DEFENSE TECHNICAL INFORMATION CENTER

Information for the Defense Community

DTIC® has determined on 7/16/2010 that this Technical Document has the Distribution Statement checked below. The current distribution for this document can be found in the DTIC® Technical Report Database.

☑ **DISTRIBUTION STATEMENT A.** Approved for public release; distribution is unlimited.

☐ **© COPYRIGHTED**; U.S. Government or Federal Rights License. All other rights and uses except those permitted by copyright law are reserved by the copyright owner.

☐ **DISTRIBUTION STATEMENT B.** Distribution authorized to U.S. Government agencies only (fill in reason) (date of determination). Other requests for this document shall be referred to (insert controlling DoD office)

☐ **DISTRIBUTION STATEMENT C.** Distribution authorized to U.S. Government Agencies and their contractors (fill in reason) (date of determination). Other requests for this document shall be referred to (insert controlling DoD office)

☐ **DISTRIBUTION STATEMENT D.** Distribution authorized to the Department of Defense and U.S. DoD contractors only (fill in reason) (date of determination). Other requests shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT E.** Distribution authorized to DoD Components only (fill in reason) (date of determination). Other requests shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT F.** Further dissemination only as directed by (inserting controlling DoD office) (date of determination) or higher DoD authority.

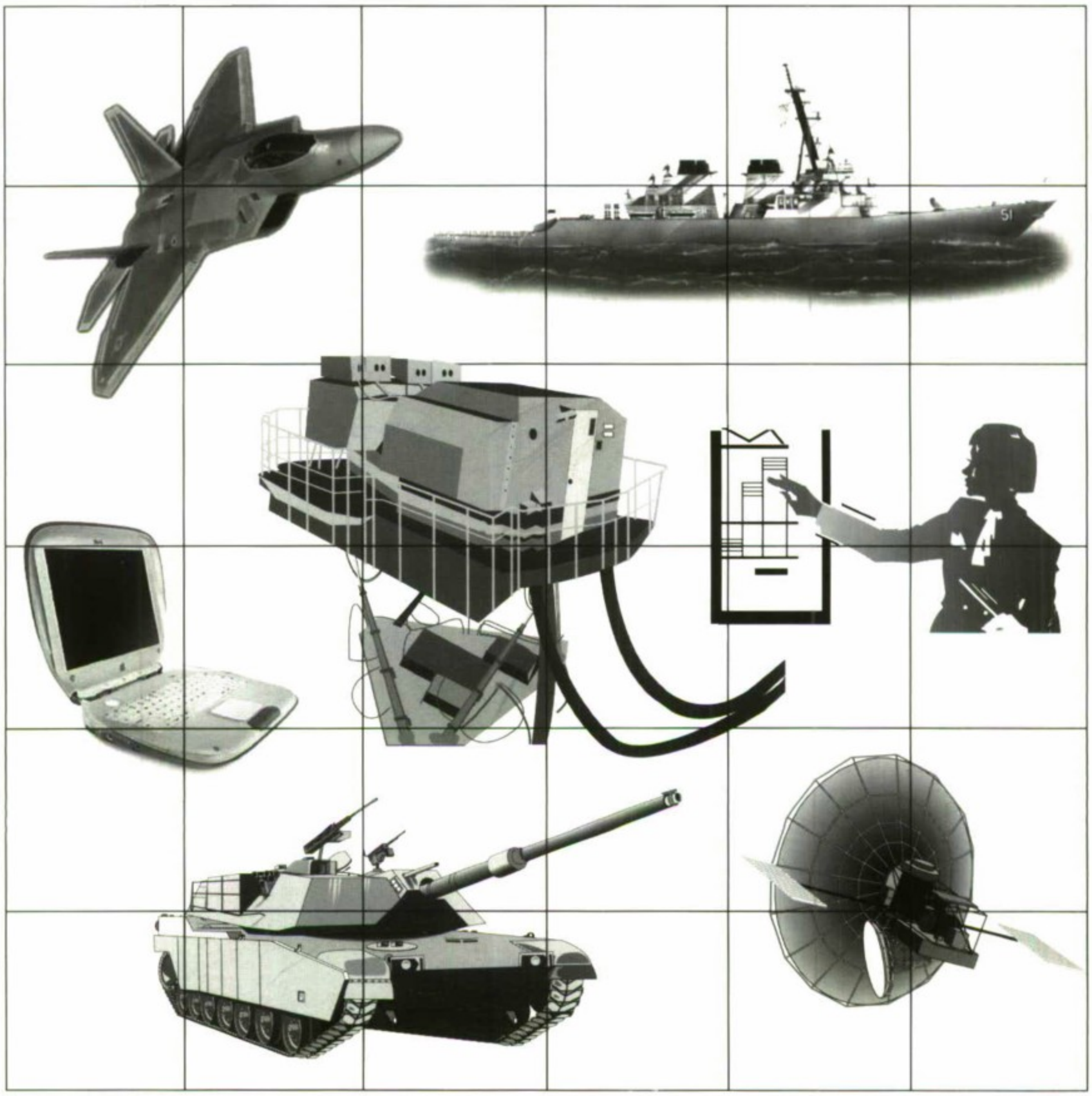
Distribution Statement F is also used when a document does not contain a distribution statement and no distribution statement can be determined.

