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BATTLESPACE INFORMATION OPERATIONS SIMULATION

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ABSTRACT

The Extended Air Defense Testbed (EADTB) is a medium to high fidelity constructive simulation that is used for theater-level operational planning and analysis of weapons systems. The EADTB was developed by the Testbed Product Office in the U.S. Army Space and Missile Defense Battlelab. It models all aspects of the battlefield to include sensors, communications, command and control (C2), munitions, and the environment. It offers a combination of scope, detail, and flexibility that is unique among simulations. The user is able to create the weapon systems, the C2 elements, threats, and the gameboard for the scenario to take place and then develop rulesets that determine the behavior of the systems in the course of the battle.

One recent scenario built in EADTB was Battlespace Information Operations Simulation (BIOS). The purpose of this experiment was to model dynamic Battle Management Command Control Communications and Intelligence, Surveillance and Reconnaissance (BMC4ISR) and the associated information management. The EADTB was able to provide visualization and analysis of decision processes, information flow and latency, and combat operations. It was also able to simulate the dynamic system response to changing conditions and assess the benefits of space assets.

EADTB

The Extended Air Defense Testbed (EADTB) offers a robust, user-flexible representation of weapon systems, sensors, and Command, Control, Communications, Computers and Intelligence (C4I) systems in a state-of-the-art synthetic environment for National Missile Defense (NMD) and Theater Air and Missile defense (TAMD) analyses. The EADTB is an object-based simulation architecture that allows the user to develop individual system object models called Specific System Representations (SSRs). SSRs define simulated battlefield entities in terms of four components: thinker, communication, platform, and sense. The thinker component includes user-definable rule sets, which contain the decision logic controlling entity behavior. Rule sets can comprise from as few as 50 to as many as several thousand lines of interpreted EADTB rule set language. The EADTB offers a number of special capabilities, which, in combination, set it apart from other simulations:

1. EADTB partitions perception from truth and propagates perception, whereas many simulations propagate truth and add errors to represent perception. EADTB simulates the real-world processes of sensors generating perceived data and thinkers making decisions based on those data.
2. The EADTB has an extensive verification and validation (V&V) legacy for library-resident SSRs and for the common model set, which provides the "building blocks" for user construction of SSRs. (Both SSRs and the V&V program are discussed in more detail below.)
3. EADTB allows users to build their own SSRs, as well as use existing SSRs from the master library. In most other simulations, the user can only set flags or modify numerical data inputs to alter the behavior of built-in system representations. When built-in representations cannot meet user needs, most other simulations must be modified by the developer or altered at the source-code level by the user, which can negate any existing V&V certification.
4. The EADTB offers a high degree of flexibility in defining the detail of SSRs, communications models, environment models, and the scope of the scenario. Scope can include theater level for TAMD, global level for NMD, or simply fire-unit level for one-on-few simulations. In addition, EADTB can mix different levels of detail in a single experiment. For example, EADTB could simulate NMD activities at low detail, theater wide TAMD at low detail, and a single fire unit or ship defending a critical theater "choke point" (e.g., a sea port) at a relatively high level of detail (e.g., 3DOF flyout, a dynamic sensor with Kalman filter, extensive C2 rule sets, and explicit communication message format representations).
5. The EADTB offers the capabilities to model command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) at a very high level of detail for a theater/global-level simulation. These capabilities are discussed in more detail below.
6. The EADTB offers a robust suite of on-line tools for visualization and numerical diagnostics. Visualization capabilities include runtime and playback display in two-dimensional (map) view

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and three-dimensional view. Playback allows continuously variable forward and reverse speeds. A full suite of spreadsheet tools and statistical diagnostics can operate on user specified measures of performance. An external stealth view can easily be added by exploiting the EADTB's DIS compliance.

