CATIES

AN INNOVATIVE SOLUTION TO A TRAINING CHALLENGE

James B. Hollis Jr., LTC, Ret.
LB&M Associates, Inc.
111 C Ave, Suite 200
Lawton, Oklahoma 73501

Joseph R. Miller
Motorola, Inc.
Government Electronics Group
2100 East Elliot Road
Tempe, Arizona 85282

ABSTRACT

Problem: US ground combat forces currently have no way of rapidly and accurately simulating and assessing the effects of artillery and other indirect and area-effects weapons during training exercises.
Solution: The Combined Arms Integrated Evaluation System - (CATIES) simulates and helps measure the effects of conventional and tactical nuclear indirect fire support, nuclear - biological - chemical (NBC) contamination, and mine warfare. CATIES was developed to meet the Army's longstanding need for an indirect fire training device which would complement and interface with the direct fire Multiple Integrated Laser Engagement Simulation System (MILES). It also has the potential to simulate the lethal and suppressive effects of Navy and Marine sea and air delivered munitions and Air Force munitions delivered during close air support and air interdiction missions.
Application: CATIES applies to all combined arms, force-on-force training from small unit exercises to major joint training exercises worldwide. With CATIES, the total Army and Marine Corps forces - combat, combat support and combat service support units, will be able to train to doctrine in a more realistic indirect, as well as direct fire training environment.
Technical Approach: CATIES uses modern spread-spectrum radio frequency technology, employing pseudo-ranging, time-division multiplexing and surface acoustic wave signal processing techniques. The system can simulate up to 50 different effects per second which allows the replication of a multitude of indirect battlefield effects. Variable "hit" and "near miss" area sizes and shapes, in conjunction with expected fractional damages and casualties from approved munitions effects manuals, and unique audio-visual effects, ensure realistic battlefield training. Direct interface with MILES-type direct fire simulation systems provides an integrated solution to the indirect fire training problem. CATIES consists of three basic elements; 1) a Master Station, which receives voice or digital data from a fire direction or support element and transforms it into digital timing and weapon data. This data is transmitted to 2) Actuators which in turn retransmit this data at precise time intervals to 3) Appliques located on vehicles, personnel and/or terrain features. The Player Detection Devices respond to the arrival time of the transmitted pulses, the weapon-munitions type, and the target type and size. The capability to relay data through other Actuators and electronic line-of-sight technology assure wide area coverage, with optimal message routing determined by the Master Station.

INTRODUCTION

As the approaching dawn peaks across the desert landscape of the National Training Center a US Army mechanized infantry task force commander searches for the tell-tale signature of the attacking enemy force. Although he is confident in the ability of his TOW gunners, his tankers, and his other **direct fire** systems to acquire and successfully engage the tanks and other armored fighting vehicles of the atttacking Soviet regiment, certain nagging doubts continue to haunt him.

In the calm before the storm he remembers his introduction to combat as a young company commander in a far off corner of the world - a night when his rifle company experienced the mortar and rocket prelude to a North Vietnamese Army ground attack. He remembers the deafening explosions, the beehive sounds of whinning shrapnel, the pungent smell of exploding munitions, and the call of his wounded for help. He recalls the almost paralyzing effects on his ability to remember what he should do next, his inability to talk to his radio-telephone operator over the roar of battle, and his near total loss of control during the first few moments of the actual ground attack. He remembers with disgust his inability to describe his own situation to an inquiring battalion commander because only one of his three platoon leaders was on the radio. Finally, he recalls how long it took for the men in his platoons to resume good firing positions and to deliver well aimed fire at the fleeting targets presented by the attacking forces. The task force commander's concern increases.

Suddenly the commander is shaken from his early morning thoughts of his first taste of combat by calls from his scout platoon to his operations element. The Bradley Infantry Fighting Vehicle (IFV)-equipped scouts positioned forward and on the flanks of the defending company/teams are reporting the initiation of the regimental attack. Dust clouds rise in the distance as the enemy tanks and BMP's approach the carefully planned and prepared obstacles of the defending task force. Enemy reconnaissance elements are already beginning to

probe his outer defenses and are attempting to determine where and how to penetrate his battle positions.

