White Papers

for Battlefield Management Training

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Introduction

With the increasing availability of advanced sensors and communication technologies in today's battlefield, more data is being made available to commanders to support their decision making processes. However, additional data can often encumber the decision process for commanders who are not adequately trained in the effective use of the new technology or, more importantly, in leveraging that information through their own logical and intuitive decision process. Short of continuous battle hardened experience, the most effective means for developing strong decision making and battlefield management skills within today's commanders is repeated simulation-based training using a wide variety of scenarios and tactical environments.

Although traditional simulators can support this training capability, users and instructors are often encumbered by the time and effort necessary to create or modify multiple scenarios to provide enough variety to stimulate the training and education process. Even if scenarios can be reconfigured in short order, performing modifications to the core models of the simulator to reflect new technology assets or to evaluate the potential benefits associated with the acquisition of new technology is often not practical given time and budget constraints.

A new approach to simulator development and life cycle model maintenance is necessary to provide end users with the flexibility necessary to adapt a simulator to ever changing battle threat environments and battlefield technology evolution.

OSim is a new software product developed by OriginalSim Inc. to address this need. Simulators developed using OSim provide unprecedented openness, flexibility, maintainability, and supportability. A Battle Management Trainer based on OSim is object oriented, incorporates a distributed execution and communication environment, supports new and legacy simulation models, can incorporate a variety of equipment interfaces and provides the user with direct access to the core modeling environment through C++ source code and development tools to modify and extend the object structure.

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Defining Battlefield Management

Battlefield Management is defined as the process whereby an array of inputs from various sensor sources is converted to directions for troop movements and equipment deployments. The process includes data fusion, tactical analysis, and rapid and unequivocal decision making.

Depending on the type of equipment available to the commander and the ability of that commander’s support staff, information at the commander’s disposal is filtered to different degrees. At the most rudimentary level, raw data in the form of communication reports and sensor images is available and must be directly interpreted by the commander. At a higher level, data fusion technology built into modern command and control systems assesses and interprets the raw data and provides a filtered or overview situation awareness display for the commander’s viewing and assessment. In less modern militaries, this data fusion capability is provided "manually" by scores of support personnel responsible for specific tactical areas. Finally, at the highest level, rule- or artificial intelligence-based decision support systems provide commanders with recommendations for tactical or strategic decisions based on the data available to the system.

The end result of the process, regardless of the source of data or extent of automation and support, is the individual assessment of the situation by the commander and the issuance of orders for troop movements and equipment deployments to counter enemy threats or exploit enemy weaknesses. The complete process repeats itself continuously throughout the course of a battle.

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Training Requirements for Battlefield Management

A direct result of the variety of operational battlefield management environments and different warfighting scenarios is that the training requirements for battlefield management are extremely varied. One of the most effective ways to train battle management and decision making capability is to provide the trainee with a large number of highly varied training scenarios. Since this is not practical in either live training or actual warfighting, the simulation-based training environment remains the only means by which this training can be undertaken.

As a result, any battlefield management training environment must address all or some of the following elements:

1. it must be flexible to allow a variety of technological environments to be addressed in the training scope now and in the future;
2. it must create a training environment that accurately represents a variety of decision support processes incorporating a combination of people and machines to meet current and future requirements;
3. it must train different combinations of individuals to ensure that information flow and joint decision processes can be realistically represented; and,
4. it must easily provide a wide variety of warfighting scenarios by being easily reconfigurable both in terms of scenario implementation and equipment modeling and simulation.

Although each of these elements is important in the training process, perhaps the most critical is the ability to train different combinations of individuals and teams.

While the commander is the ultimate authority and decision maker on the battlefield, the accumulation and dissemination of information is a team activity which incorporates the commander and all of his support staff. It is essential to be able to train the complete team in a coordinated and controlled environment to ensure that the relationships and information flow adequately support the decision making process, and that the resultant decisions effectively communicated to field units.

However, the costs associated with bringing a complete team together for joint training are often prohibitive. As a result, the training environment must support two related elements:

- the ability to conduct distributed command and control training across multiple geographic locations
- the ability to train a subset of the team with automated components to support

other elements of the command and control infrastructure

To successfully provide each of these capabilities and simultaneously provide the flexibility necessary for future growth and modifications, the training environment must be effectively designed in an environment that intrinsically supports these characteristics.