☐ **DISTRIBUTION STATEMENT X.** Distribution authorized to U.S. Government Agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoDD 5230.25; (date of determination). DoD Controlling Office is (insert controlling DoD office).

Interservice/Industry Training, Simulation and Education Conference

"Partnerships for Learning in the New Millennium"

Abstracts



Orange County Convention Center

Orlando, Florida

November 27-30, 2000

Sponsored by

The National Training Systems Association (NTSA)

An Affiliate of the National Defense Industrial Association (NDIA)

TABLE OF CONTENTS

EMERGING CONCEPTS TECHNOLOGY APPLICATIONS

20100715183

TABLE OF CONTENTS

EDUCATION INSTRUCTION AND TRAINING METHODOLOGY

TABLE OF CONTENTS

TABLE OF CONTENTS

HUMAN FACTOR ENGINEERING AND INTEGRATION

TABLE OF CONTENTS

MODELING AND CONSTRUCTIVE SIMULATION

TABLE OF CONTENTS

POLICY AND MANAGEMENT

TABLE OF CONTENTS

TRAINING AND LIVE/VIRTUAL SIMULATION

TABLE OF CONTENTS

WHAT MAKES A DISTANCE EDUCATION PROGRAM FIRST RATE?

Camille K. Fareri
Electronic Data Systems, Distance learning Solutions

This paper addresses the issue of quality in Distance Learning ("DL") programs. It attempts to examine the issue of quality in distance learning from different angles. Everywhere you look, new "electronic" institutions are offering distance learning courses. The proliferation of DL courses means that colleges, businesses and the military now have choices in selecting distance learning programs and can implement first rate programs. At issue in determining quality in distance learning is "through whose eyes is the quality determined?" On one hand, technologists built the systems and networks on which DL programs operate and view quality in mostly technological terms: access, successful transmissions, download time, etc. On the other hand, educators, who also view access as a criterion for quality, concentrate more on the program's ability to elicit learning. Educators are more interested in the conditions of learning than bandwidth size.
One of the major components of a first rate DL program is the DL strategy employed by a specific institution. About a decade ago, the first, crude attempts at "distance learning" incorporated various methods to teach people who were widely dispersed geographically. In the early days, video broadcasts presented lectures and early attempts at computer-based learning consisted of throwing text onto the computer screen. Electronic books were merely poor imitations of their print counterparts. For the most part, these first approaches were rather unimaginative. In the last decade, the continuum of distance learning strategies progressed from the simple -- Web pages with text delivered over the Internet, Computer Based Training (CBT) delivery and one-way teleconferences/ videoconferences – through more advanced – synchronous instruction using white boarding available online; two way, interactive synchronous teleconferences; asynchronous videoconference supported by online materials with student collaboration and interaction -- to the more mature technologies of today: online synchronous and asynchronous delivery of instructor-developed curricula and multi-media instructional objects, artificial intelligence including various avenues for student interaction/ collaboration and total virtual campus solutions integrating DL courseware with other school functions and student support applications. Regardless of the DL strategy, courseware online needs to motivate, interest and fully involve the students in the learning process. When a boring campus lecture course is converted to monotonous text scrolling across the screen, even the most dedicated and motivated students zone out. The primary test of a course's inherent quality is if it fully engages the students and elicits the desired learning outcomes. This paper explores what research has indicated are the components of effective courseware, how distance education programs can meet the conditions of learning and how to determine quality.