Knowing Soviet doctrine as he does, the task force commander expects to receive a devastating volume of preparatory fires by enemy divisional and regimental artillery groups. (According to a recently published Field Artillery School "white paper" on Warsaw Pact artillery, a task force in a similar situation could receive as much as 20 to 50 minutes of preparatory fires. The preparation fires could include up to 23,000 artillery, mortar, and rocket rounds, or over 2300 tons of HE, fragmentation, illumination, and smoke rounds). On this day at the NTC nothing occurs except a couple of fire marking teams strolling through his company/team positions throwing artillery simulators and subjectively causing casualties with the "God Gun", a master laser gun used to turn on the "hit" mechanism in the Multiple Integrated Laser Engagement System (MILES) worn by solders and strapped on selected combat weapon systems.

The nearby task force fire support officer announces that he is beginning to monitor calls for artillery fires on his TACFIRE Variable Format Message Entry Device (VFMED) - calls for fire which are being transmitted digitally from the infantry and armor fire support team (FIST) chiefs and forward observers (FO's) to the direct support artillery battalion's Fire Direction Center (FDC). He waits expectantly for the impact of the supporting artillery. Once again, very little indirect fire simulation occurs. In a very unconcerned manner the opposing forces (OPFOR) quickly breach the mine field and wire barriers which protect his positions. The calls for "final protective fires" quickly follow and are met with the same response - a complete absence of battlefield effects.

For the next four hours the battle swirls about him as he maneuvers his defending forces and as his direct fire elements give a good account of themselves. Because he has trained his forces well for the direct fire battle, and because he has successfully anticipated the flow of the maneuver battle and insisted on the preparation of alternate and supplementary fighting positions, his task force carries the day.

The after action review addresses in glowing terms the ability of the task force commander and his staff to understand the brigade's scheme of maneuver and plan of fire support, prepare and distribute combat plans and orders including a vivid description of the task force commander's intent, anticipate the maneuver of the enemy forces and to exercise initiative within the scope of the brigade commander's intent, react to unexpected threats and opportunities, and to engage enemy forces with their direct fire weapons.

Unfortunately, the after action review contains very little objective and factual information about the effects of friendly and enemy artillery, mortars, mines, and chemical weapons delivered by either side during the battle. None of the NTC controllers really know what effects the enemy's regimental and divisional artillery groups' prep might have had on the defending friendly forces. No one really knows whether the task force's supporting artillery could have suppressed enemy gunners and forced enemy tank commanders to "button up" thereby degrading their target acquistion and engagement capabilities. No one really knows if we could have delayed and suppressed follow-on and uncommitted forces and prevented the enemy from "piling on" in the vicinity of the FEBA. In effect, no one really knows if certain fundamental aspects of our AirLand Battle doctrine are valid at the brigade and battalion levels of conflict.

Throughout the task force commander's 14 days of training at the training center the story is the same - less than effective means of crediting the maneuver, fire support and engineer communities for effective indirect fire and barrier planning and coordination, and practically no experience for his troops in preparing physically and psychologically against enemy weapons systems (artillery, mortars, and rockets) which outnumber our own by ratios of 5 or 6 to 1, or more . And so the questions remain. How prepared are the task force commander's troops for war, **really**? How competent are his forward observers and fire support officers? How good are his engineers at emplacing mines and preparing obstacles? How ready are his troops to engage in offensive and defensive chemical operations? Can we delay follow-on forces and suppress enemy artillery and air defense firing elements? **How sound is our doctrine?**

THE TRAINING REQUIREMENT

Currently the US Army has no way to realistically simulate and to accurately measure the effects of area weapons such as artillery, mortars, mines, chemical and certain aerially delivered munitions. Specifically:

- The disruptive artillery fires are frequently notional and, at best, simulated by manpower intensive and less than timely fire marker teams tossing unrealistic artillery simulators that seldom represent the coverage and never the suppressive effects of indirect fire munitions.

- Chemical attacks are rarely a surprise in training exercises, and because they are usually notional (the NTC does use CS or tear gas), there are no objective methods to sense and penalize failure to meet accepted chemical defense postures.

- Employment of barriers in most training situations is often notional and does not delay or canalize the oppposing force realistically, again because there are no objective methods to sense and penalize failure to meet accepted procedures. Because of a lack of realistic simulation of the lethal and audio-visual effects of indirect fire enhanced barriers, opposing force elements are not suppressed and slowed as they might be in combat.