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Training Systems Based on OSim

OSim is the core simulation framework upon which open, flexible, and growth-oriented simulators and trainers can be developed and delivered, providing end users with the ultimate flexibility for trainer use and modification. OSim provides simulator developers with an object-oriented framework that enforces an object-oriented design and implementation process on the developer. Object oriented design intrinsically supports flexible and reconfigurable simulator designs that have low life cycle cost.

This support is provided by the fact that object oriented systems incorporate inheritance and encapsulation. Inheritance allows class or object capabilities to be derived from other classes without the need to rewrite the software code or redefine the capabilities. The common models are written once and maintained in the class at the highest level of commonality. Derived subclasses need only define the differences in behavior or capability from the class from which it was derived. The encapsulation of models and behaviors within a particular class supports both development and life cycle maintainability since any change which affects a particular class need only be implemented within that class without having to search throughout the rest of the simulation for other possible conflicts.

Using OSim, simulator developers can implement the results of their object-oriented simulator design analysis by defining class libraries and by editing class behaviors and multimedia representations using a user friendly drag and drop user interface that facilitates development and improves efficiency. Furthermore, OSim incorporates a real time execution engine and distributed communication bulletin board system which is automatically linked to the classes being defined by the developer. Finally, OSim incorporates C++ code generation, compiling, and linking which occurs automatically and continuously as a background process while the developer is creating and modifying class characteristics and object capabilities.

Parallel to the development of simulation behaviors within the OSim environment, developers can design and create multimedia viewers which provide trainees and instructors with displays and mechanisms for battlefield status information and data entry or communication. These viewers are then integrated with the OSim bulletin board system to provide a cohesive distributed training environment.

OSim supports a collaborative and spiral development process allowing multiple designers to simultaneously access and contribute to the system design in an iterative manner as each component of the system is conceived and implemented. The end result of each of these capabilities, is that a simulation or training environment developed using OSim can be developed in less time and at lower cost than could be achieved using traditional development processes. Furthermore, the OSim development process supports greater development visibility, thereby decreasing risk to both the development team and the end customer. Finally, the object oriented and C++ code generation implementation of the simulation environment ensures that life cycle costs can also be reduced and that future modifications can be easily be achieved.

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Developing Battlefield Management Trainers with Osim

OSim provides the core capability to implement a training environment that addresses the critical elements of battlefield management training including flexibility, reconfigurability, distributed access, and future growth or expansion.

Combining the capabilities inherent to OSim together with the command and control domain expertise resident within OriginalSim and our partners, we are confident that an effective training device can be created and delivered in a very cost effective manner. Using OSim, a Battlefield Management Trainer can be produced which provides:

- core class simulations of battlefield weaponry and sensors, including movement, detection, and kill capabilities representative of the actual equipment and strategies of red, blue, and orange (or purple) forces;
- multiple 2D, 3D, and audio viewers representative of typical command and control sensors and equipment in use by the friendly command and decision support infrastructure reflecting their display and communication equipment capabilities;
- simulation of decision support processes to automatically replicate components of the command and control hierarchy not present in a particular training course;
- real-time execution;
- distributed communication for both local multi-workstation and geographically dispersed training;
- multiple instructors stations incorporating displays and data entry viewers to allow different instructors to manage different elements of the scenario or to role play the functions of different elements of the command and control process when automated forces are not utilized; and
- data logging and replay capabilities for debrief.

Using this training device, the object oriented attributes of the simulator can be exploited to rapidly create a large number of scenarios incorporating a wide variety of equipment and command and control environments. As necessary to fulfill particular training goals, the simulation environment can be easily reconfigured and optimized to provide different equipment suites, different, force structures, and different levels of manual and automated command and control infrastructure support.

Furthermore, the delivered training environment can be easily upgraded and expanded in the future by the end user, a support contractor, or OriginalSim to provide additional equipment functionality representing new assets to be acquired or evaluated, or new equipment being deployed by potentially hostile forces.

OSim is the facilitating tool underlying the flexibility provided in such a simulator; the domain knowledge of OriginalSim and our partners, together with our inherent knowledge of the design and use of OSim, ensures that this combination of Battlefield Management training capability and flexibility can be achieved and delivered with minimum risk at a cost significantly less than previously possible.

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