REALISTIC TARGETS FOR ARMY TEST AND EVALUATION

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ABSTRACT

The use of some type of target as an aiming point has been an essential part of weapon system testing since the beginning of history. Today, with the complex arsenal of high technology weapons used by the Army, the need for targets is critical. There is currently a shortfall in the performance that can be obtained from existing targets. The development of new and improved targets and target control systems will be a high priority task in the next decade.

INTRODUCTION

This paper will briefly discuss the present situation in aerial and ground targets within the Army, and highlight the directions targets will be taking in the next several years.

The simplest definition of a target is simply an aiming point for a weapon. A bull’s eye is just such a target. Obviously a bulls eye is not a particularly good representation of the enemy upon which the weapon will be employed in a battle. Only the most liberal interpretation of the word “threat simulator” would include such a target. At the other extreme, some targets are very realistic -- an exact replica of the threat system which the weapon is to attack, or even the actual threat itself. Targets used by the Army include both extremes and lots that fall in-between.

In my mind, the defining criteria between a target and a threat simulator, is simply that a target is intended for destructive testing--you actually shoot at a target--generally you do not shoot at a threat simulator.

All three military services use targets. The Air Force has a large inventory of aerial targets, used primary for tests of air-to-air weapons. The major, full-scale aerial target programs are managed by the Air Force and utilize surplus fighter aircraft, which are converted to drone targets. The Navy has an active target program which gained emphasis in the area of low altitude, high-speed, anti-ship target missiles after the Faulkland conflict.

All three services also use ground targets. The Air Force and Navy apply ground targets in tests of air-to-ground weapons; the Army uses them both to test air-to-ground and ground-to-ground, anti-vehicle systems.

In an effort to improve overall target management within the Army, TECOM, last year established an Office for the Management of Targets and Threat Simulators. This office, known as MATTS, will be responsible for the long-range planning and technology forecasting for targets used by the T&E community within the Army. MATTS will act as a central focal point for all actions concerning Army targets, both ground and airborne.

The MATTS Office must maintain a close relationship with the intelligence community to foster communications. MATTS will work closely with the existing intelligence structure to provide threat assessment and validation of Army targets.

I will now briefly discuss the current situation in ground and aerial targets within the Army. A ground target which might have been called a state-of-the-art ground target only a very few years ago is a cloth aiming point mounted on a rail car which is pulled by a locomotive around a circular track. At first glance, this might seem to be an obsolete target concept. It does not look like a threat vehicle, movements are totally predictable and there is a notable lack of realism in general.

Viewing it from another angle, there are numerous advantages to a target of this type, particularly in the development testing arena. In the first place, it turns out to be a very inexpensive target. We can shoot the target screen full of holes and when we finally have to replace it, we are only out a few dollars. Contrast this with the cost of replacing some of the more realistic targets.

Another advantage of a target of this type, is precisely that it’s movement is highly predictable and repeatable. Realistic targets must have random motion capability and be able to take evasive maneuvers; however, in development testing we often need to replicate a particular target presentation over and over again. A target such as this is ideal. It is precisely controllable, low in cost, and easily maintained.

Another low-cost technique is to use simulated targets, such as the Live Fire Evasive Target Simulator shown where a laser provides a spot two kilometers down range as an aiming point for weapons to fire upon. Here again, the primary advantage of this system is its low cost and precise repeatability. Thru computer control, the target spot can be made to perform almost any type of motion and that motion can be precisely repeated over and over again. The cost per shot of such a target is extremely low. Although the laser spot does not look at all like an actual threat vehicle, it provides a very precise and well-defined aiming point for evaluations of the fire control system. There's no doubt that such simulated target systems have a very important role to play in efficient evaluation of fire control systems.

Many ground target systems today utilize surplus vehicles, such as the M-47 tank. The M-47 is a very attractive target vehicle. It has good all-terrain capability, it provides a signature that is characteristic of a tracked vehicle, right down to the thermal energy it leaves on the ground it moves across. It is also highly survivable against many types of weapons. However, this is not the ultimate target, there are also disadvantages. It does not have the performance equivalent to modern threat vehicles, and its signature in the IR, visual, or millimeter wave spectrum do not precisely replicate the current threat. In addition, it tends to be rather expensive to operate, maintain and control. Its biggest disadvantage is simply that surplus vehicles, such as the M47 are increasingly difficult to obtain in necessary quantities to use for destructive testing. Even if we were perfectly satisfied with targets of this type, we would have to move toward other types of vehicles simply due to the fact that requirement we forecast in the next few years would greatly exceed the supply.

These wheeled vehicle target systems which can utilize a variety of fiberglass target shells, such as the tank shown in figure 1, are now under development. This shell can be mounted relatively high on the chassis in many cases to reduce the vulnerability of the vehicle itself to anti-armor fire.

At will, we can make it look like any number of vehicles. Realistic IR signature is provided by heated panels incorporated into the fiberglass shell. In the future, millmeter wave radar reflectivity will be incorporated into these target shells.

These vehicles can utilize a number of different control systems, including the simple line-of-sight manual control, wire following systems, guided systems, either those that repeat a pre-driven course or those which can maintain complete computerized control from a remote location. The capability of these latter systems include multiple vehicles in formations.