- Aside from the objective assessment made possible by fielded and emerging direct fire training engagement simulation systems, personnel and equipment casualties are determined by subjective, inconsistent estimates, usually well after-the-fact.

A recently published study by Rand Corporation's Arroyo Center analysis group describes the indirect fire simulation and assessment system presently in effect at the National Training Center.

> "During force-on-force battle simulations at the NTC, artillery fires are represented on the Core Instrumentation Subsystem. Unlike direct fire, however, the inputs to and outputs from the computer must be accommodated manually, and battle damage assessment relies in part on subjective judgements.
>
> Calls for fire pass up the normal fire direction system from the forward observers (or whoever is calling for the mission) to the artillery operations center. (Most training units use TACFIRE systems, and a few still use voice radio.) There the mission will be "fired" by order to the firing battery. Some requested missions are not fired, owing to priority allocation of fire. The fire order is also passed to the artillery analysis team in the Central Instrumentation Facility, where the firing data are entered into the computer (tube location, target location, rounds fired, etc.). At the same time, fire markers or observer/controllers are directed by radio to mark the fires using pyrotechnic simulators at the target location.
>
> The computer displays the mission, but the analysts in the facility and the field observers or fire markers manually carry out the damage assessment. An impact box of standard form is shown on the display. If the analyst watching the unit sees the box cover a part of the unit, or if the O/C or fire marker in the field, directed to the location of the "impact," finds forces near it, they can agree, by radio link, to the proper battle damage assessment.
>
> Standard tables are used to determine the damage to be assessed by a given mission (e.g. 24 rounds of high explosives) against a given target (e.g. a dismounted platoon in prone positions). The assessed artillery results are not made a part of the computer record, although the observer/controllers may make a field note of the results. The artillery analysis team records each fire mission in a log. That log shows the time of fire, the caller (if known), the type of mission, the target location, and whether the mission was good (hit an enemy target), no good, or has hit friendly forces. The log does not contain information about the target or the battle damage assessment. These manual logs are retained in the artillery section for a few months and then discarded. A similar system exists for OPFOR artillery play."

The ability of commanders at all levels to achieve maximum, synchronized combat power at the proper time and place on the battlefield is dependent upon the extent to which they are able to train themselves and their subordinates in peacetime. As alluded to above, such training is currently hampered by a training environment which neither portrays the contribution of fire support to the combined arms effort, nor represents the effects of friendly and enemy fire support on combat operations at all tactical levels.

With the arrival of MILES and more recently the Army's MILES-compatible Air Ground Engagement Simulation-Air Defense (AGES-AD), the maneuver, air defense and air support components gained a more realistic and effective training system to simulate the effects of direct fire. The line-of-sight characteristic of these systems makes them ineffective in the simulation of indirect fire munitions, thus, the indirect fire support elements can not realistically participate. As a result, training of the maneuver elements, who benefit most from an understanding and appreciation of the effects of both friendly and enemy fire support is less than adequate.

The absence of a means to simulate objectively the effects of indirect fires has produced at least three distinct training deficiencies:

- Maneuver unit commanders often under-emphasize the use of indirect fires because of the unrealistic, subjective and time consuming nature of current simulation systems. This leads to a lack of appreciation for the contribution of artillery and mortars on the battlefield. For example, in a letter in the March-April 1986 INFANTRY magazine an armored cavalry squadron commander stated:

> "...We have been on more than a dozen REFORGERs over the past ten years and I can tell you that artillery is virtually worthless to the tactical commander in these exercises. This is because the cumbersome system used to allocate credit for artillery is unworkable. Many commanders stop using artillery because they will never get credit for it, and there are other things they can do with their time..."

- Combat arms, combat support and combat service support elements train in an environment devoid of the suppressive effects of the enemy fire they are most likely to experience in combat, i.e., air and surface-delivered indirect fires.

- The individual soldier, even in the maneuver battalion task force, cannot experience in training the surprise, destruction, disruptive and suppressive effects of indirect fires.