LEARNING WITH REFLECTION: PROJECT PRAXIS

Bradley Goodman, Information Management and Instructional Systems Department
The MITRE Corporation

Luciano Iorizzo, Distance Learning Office
United States Army Intelligence Center

Classroom learning improves significantly when students participate in structured learning activities in small groups of peers. As the U.S. military moves from schoolhouse instruction to web-based distance learning, the student loses this important contact with other students. The educational value of student collaboration has led to the use of conventional groupware tools, such as chat and email, in distance learning environments. While these tools can enrich learning, they require at least two participants who are available at the same time and cannot guarantee the quality of assistance. Students in a web-based environment require high-cali∑ber instructional support on demand. A simulated *learning companion*, acting as a peer in a distance learning environment ensures the availability of a collaborator and encourages the student to learn collaboratively, while drawing upon the advantages of distance learning. The learning companion we designed for PRAXIS encourages the student to reflect on and articulate past actions, and to discuss future intentions and their consequences.

Previous Years Papers Available on CD

EXPERIMENTS IN DECISION ANALYSIS TECHNIQUES FOR SIMULATION BASED ACQUISITION

Peter Eirich, The Johns Hopkins University / Applied Physics Laboratory

Simulation Based Acquisition (SBA) is an emerging approach for DoD systems acquisition. SBA can be applied to a number of acquisition areas, and could be considered as a candidate strategy or best practice for training systems acquisition. In particular, since training systems often directly include a simulation component, the potential benefits from SBA may be even more significant for training systems acquisition than for other types of systems. It is generally accepted that SBA must be supported by a collaborative information technology environment, built around integrated design tools, product and process databases, models, and simulations.

The author's paper published in the 1999 I/ITSEC conference proceedings (see Reference 1) described the preparation of an experimental environment to evaluate candidate data analysis and decision-making techniques that appeared promising for use within SBA. The experimental focus included techniques for the post-analysis of model results, and an evaluation of the desirable characteristics for tools and techniques that could be used for shaping, defining, and quantifying the "decision space" very early in the analysis and design process. The 1999 paper discussed some insights gained during the preparation process for the experiments, but the experimental results were not available in time for inclusion. This paper is a continuation that presents the experimental results.

The research involved a series of experiments in which groups of experts applied different pre- and post- analysis methods to a small scale but realistic design problem – in this instance, the design of a notional missile. Data believed typical of what may be expected from future SBA environments were presented to experts in missile design, who then used the data to reach missile design trade-off decisions. A number of information displays were programmed, and in the course of a series of decision problems, the experts' preferred display formats became apparent. Suggestions for making the preferred displays even more useful were recorded during the sessions. This paper reviews the types of information display formats utilized, indicates the ones found to be most useful by the decisionmakers, and identifies their proposals for further improvement. In addition, to help prepare for the graphical data presentation sessions, structured group decision analysis techniques were employed in advance to assess the relative importance of several of the decision factors. This paper summarizes additional insights for SBA decisionmaking based on employing this alternative decision analysis approach.

IMMERSIVE VIRTUAL ENVIRONMENTS TO SUPPORT SYSTEM DESIGN AND ACQUISITION

Grace M. Bochenek, Ph.D. and Kenneth J. Ciarelli
U.S. Army Tank Automotive Research, Development, and Engineering Center

Engineers at the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) are developing and applying high end projection-based immersive virtual reality tools and engineering-fidelity simulations to meet Army customer demands for simulation-based evaluation of ground vehicle designs, technology, and proposed product improvements throughout a vehicle's life cycle. As part of TARDEC's continuous improvement of its Simulation-based Development Processes, TARDEC acquired two projection-based immersive visualization facilities (i.e., CAVE™, PowerWall™) to permit multi-functional integrated concept/product teams to assemble and solve design problems with the assistance of high-end computer visualization tools. These technologies involve real-time simulation and interactions through multiple human sensorial channels making users believe they are interacting with real vehicle systems when in actuality they are only interacting with computer generated replicas.
Within this synthetic environment team members can simultaneously enter a virtual product design world and jointly evaluate design issues, ideas and parameters, each from their own experience, perspective, and functional responsibility. This paper will describe our virtual product design process, the visualization toolset assembled, a summary of the customization necessary, highlights of our experiences to date in a series of user applications, changes and effects on the Army acquisition process, and future research directions. These visualization tools are being used in the Army to evaluate technologies that will significantly change the user's role in the operation of its vehicles. It will also have application in the development and evaluation of technologies going into the Army's Brigade Combat Team and Future Combat Systems.

