral operations.

With the ALE-50 repeater under its belt and the ALE-50 fiber-optic variant under funded development, Raytheon hopes to complete the picture with an infrared variant of the towed decoy. The company's strategy is to develop a family of decoys that can be deployed from the same ALE-50 launcher. Thus an aircraft, depending on its mission, can carry a mix of IR and RF towed decoys and deploy them simultaneously, since the IR decoys are towed at a significantly shorter distance from the platform than the RF payloads (more on this IR decoy in the April issue).



Daimler-Benz Aerospace has entered the fiber-optic decoy arena with a device designed to protect large aircraft as well as tactical fighters. (Daimler-Benz photo)

Fiber optics, it seems, is the technology of choice. Klemm points to extremely high bandwidth as the reason we are seeing the fiber optics trend. "If you look at electronics components they tend to be very bandwidth limited," he said. Not the case with fiber optics. Active decoys can be improved for the Navy through the use of fiber optics by reducing the size of the components, thus reducing the cost, Klemm explained. Why is smaller better? Decoys are like bullets, he said. In some cases you fire them and never get them back. "If you get the cost and size down, you can carry more of them so you have more bullets to fight the war," he explained. Evans added that fiber optics allows the size of the decoy to be reduced, "which does all those good things for you in terms of increasing your bandwidth." On towed decoys, for example, the fiber optics are used as the link between the platform that is being attacked and the decoy (physically located far away from the platform). "That gives you a very high bandwidth [link] between the platform you are protecting and the decoy that may get shot down by the enemy weapon," Evans explained.

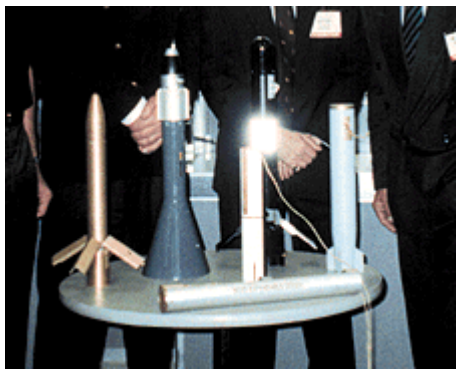
The popularity of fiber optics will undoubtedly spawn newer active decoys as EW houses look to meet the market demand for affordable protection against modern threats. For example, using its own funds, Germany's Daimler-Benz Aerospace flight tested a new fiber-optic decoy system in late-1997 on a Tornado fighter and an F-4 Phantom. In its test configuration, the system is fitted in a pod and mounted on the outer wing station. Two canisters, fitted side by side within the aft section of the pod, launch the decoys.

According to the company, the fiber-optic decoy is being developed to protect fighters as well as large aircraft. One interesting feature (also characteristic of GEC-Marconi's Ariel repeater decoy) is the ability to recover the decoy after it has been deployed. When used on fighter aircraft the decoy is equipped with a parachute, thus making it potentially recoverable. When used on transports, it can be retracted after use and placed back into its dispenser. The company expects to begin decoy production later this year.

Daimler-Benz is not the only EW manufacturer pursuing the cutting edge of decoy technology. GEC-Marconi (Stanmore, Middlesex, UK) also has garnered a piece of the fiber-optics

action with the development of a new decoy for the Eurofighter, a variant of its Ariel decoy. France's Dassault Electroniqe (Saint Cloud, France) has teamed with GEC-Marconi to create a decoy for the Mirage 2000. At the same time, CelsiusTech in Sweden plans to deliver their wide-band towed repeater decoy to the Swedish Air Force in early 1999.

AIR-LAUNCHED SEAD



At the 1997 AOC International Convention, all five existing active towed decoys were presented in a rare photo opportunity. From left to right are the Sanders ALE-55, GEC-Marconi's Ariel, a yet-to-be-named device from Daimler-Benz and Raytheon's ALE-50. CelsiusTech's decoy is positioned in front. (*JED* photo)

Towed active decoys do not represent all of the active airborne decoy development underway. Air Launched decoys such as the BQM-74 drone (fitted with an EW payload) and the Tactical Air-Launched Decoy were quite effective during the Gulf War. Not only were these free-flight decoys adept at deceiving and saturating Iraqi air defenses, but they caused the air defense radars to track them, allowing RC-135 Rivet Joint and other SIGINT aircraft to pinpoint the positions of Iraqi radars for lethal suppression of enemy air defense (SEAD) missions.

Based on the lessons of the Gulf War, the US set about developing a follow-on decoy program that calls for a strict $30,000 per unit cost. But low cost does not translate into low performance. Since the Gulf War, significant strides have been made in air-launched decoys and have manifested themselves in the Miniature Air Launched Decoy (MALD). The MALD is sized at a fraction (25-in. wingspan and 6-in. diameter) of earlier air-launched decoys and can replicate the RF signature of such tactical fighters as the F-15 and F-16. The MALD's SEAD concept of operation envisions it supporting reactive suppression, diversion, saturation and preemptive destruction roles.

In 1996, a Teledyne Ryan Aeronautical Systems (San Diego, CA)-led team was selected by the Defense Advanced Research Projects Agency to complete a 30-month advanced concept technology demonstration to develop and deliver 42 MALD vehicles. Last year Northrop Grumman Electronic Sensors and Integration Div. was selected to build the secretive MALD radar signature payload.

Ten MALDs are being assembled for flight tests this summer at Edwards AFB, CA. The flight tests will use an F-16 to launch the decoys, but sources suggest the decoy's small size will permit a

variety of fighter aircraft from an F-15 to the F-22 and Joint Strike Fighter to carry it. If the flight tests are successful, improvements can be worked in to the remaining 32.

The possibilities for MALD seem endless. Numerous payloads, in addition to the radar signature payload, have been suggested, and the Air Force is reportedly studying a ground-launched version of the system. If the 30-month demonstration is successful, up to 3,000 MALDs could be ordered by the Air Force and Navy.

A COUNTERMEASURE FOR ALL SEASONS?

Fiber-optic decoys hold the promise of longevity, according to one industry source, who speculated that it would take 25 years of threat system evolution to consistently defeat fiber-optic decoys. In the meantime, EW houses will be improving the capabilities of their decoys, not only for airborne applications, but also at sea and on land in both the RF and IR spectrums. After all, keeping up appearances is the name of the game.

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