To train effectively, the total force needs to be able to train in a more realistic indirect fire, as well as the more realistic direct fire environment made possible by the MILES-type training simulators. To quote from *The Posture of the United States Army for Fiscal Year 1987*;

"...While MILES has provided unparalleled opportunities for realistic, two-sided, tactical training world-wide, true combined arms tactical engagement training is being sought. Efforts to incorporate the simulation of artillery and mortar indirect fire, mines, and NBC area weapons effects into MILES exercises will improve tactical engagement training."

Another document, the U.S. Army approved *Fire Support Mission Area Analysis* (MAA) states the need for realistic, effective and safe indirect fire simulation and evaluation in training exercises.

"... a large training gap exists in the need for devices and methods to realistically play indirect fire systems in the MILES exercises both at the National Training Center and other installations having MILES equipment."

The MAA further specifies the need for ----

- A flash, bang, smoke cue that gives training participants an appreciation of the lethal and suppressive effects of indirect fires and causes them to take proper preventive measures to survive and carry out the mission.

- An automatic casualty assessment system which alleviates the need for fire markers and assesses casualties based on the type and coverage of munitions employed and nature of the targets in the affected area.

The Solution is a system which simulates the contribution of Army, Navy, Air Force and Marine fire support to the AirLand battle, portraying the effects of indirect fire support. A training system which integrates and simulates these effects should --

- Capitalize on and complement existing and developmental MILES-type direct fire engagement systems.

- Provide realistic battlefield effects.

- Provide realistic training for the total combined arms force.

There have been several attempts over the past ten years to get beyond the old fire marker and subjective assessment operation, but technology and safety restrictions have limited the development of cost-effective solutions. However, recent advancements in micro-chip and radio frequency technology, particularly the miniaturization, increased capacity, and reduced cost of key electronic components, permit applications of unique combinations of these components to meet this simulation need.

The Solution

CATIES meets the urgent training requirement for a complete fire support simulation and assessment system. CATIES will provide the capability to simulate the effects of conventional and tactical nuclear fire support, NBC contamination and mine warfare in combined arms, force-on-force training, from small unit exercises to major joint training exercises, worldwide. With CATIES, Army and Marine combat, combat support and combat service support forces will be able to train to doctrine in a more realistic indirect fire training environment that will include simulation of the lethal and suppressive effects of Naval gunfire, and Air Force, Navy and Marine Corps aerially delivered munitions.

CATIES: THE SYSTEM

Currently, MILES provides a means to judge the effectiveness of direct fire weapons on an opposing force. When MILES sensors on opposing force soldiers and equipment are activated by laser energy, they indicate either a "near miss" or "hit". A hit can be further categorized as resulting in either damage or destruction (wound or kill for personnel). The system takes into account the type weapon, tracking requirements and the nature of the target. In a parallel manner, CATIES employs radio frequency (RF) energy to activate a target sensor (Appliques) while taking into account weapon and munition characteristics and the nature and disposition of the target. The RF signal is not easily attenuated by dust, smoke or foliage; thus, it is better suited to simulate the effects of indirect fires, NBC and mine warfare. As depicted in Figure 1, CATIES has three primary components:

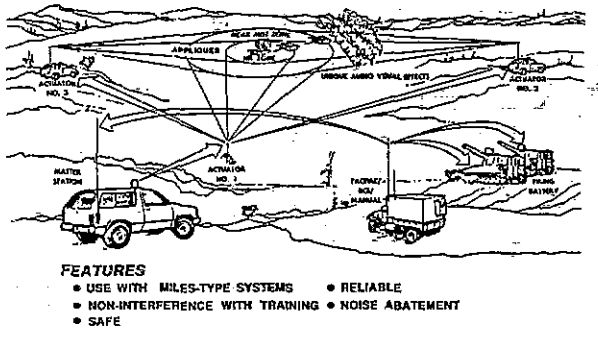


Figure 1 - CATIES SYSTEM

- The Master Station, which initiates and controls the system through the transmission of attacking weapons and timing data to selected Actuators.

- The Actuators, which transmit directly or act as relays for the transmission of weapons and timing data that cause the activation of appropriate Player Detection Devices.

- The Appliques, which sense Actuator transmissions of coded energy and provide indications of the effects of the simulated munitions on the targets.