The EADTB has extensive data logging and recording capabilities that allow the user to do detailed analysis of the experiment once it has been completed. Included with EADTB are numerous built in measures of effectiveness (MOEs) and measures of performance (MOPs) that can be used to display the data. Also included are commercial off the shelf (COTS) software packages that allow the analyst to take the recorded data and display MOEs and MOPs that may not be built in. This data and analysis tools allows the analyst to determine the details of the battle. The analyst can determine when each decision was made, the data used to make the decision, and the resulting response from the decision.

Introduction

One recent scenario built in EADTB was Battlespace Information Operations Simulation (BIOS). The purpose of this experiment was to model dynamic Battle Management Command Control Communications and Intelligence, Surveillance and Reconnaissance (BMC4ISR) and the associated information management. The EADTB was able to provide visualization and analysis of decision processes, information flow and latency, and combat operations. It was also able to simulate the dynamic system response to changing conditions and assess the benefits of space assets.

Scenario Laydown

The scenario took place on the Korean Peninsula and was constructed using unclassified data. It begins with a constellation of satellites detecting enemy forces moving toward the border and the resulting attack of these forces as well as a few tactical ballistic missiles (TBMs) being launched toward the friendly forces and the intecepts of these TBMs.

The threat forces are located in North Korea and include 3 TBMs aimed at South Korea. O.K.
Also there is a column of tanks and a column of trucks located in North Korea moving south toward the boarder of South Korea.

The friendly forces located in South Korea include a constellation of 24 satellites positioned in 8 rings of 3 satellites each. The BMC4I elements are the Analysis Control Element (ACE) which receives and analyzes the imagery from the satellite, the Fire Support Element (FSE) , which will direct the attacks on the targets, and an Air Support Operation Center (ASOC) which controls the air assets. The EADTB does not explicitly model the imagery but does simulate data being passed down and the analyst in the ACE being able to determine that there are targets on the battlefield. With the satellite as we modeled them, they do not have the ability to classify the targets as either wheeled or tracked. Other friendly assets include a Unmanned Aerial Vehicle (UAV), a Multiple Launch Rocket System (MLRS) with Army Tactical Missile System (ATACMS), a Navy Cruiser and a Patriot battery for TBM defense, and a flight of A-10 fighters for attack operations. O.K.

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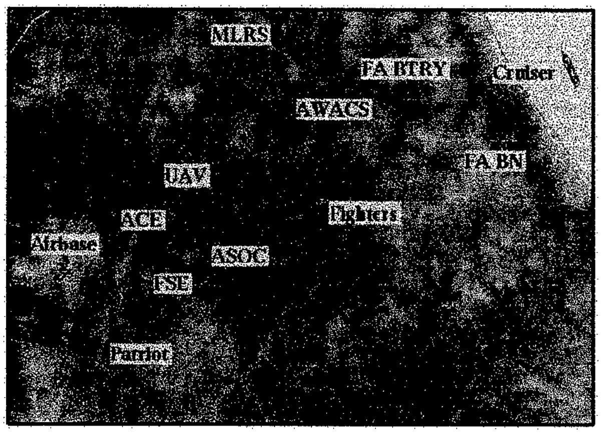


Scenario Events

After the ACE receives the imagery from the satellite, the UAV is sent a tasking to get a higher resolution image of the targets so the ACE will be able to determine the type of vehicles on the ground. After the UAV sends the imagery to the ACE and it is determined that the first set of targets are trucks the ACE sends a "Call for Fire" order to the FSE to attack the target and task the UAV to image the next set of targets. Since these wheeled vehicle are "soft targets" the FSE send a "Fire" order to the Field Artillery (FA) Battalion which then sends the order to the FA Battery. The FA Battery will then assign a MLRS to launch an ATACMS missile at the trucks. After the ACE determines the next set of targets are tanks he will send another "Call for Fire" order to the FSE. The FSE will then send a "Close Air Support (CAS) Divert" order to the ASOC to attack the "hard" targets. The ASOC will vector the A-10s against the tanks. The ACE will task the UAV to do a Battle Damage Assessment (BDA) mission on each of the targets.