Moving on to aerial targets, the Army utilizes a wide variety of targets. Individual types, include the full-scale targets consisting of droned fighter aircraft like the QF-86 based on the F-86 of Korean War fame. Other targets include model aircraft, sub-scale drones, and ballistic targets. Recently a great deal of interest within the Army has centered around rotary wing targets, such as the OH-50.

The QF-86, along with targets using the F-102 based drone shown in figure 2, are being replaced as they are destroyed by targets using the F-100 airframe. This target, the QF-100, will do mach 1.2 at 35,000 feet and can do 7 g turns.

The next generation fighter aircraft considered for droning by the Air Force is the F-106, and the program to produce a drone based on this aircraft is now underway. We expect to utilize these new full scale drones in the Amy as they become available.

The first sub-scale target, developed in 1938, was the progeny of a long line of targets to which improvements were made as they became practical or necessary. The interesting thing is that much upgraded versions of this target are still in use today, nearly 50 years later. This target is the creeper or MQM-33. Its speed of 200 knots and max altitude of 23,00 feet limit it's use to certain training missions.

A work horse of sub-scale drones is the MQM-34 or FIREBEE. This is a very capable drone with speed in excess of 500 knots and it has operated as high as 61,000 feet altitude. The flight duration of the FIREBEE is 90 minutes at optimum altitude. The Army is planning to phase out the FIREBEE in favor of the improved MQM-107, which has similar capability at lower cost.

The sub-scale MQM-107 is also known as the Streaker or Variable Speed Training Target. As the latter name implies, this drone was developed by the Army to train anti-aircraft gunners. However, the MQM-107 is now also used extensively for test and evaluation. In general it has a capability somewhat less than the FIREBEE, but is lower in cost and more efficient to operate.

It can carry a wide variety of payloads, as illustrated in figure 3, allowing it to serve as a realistic target for a number of weapon systems. An upgrade program is now underway for the MQM-107, which will increase the capability considerably.

The Army's inventory of rotary wing targets consist mainly of the QH-50 in figure 4, and droned versions of the UH-1, or Huhey. It is well documented that these helicopter drones are not realistic representations of the known threat. Perhaps the biggest shortfall in Army targets today is lack of a realistic helicopter drone capable of performing in the current threat envelope. The Army needs helicopter drones, both for low altitude air defense systems and increasingly for targets to challenge air-to-air weapons.

Aerial targets are augmented by a variety of equipment which can enhance or alter the signature and make sub-scale drones appear like much larger aircraft. In addition, countermeasures, particularly ECM, can be installed in many of these systems.

There are two primary target control systems in use for aerial targets today. The Target Tracking and Control System flies a single drone at a maximum range of 115 nautical miles. It is essentially a highly portable, manual control system. It is the primary system used to fly training targets. This control system can also be integrated with an instrumentation radar, such as the MPS-36 or our new Multiple Object Tracking Radar. For test ranges with instrumentation radars, this is the normal mode for drone control.

Our premiere control system is the the Drone Formation Control System, DFCS, which has a number of critical capabilities. In particular, it it can fly multiple drones in close formation. Wing tip to wing tip separations of 200 feet are possible at supersonic speeds. This system also accomplishes automated take-off and landing of droned aircraft. The DFCS can fly both full-scale and sub-scale drones in formation, including mixed formations. Currently, effort is underway to improve the capability of the DFCS, including the addition of an ability to fly helicopters at nap of the earth.

The ground target of the future will be a low-cost, highly maneuverable system capable of selective realism. That is, it simulates the signature of the threat vehicle, as needed by the weapon to be tested. IR seekers will require targets that have the thermal signature of the threat, while radar guided systems are less interested in the thermal signature, but require highly realistic millimeter wave radar reflectivity.

The trade off in survivability and cost of targets is interesting. There is a philosophy which says the ultimate target presentations are those that are low in unit cost and can be replaced when destroyed with new vehicles. The other philosophy prescribes highly survivable targets which can withstand several exercises and are reused over and over. Both philosophies have merit, the objective of both is to lower the cost of target presentations.

Target performance has several important aspects. Realistic maneuverability is particularly important in guided weapons, where evasive maneuvers must be programmed into the target if the weapon is to be fully stressed. In so called predicted fire systems, such as anti-armor gunnery, where the location of the projectile at a given point in time after the weapon is fired is known, the most critical target performance parameter is lateral acceleration.

Future trends in aerial targets include the need for a good, highly maneuverable helicopter target, which can replicate the threat. The recent SGT York test proved that the Army did not have a good rotary wing target to fully ring out that air defense system.

Aerial targets will increasingly be required to exhibit realistic characteristics and to include ecm and other countermeasures. This is normally accomplished thru augmentation packages to the basic vehicle. Again survivability and cost of targets will be a primary consideration.

An interesting development which is seriously being considered is designing and building a full-scale target from the ground up. It has usually been cost effective to use surplus aircraft as low cost airframes for target aircraft. With increasing cost and complexity of fighter aircraft, we are now nearing the break-even point for a dedicated low- to mid-performance target. By utilizing some surplus components, such as the engine, and designing a bare bones, non man-rated airframe an attractive alternative to droned fighter aircraft is possible.

Targets will continue to provide the means for “bottom line” performance evaluation of modern weapons. Regardless of advances in simulation, and modeling, decision makers will want to kill realistic full-scale ground vehicles and aircraft whenever possible, as a final demonstration of weapon system effectiveness. We will continue to need more advanced and sophisticated targets for the foreseeable future.