Master Station

The Master Station, shown in Figure 2, consists of a micro-computer, receiver/transmitter, graphics display and necessary communications equipment to link with firing unit's fire direction facilities and fire support elements.

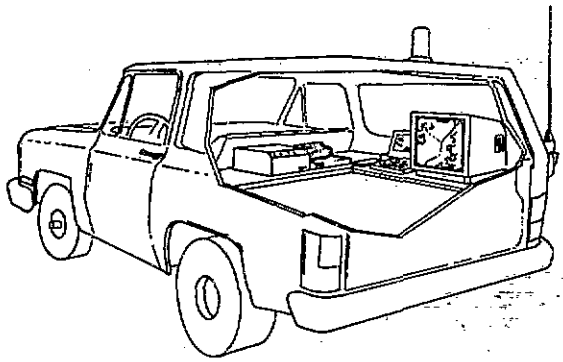


Figure 2 - Master Station (MCS)

Based on the target location, method of fire, and time, the Master Station computes the data required to cause each of at least three coded, omnidirectional, RF energy pulses to be transmitted through selected Actuators to intersect over the target location at precise time intervals. Considering electronic line-of-sight technology and using Actuators as relays, the system's range can be extended to over 100 kilometers.

Actuator

The solar battery powered remote Actuator (Figure 3 below), consists of a microprocessor-controlled receiver-transmitter, antenna, cabling, and an auxiliary communications device, all contained in an easily carried combination case.

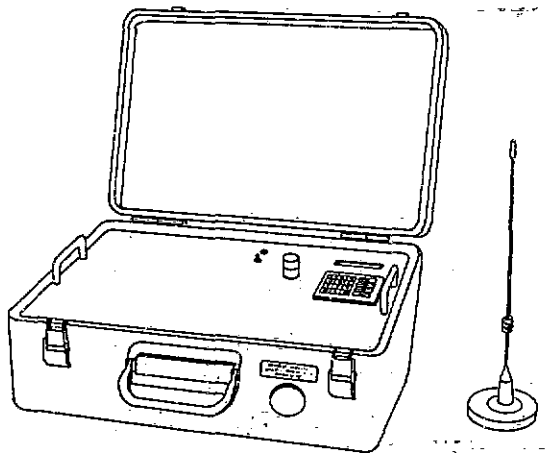


Figure 3 - Actuator

The Actuator receives the timing and weapons data from the Master Station , and transmits the coded radio frequency signal to Appliques positioned on personnel, equipment, and terrain features. The Actuator includes a keyboard and digital display used to input surveyed location data at time of emplacement, and to perform other routine functions such as self-test. At least three Actuators, each with electronic line of sight to the designated target, are required to activate an Applique. The maximum Actuator-to-target range is over 15 kilometers, and as stated earlier each Actuator is capable of relaying Master Station data to other Actuators in order to extend the operating range of the system and circumvent RF line-of-sight problems. The Actuator, once emplaced is designed for autonomous operation. Typically the Actuators will be located in vehicles, or when used in permanent training areas such as the National Training Center, on man-made structures such as small towers or platforms.

Applique

The Applique, depicted in Figure 4, is a receiver-decoder slightly larger than a cigarette package, and is placed on an individual soldier, vehicle or other appropriate object and linked to a flash-bang-smoke cue and MILES-type device. Receiving the appropriate, coded signals an Applique activates to indicate either a "hit" or a "near miss".

Figure 4 - Applique

Safe, nondud producing, indirect fire unique audio-visual effects will represent either result. A "hit" will actuate the MILES device for casualty or damage assessment. The Applique is programmed with a changeable "target plug" to represent a specific type of target and uses established effects probability data to determine the effects on that type of target.

Audio-Visual Cueing Device

A fourth component, not listed earlier as part of CATIES, but just as important, is a flash-bang-smoke producing device. It will complement the lethal effects simulation with appropriate audiovisual cues so critical to the soldiers affected by simulated indirect fires, chemical contamination or mine warfare.

OPERATIONAL CATIES

The Training Environment

CATIES is adaptable to large Advanced Collective Training Facilities (ACTF's) such as the Army's National Training Center at Fort Irwin, CA. or

to large training exercises which use civilian owned land and facilities such as the Army's annual Redeployment of Forces to Germany (REFORGER) exercise. It is also appropriate for use in highly confined and restricted Local Training Areas (LTA's) such as those found on or near posts in Germany and in the continental United States.