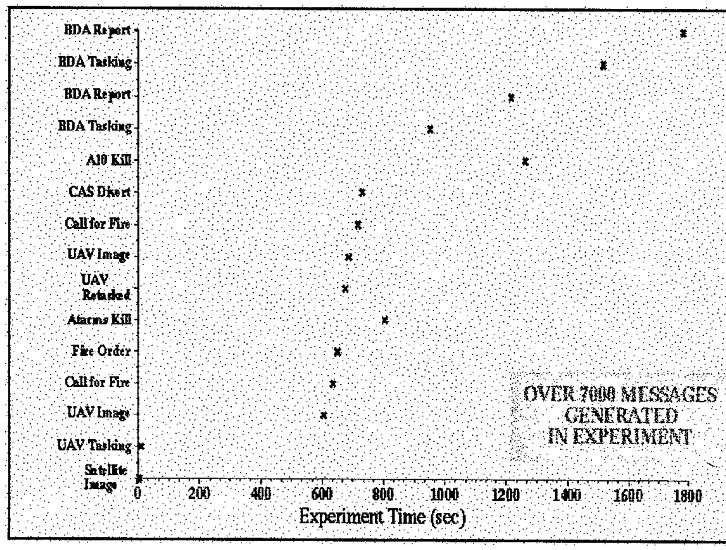
During this experiment 3 TBMs are launched from North Korea into the area occupied by the friendly forces. The Patriot and the Navy cruiser intercept these TBMs.

Messages

In this experiment all the messages and the decision-making processes are modeled in detail. This begins with the initial satellite detection, through the G2 tasking of the UAV to determine the type of enemy forces, to the call for fire, fire order, and BDA. These "call for fire" messages are sent from the ACE to the FSE who either sends a "fire order" message to the MLRS or a " CAS divert" message to the ASOC. When sufficient time has elapsed for the attack to occur, the ACE will send a "BDA tasking" message to the UAV. The UAV will then image each target area again so that the ACE will be able to generate a BDA report.

Analysis

After the scenario was executed in EADTB analysis was done on the recorded data. There were over 7000 messages generated in the entire scenario. A chart was developed to look at the flow of some of the key messages associated with the detection and attack of the ground targets. This type of analysis will provide insight to the processes that are happening and the timing of these processes. Therefore it is readily apparent if something is not functioning as it was expected to perform.



Another chart was developed to look at the intercept of a TBM by Patriot. The altitude of the TBM is plotted over time and the key event of the Patriot detection, launch, and intercept are plotted on this trajectory. This provides insight into when in the key events of the Patriot take place in the TBM flight.

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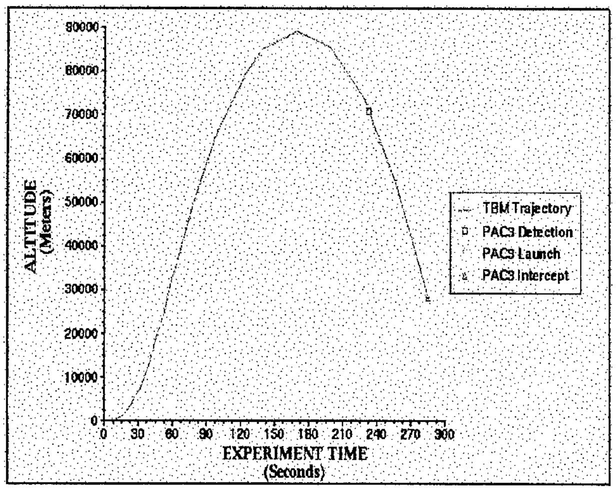

Conclusion

The EADTB is a simulation that is well suited to study issues associated with Information Operations. It has the ability to simulate the systems performance and decision processes as well as the communications between different systems. This includes the Space Based Early Warning Systems, the ground control BMC4I elements, the threats, and the weapons systems. The EADTB then has a robust analysis capability that allows the user to do detailed analysis of the experiment once it has been completed.

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2. The point of contact for this action is Gerda Sherrill at 955-3888.

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