DEVELOPMENT OF A VIRTUAL DISTRIBUTED COLLABORATIVE ENVIRONMENT

Grace M. Bochenek, Ph.D.[1], David A. Brown[2], Robert Heinlein[4], Abhinav Kapoor[3], Yair Kurzion, Ph.D. [5], Alexandre Naaman[5], Thomas D. Rikert[5], Mark Sokolik[2], Jenny Zhao[5]
[1]U.S. Army Tank Automotive Research, Development, and Engineering Center,[2]EDS VR Center, [3]MultiGen-Paradigm Inc.
[4]EDS Federal, [5]SGI OpenGL Performer

As a dual use science and technology effort, the U. S. Army Tank Automotive Research, Development, and Engineering Center (TARDEC), in partnership with EDS, SGI and MultiGen-Paradigm, is developing a unique suite of software tools that provides the capability for geographically distributed teams or individuals to conduct engineering level design reviews and analysis within a common synthetic environment, a virtual distributed collaborative environment (VDCE). This paper describes the impact of collaborative virtual environments on Army acquisition processes, issues related to collaboration, methodologies used to develop technical solutions, an overview of the technical architecture, and results of experimentation and applications to military system acquisition. The VDCE technology and its application to Army processes has the potential to improve Army acquisition processes, to improve system product quality, and to reduce system development costs.

DEVELOPMENT OF A VIRTUAL POVING GROUND USING HIGH-RESOLUTION TERRAIN

Alexander A. Reid, Ph. D.,Researcher Electrical Engineer, Stacy A. Budzik, Mechanical Engineer, U.S. Army Tank-automotive, Armaments Command,

TARDEC, in conjunction with their Dual Use Application Program partners, is collaborating to create a realistic, engineering-level of detail, virtual environment in support of, both the Army's Simulation Based Acquisition and Simulation Through the Life Cycle programs, along with commercial product development. The Vehicle and Heavy Equipment Virtual Proving Ground (VHEVPG) will be used by the Army and Industry to apply "proof of concept" demonstrations through use of high fidelity, motion based, human and hardware-in-the-loop simulations. This is being accomplished through the utilization of high-resolution engineering-level vehicle models, terrain and visualization, along with three of the worlds most advanced ground vehicle motion simulators. These include both TARDEC's Ride Motion Simulator (RMS) and Crew Station/Turret Motion Base Simulator (CS/TMBS) and the National Advanced Driving Simulator (NADS) located at the University of Iowa. Environment will exploit the unique capabilities provided by each individual simulator- the high frequency capability of the RMS (up to 50 Hz), the large active payload (25 tons) of the CS/TMBS, and the sustained accelerations and large motion envelope of the NADS. The objective of these programs is to develop a high-fidelity VHEVPG comprised of dynamic models, experimental terrain techniques, enhanced graphics and associated data collection and analysis techniques across distributed, concurrently running, simulations. This environment facilitates the evaluation of vehicle and human performance, human-machine interoperability, vehicle and crew compartment design, along with the design of training simulators. The results of this program will enable the acquisition of vehicles and their subsystems, resulting in an efficient user oriented design process.

21 ST CENTURY TERRAIN – ENTERING THE URBAN WORLD

Jeffrey T. Turner, Christian P. Moscoso
Program Executive Office – Intelligence, Electronic Warfare, and Systems

This paper describes the Rapid Terrain Visualization (RTV) programs advancements in the rapid collection of high-resolution digital topographic elevation and feature data in support of crisis or contingency operations for both military and civilian users. The ability to rapidly collect high-resolution urban terrain data affords our leaders and planners the capability to implement the next generation of visualization tools and tactical decision aids.
Information in this paper highlights the technology developed to collect this data as well as prototype applications evolving to exploit high-resolution urban terrain.