Set Up

Preparation time and effort varies in relation to the permanency of the training area, but in general "prepare-to-train" operations proceed as follows. Once the limits of the training area are defined, the Actuators are positioned where they provide coverage of the area of operations. Actuator locations must be precisely determined and recorded. The number of Actuators required is a function of the size and terrain characteristics of the exercise area. When an exercise moves over large expanses of terrain, such as during REFORGER, the Actuators can be moved quickly; however, to ensure continuous, electronic line-of-sight coverage for a brigade-size element, at least three, preferably five Actuators, must be in position and operational all of the time. Actuators can be operated by vehicle power or by an internal solar charged battery.

The Master Station is positioned where communications can be established with appropriate fire direction centers (FDC's), fire support elements, and the Actuators. The size of the organizations exercising and the size of their area of operations may require more than one Master Station. Normally, one Master Station will be in communication with unit mortar platoon FDC's as well as supporting field artillery FDC's. When the Master Station relocates the micro-computer must be initialized by entering the type and location of all its associated indirect fire units, and the surveyed locations of its Actuators. Two Master Station operators are considered sufficient manning for continuous operation of an Master Station over a three-day exercise.

CATIES Appliques are placed on all appropriate personnel and equipment participating in the training exercise. The Appliques are initialized by inserting a target plug which identifies the Applique as a certain type of target (e.g. individual soldier, tank, infantry fighting vehicle, truck, etc.). The CATIES Appliques interface with the MILES sensor equipment worn by a soldier or affixed to a vehicle, allowing the audio and visual alerts within the MILES device to signal an indirect fire "hit". Additional distinctive tones and visual signals will be used to distinguish between direct fire and indirect fire "hits" or "near misses", and to cause the individual trainees to take appropriate action. The Applique can be deactivated and reset by the same controller who resets the MILES devices.

Operational Sequence

Following a single manually processed fire mission demonstrates how CATIES will be used in a tactical engagement simulation. Although this paper illustrates a manual solution, the fully developed CATIES will be capable of receiving and processing digital information.

• Indirect fires are planned and requested in accordance with current doctrine. The sequence to be used here starts with a fire request from an FO supporting a maneuver unit. The FO requests fires either digitallly or by voice means, over the appropriate field artillery fire net. As a minimum, the FO indicates the target location, nature of target and method of control. For this scenario the target is a platoon of tanks and an accompanying platoon of dismounted infantry.

• The supporting field artillery 155mm howitzer battalion designates an available battery to fire the mission with two battery volleys of dual-purpose improved conventional munition (DPICM). The battery performs the required technical fire control operations at its FDC. The exercise controller in the FDC or one of the unit's FDC personnel sends the following information to the CATIES Master Station as soon as it is available.

- Location of target.
- Time of flight.
- Shell-fuze type.
- Number of volleys and number of tubes firing.
- Radius of target.

• The operator at the Master Station enters this FDC data into the micro-computer which selects at least three Actuators that are in range and have electronic line-of-sight with the target. Then the operator awaits receipt of the time of "shot" from the FDC. When the time of "shot" is received, the Master Station operator enters it into his micro-computer.

• Based on time of flight, the computer calculates time of impact of the shot and time codes needed to transmit the RF signal through the Actuators to the impact area. At the calculated time the Master Station transmits the coded signal containing the type weapon and munition data to the selected Actuators (Figure 5). The Actuators process and retransmit the coded pulses to arrive at the target area in the proper sequence at the time of impact of the simulated indirect fire. The pulses are separated by very small, precise time increments which cause the proper effect on target Appliques. The Appliques decode the pulse timing to indicate either noneffect, actuation of Appliques to indicate a "near miss", or actuation of the Appliques to indicate a "hit" in accordance with JMEM-based probabilities. The time of each of the pulses is critical because the intersection of these pulsed signals at their time increments described above define the target area. In this example, the target area will be roughly elliptical, approximately 300 meters by 200 meters.

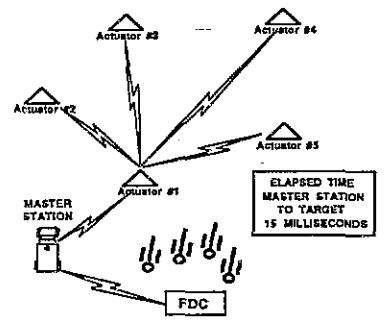
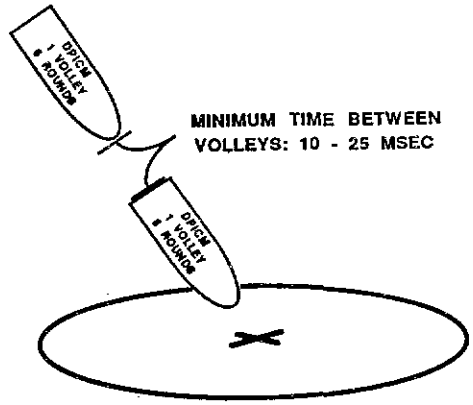


Figure 5 - CATIES Pulse Sequence

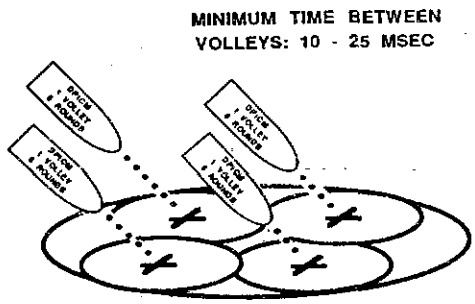
• The same procedure is followed for subsequent (in this case the 2nd) volleys (Figure 6). Multiple volleys on separate aim points can also be simulated (Figure 7).



MULTIPLE VOLLEYS ON SAME AIM POINT

Figure 6 - CATIES Simulation Capability

Flight times for indirect fire munitions are on the order of magnitude of tens of seconds with minimum time intervals between volleys from the same weapons of approximately 10 to 15 seconds. Thus, the minimum times indicated in each of the figures shows the responsiveness of CATIES to be more than sufficient to allow real time simulation of indirect fires. CATIES represents both flight times for projectiles and timing between volleys in real time to coincide with the simulated firing and impact of subsequent rounds or volleys.



MULTIPLE VOLLEYS ON SEPARATE AIM POINT

Figure 7 - CATIES Simulation Capability

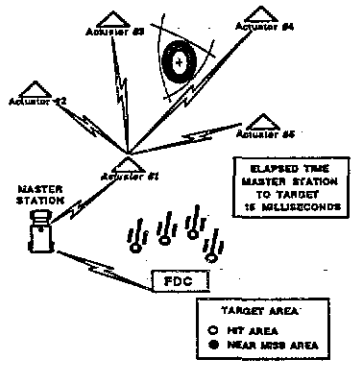


Figure 8 - CATIES Pulse Sequence

• As stated earlier, the target area is defined by the intersection of at least three RTD signals (Figure 8). Because these signals are omnidirectional, they naturally intersect at numerous points in the training area.The precise increments of time that each Applique will accept and process properly coded signals determines which of the intersections define the "near miss" area and which define the "hit" area (Figure 9).

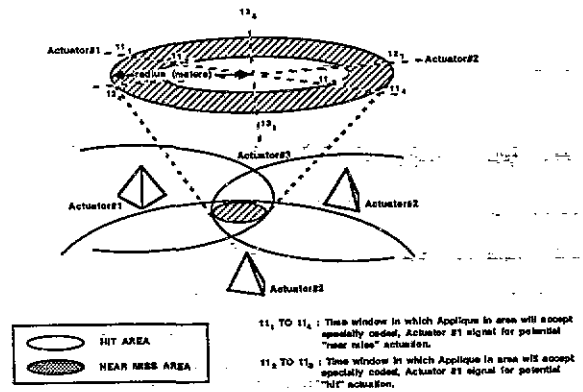


Figure 9 - CATIES Target Area Simulation

• An Applique in the "near miss" area will activate if it receives at least three separate properly coded signals within a specified period of time. When activated, the Applique will cause audio and visual cues to be emitted from devices that will indicate indirect fire-unique sounds and visual effects. An Applique in the hit zone is designated as a "hit" or "near miss" based on JMEM probabilities for the type target and munition fired. If designated as a "hit", the Applique will cause emission of indirect fire unique sounds and visual effects and cause the MILES device to emit "hit" audio and visual alerts. If no hit has occurred, the "near miss" alerts are emitted.