DYNAMIC TERRAIN IN A DISTRIBUTED SIMULATION ENVIRONMENT WITH LOW COST PC

Rita Simons
Simulation, Training and Instrumentation Command (STRICOM)

Jesse Liu, AcuSoft

Graham Upton and Tim Woodard,Diamond Visionics

As technology utilized in simulation has grown, so have the requirements for a realistic solution to the dynamic terrain problem in the synthetic environment. In order to support the DoD Simulation Based Acquisition (SBA) initiative, the need for a high fidelity Synthetic Natural Environment simulation is fundamental and critical. Specifically, a realistic dynamic terrain solution is required by the Advanced Concepts and Requirements (ACR) community, and maneuver forces using simulation to support their collective training objectives. Research has previously been conducted in the area of dynamic terrain implementation, and the dynamic environment. Dynamic terrain is not new to the simulation community, however previous efforts have required high-end computational platforms, were unable to perform in real-time, and were often low fidelity in appearance. With the fast paced improvements in the performance of Personal Computers (PCs) and image generators, the realism that is required for a dynamic terrain implementation is now achievable on a PC. The US Army STRICOM sponsored a Phase I Small Business Innovative Research (SBIR) topic addressing these requirements, which has progressed to a Phase II effort. In the Phase I effort, Diamond Visionics Company (DVC) and AcuSoft teamed to provide a PC based technology demonstration of dynamic terrain incorporating simple soil dynamics. Phase II objectives include the development of a platform independent software solution that has an open architecture and application program interfaces, providing the fundamental functionality required by digital synthetic environments to implement dynamic terrain in a DIS/HLA network. The developed solution will use SEDRIS (Synthetic Environment Data Representation and Interchange Specification) as the underlining data standard. This paper will address the use of dynamic terrain in a Distributed Simulation Environment utilizing low cost PC platforms. It will examine the challenges of implementing dynamic Synthetic Natural Environment in a distributed simulation environment, specific issues related to DIS networking, and the challenges and advantages associated with HLA migration. It will also address interoperability with simulations and systems that encompass a wide range of fidelity, resolutions and application domains.

Previous Years Papers Available on CD

QUANTITATIVE PERFORMANCE-DRIVEN PC-BASED IMAGE GENERATOR EVALUATION FOR VISUAL INTEGRATED DISPLAY SYSTEMS

Budimir Zvolanek, Training and Support Systems – The Boeing Company
William Paone, PureLogix Division - Westar Corporation
Ed Elking, Training and Support Systems - The Boeing Company
Tim Dwyer, Training Systems Product Group – USAF ASC/YW

Affordability and performance of training systems devices have become key factors in improving availability of training to a broader military community. An example of this is the Target Projection System (TPS) embedded within Boeing's Visual Integrated Display System (VIDS) – a product delivered to a number of military training programs such as the T-38 and the USAF Distributed Mission Training (DMT) F-15C and DMT F-16 programs. Driven by a dedicated image generator (IG), the TPS simultaneously projects multiple high-resolution images of aircraft onto VIDS screens. Until recently, only a desk-side workstation or a full-featured, high-performance IG has had the polygon and pixel-fill performance necessary to generate the TPS aircraft imagery. However, rapid advances in PC-based three-dimensional (3-D) graphics technology have finally offered such performance at a much lower cost. This paper describes Boeing's effort in transitioning PC-based IG technology into the VIDS product by quantitative measurements of PCIG performance using TPS-specific benchmarks. IG performance requirements and their embodiment in benchmark databases and test software are described. Available PC-based IG descriptions are provided followed by a comparison of the benchmark test results, as well as a discussion of issues with real-time image generation hardware and software integration. Finally, a recommendation of the TPS PC-based IG is presented based on the observed performance, as well as IG features and other 'non-performance' factors. Suggested PCIG applications conclude the paper.

DEVELOPING INTELLIGENT INFRARED TARGETS FOR TESTING AND TRAINING (IRT^3)

Primary Author: Dan Mullally, Secondary Author: Thomas L. Clarke
Institute for Simulation and Training, University of Central Florida
Third Author: Glenn Boreman, Center for Research, Education in Optics, Lasers, U of Central Florida

This paper will describe the developmental steps of a Live Fire Testing and Training Initiative project to develop intelligent, interactive infrared (IR) targets for use in both training and testing. The University of Central Florida (UCF) team will develop an IR projection capability suitable for providing live-fire targets for testing and training with IR systems in the 8-12 micron band. The system will use a Computer Generated Forces (CGF) system to control the IR projector imagery to provide intelligent, shoot-back capable, IR targets projected onto a fountain of water. Current IR Target systems are unsatisfactory. Conventional approaches use IR targets physically heated with heating strips that are constantly being "blown away" when used in live fire. In addition heating strips have slow response time and cannot provide fast changing and moving imagery. Scanning laser projectors are not suitable since their interaction with the scanning mirrors in Forward Looking InfraRed (FLIR) sensors produces the appearance of a cloud of butterflies. The unique developmental approach detailed in this paper is based on the Texas instruments (TI) video projector Digital Light Processor (DLP) technology. The project is designed to produce the full range of military targets on unique reusable and renewable water-based projection screens.

ESTABLISHING A UNIT CONTROL METHODOLOGY TO SUPPORT EMBEDDED SIMULATION

Vanna McHale, Applied Software and Systems Engineering Technology Group, Science Applications International Corporation

The Inter-Vehicle Embedded Simulation Technology (INVEST) program is dedicated to providing onboard simulations in support of training exercises for tactical vehicles. The Synchronized Player Model (SPM) portion of the INVEST program was conceived to reduce the wireless communications bandwidth between the embedded simulations used in a coordinated training exercise. Current research of the SPM project focuses on the development of a Unit Control Language (UCL) used to provide the virtual models of a live unit.This research identified a set of unit control primitives that operate as high level behaviors to facilitate synchronization between live vehicle(s) and their simulation model. This paper describes the primitives identified for successful control and the Difference Analysis Engine (DAE) developed for primitive selection. Experiments to validate the UCL as a potential means of vehicle synchronization were executed within a Java testbed environment and generated results that were evaluated against current dead reckoning techniques. The success of this unit control language, merged with previous research in independent vehicle control provides optimal solutions for reducing bandwidth in coordinated training. Future research includes analysis of Subject Matter Experts decision making criteria for DAE refinement.

SIMULATION DRIVEN VIRTUAL OBJECTS IN REAL SCENES

Erol Gelenbe and Khaled Hussain
School of Electrical Engineering and Computer Science
Billy Foss, Institute for Simulation and Training
Niels Lobo, School of Electrical Engineering, UCF
Hubert Bahr, U.S. Army STRICOM, Orlando, FL

STRICOM, together with the School of Electrical Engineering and Computer Science (SEECS) and the Institute for Simulation & Training (IST) at the University of Central Florida are developing a system to allow virtual objects to be placed in live images in real time. The proposed approach is simulation driven in that it will use a geometric database of the site of the live scene to drive a simulator which will be used to predict the location of the synthetic object in the real scene at each instant of time. The research we are conducting involves object identification in the real world scene using registered overlays, registration of the real world view with the synthetic view of the virtual terrain data, placement of the virtual object with the synthetic terrain and then the natural view using simulation, and finally realistic integration of the synthetic object into the live scene. New techniques are being developed to determine the occlusion of virtual objects based on their relation to terrain features in the live scene. This paper describes the whole process used in the project, discusses the basic algorithms and presents novel techniques used for recognition and placement of the objects.