• When "shot" for the second volley occurs, the above procedure is repeated. If all or a portion of the tank/infantry target, having been alerted by "hits" and "near misses" from the first volley, is able to move out of the target area, then fewer "casualties" will result from the second volley.

• Exercise controllers reset MILES devices which have registered "hits" using the same procedures they use for direct fire activations. Personnel casualties can be assessed by using the same cards as are used for direct fire assessment.

SUMMARY OF CATIES FEATURES

CATIES possesses the following characteristics

• Indirect Fire Effects Assessment - CATIES provides a means of assessing the effects of indirect fires on the battlefield. The CATIES system uses JMEM-related probabilities for target damage based upon the nature of the target and the types and numbers of munitions employed.

• Timely and Realistic Indirect Fire Simulation - The effects of indirect fires in battlefield simulations with CATIES are simulated in real time through the use of radio frequency signals which accurately define the target area. No longer must trainers wait on fire marker teams to arrive at a target and attempt to define the boundaries of the target area with simulators. CATIES gives soldiers greater battle realism and awareness of indirect fires in their vicinity through MILES audio and visual cues and indirect fire-unique sound and flash devices.

• Savings in Manpower - CATIES interfaces directly with MILES, requiring no additional controllers for indirect fire engagement simulations. In fact, the elimination of need for dedicated indirect fire markers offers a significant opportunity for overall reduction in controller requirements. CATIES itself requires very few personnel and minimal training. Actuators can operate unattended, requiring only one or two personnel to move them and set them up. The Master Station can be operated by as few as two people.

• Offers Opportunity to Train to Doctrine, Worldwide - CATIES can be integrated into training exercises at all levels - from platoon through corps anywhere that MILES-type devices are used. For a platoon-size exercise, for example, the battalion mortar platoon FDC provides sufficient capability to answer forward observer calls for fire, thereby exercising the fire support system at the lowest echelon.

• Minimal Interference with Training - CATIES has no adverse impact on the training area and its operating considerations are virtually transparent to exercise participants. No vehicle cluster need be established between opposing forces, nor are other elements of artificiality needed with CATIES. Weapons effects simulators which create potential safety hazards are no longer required.

• Application to NBC and Mine Warfare - CATIES offers a capability beyond the fire support arena. The CATIES concept can be adapted for use in both the simulation of minefields, chemical and nuclear battlefield operations. The capability of the Master Station and its set of Actuators to cover (within range) up to 50 different areas per second gives CATIES the potential for continuous pulsing of areas to simulate the family of scatterable mines (FASCAM), conventional mine fields, chemical contamination (both persistent and non-persistent), and the downwind movement of contaminants. CATIES offers tactical engagement simulation for virtually the entire combined arms team.

ABOUT THE AUTHORS

Mr. Hollis is a recently retired Armor officer currently serving as a systems analyst with LB&M Associates in Lawton, Oklahoma. He is responsible for the operational and functional analysis and development of CATIES. His career in the Army included assignments as doctrine writer and maneuver tactics instructor at the Field Artillery School and the Command and General Staff College. He was an armored cavalry troop commander in Vietnam and Germany, and a tank company commander and battalion S3 in CONUS. He is a graduate of the U.S. Army Command and General Staff College, the U.S. Army War College Defense Strategies Course, and holds graduate degrees in Public Administration and Human Resource Development from the University of Oklahoma and George Washington University, respectively.

Mr. Miller is the Motorola staff engineer and project leader responsible for the design and development of a proof-of-principle system which simulates area weapons effects. Previous Project Leader experience includes the engineering development of the Portable Control System (PCS). System capabilities include command and control of Remotely Piloted Vehicles. He is also currently a Design Engineer for the hardware portion of AFDC (Automatic Formation Drone Control) including airborne range-to-range processing and ground station modification for multiplexed command and telemetry. Mr. Miller received Honors at Entrance and was on the Dean's List at Arizona State University. He also holds Tau Beta Pi, Eta Kappa Nu. In 1976, Mr. Miller was awarded the "Engineering Creative Design Display" at the University of Tennessee at Knoxville, by ASEE.