Previous Years Papers Available on CD

TRACKING TECHNOLOGIES FOR VIRTUAL REALITY TRAINING APPLICATIONS: A CASE STUDY

Malachi J. Wurpts, Tammy L. Swanson, Rolan Tapia
Southwest Research Institute

In response to continuous reductions in available funds, time, personnel, and facilities dedicated to training, the United States Marine Corps (USMC) is avidly exploring supplementing its current training with virtual reality (VR) training applications. The goal of these applications is to provide a computer-mediated experience in which trainees can perceive and interact with a synthetic or simulated battlefield and simulated objects in a realistic manner. VR training devices have the potential to meet the flexibility, portability, and reconfigurability training requirements that are now necessary to prepare for ever-increasing USMC operational demands. Recent advancements of VR technologies are increasing the potential for more realism in VR training devices. Despite the tremendous advancements in VR technologies, one major question remains. Are these advancements significant enough to support the levels of realism required for training purposes? To answer this question, the USMC through the Office of Naval Research (ONR) is conducting several VR initiatives. One of these initiatives is the Small Unit Tactical Training Advanced Technology Demonstration (SUTT ATD) Program. The top-level goal of the SUTT ATD is to demonstrate how VR technologies can be used to support current and future USMC training requirements. These requirements range from the training of individuals operating in close combat situations to the training of a crew of individuals operating in a wide array of combat vehicles. One of the major SUTT ATD tasks is the evaluation and assessment of various VR technologies. These include computers (hardware and software), tracking systems (for human and/or weapon motion), locomotion systems (for traversal through a virtual environment), and graphical display technologies. This paper focuses specifically on the SUTT ATD tracking technology studies. With the emergence of many new tracking technologies (e.g., mechanical, acoustic, inertial, magnetic, and optical) over the last few years, it is extremely difficult to determine the appropriate tracking solution(s) for various training applications. Because tracking requirements may differ significantly for different applications, selecting the appropriate tracking system for a specific application becomes even more challenging. While technical specifications such as accuracy and resolution may be useful indicators of tracking system performance, for comparative purposes they can be misleading. In most cases, these specifications are tied to environmental conditions that are ideal for the specific technology. In addition to conducting accuracy measurements in more representative environments, these studies address other qualitative measures such as cost, ease of use, footprint, reliability, expandability, and technical support. They are also intended to present an approach to resolving the technical issue of finding and selecting appropriate tracking technology solutions.

Previous Years Papers Available on CD

AN EVALUATION OF THE TRAINING EFFECTIVENESS OF VIRTUAL ENVIRONMENTS

Barbara Barnett, Katrin Helbing, Glenn Hancock, Raymond Heininger, Bruce Perrin, The Boeing Company

During the Boeing Joint Strike Fighter Concept Development Phase, we investigated the feasibility of using three-dimensional (3D) solid models, implemented within a Virtual Environment (VE), as a low-cost partial replacement for conventional hardware mockup trainers for aircraft maintainers. Currently, there are few studies directly comparing performance using VE-based training to more conventional methods. This paper summarizes the results of several empirical studies conducted to evaluate the effectiveness of aircraft maintenance training within VEs. In these studies, trainees were taught a simple remove-and-replace maintenance procedure. The task, while not complex, required a number of ordered steps involving visual and physical obstructions. Training effectiveness was assessed with a written test of task procedures and with an objective assessment of task performance on a hardware mockup. Measures of performance included task completion time and procedural errors (e.g., incorrect action, wrong tool). The initial study compared hardware mockup training to two alternative display formats: solid model-based VEs and 3D line drawings implemented as computer-based displays (CBD). Within each of these display formats, we compared passive "hands-off" training with user-interactive training. Results of the study indicated that as realism in the virtual training environment increased, performance approached that achieved with the more costly, time-intensive hardware mockup training. Another study assessed immersive Virtual Reality (VR) for task training. Participants in this condition trained for the maintenance task in an immersive VR, wearing a head-mounted display and interacting with task components using a 3D mouse. Results indicated that training time for the immersive condition was longer than the other CBD training methods, with a diminished task performance. Finally, using participants from the initial training study, we addressed the effectiveness of using Ves for maintenance rehearsal three months after completing initial training. Rehearsal involved a review of the task using one of two CBD methods. The first rehearsal condition was a review with annotated technical drawings; the second was the solid model-based interactive VE. A third group, the control, had no rehearsal. Performance for all participants was evaluated as before – with a written test of task procedures and performance on the hardware mockup. Results of this study showed a trend for better performance after interactive VE rehearsal over that of the other two conditions. Collectively, these studies indicate that solid model-based VEs provide a potentially significant alternative to hardware mockup based training, resulting in savings in training time and cost. Further research is needed to identify the types of training scenarios for which VEs are most effective.

Previous Years Papers Available on CD

EMPLOYING AUGMENTATION IN VIRTUAL ENVIRONMENTS FOR MAINTENANCE TRAINING

AXEL HINTZE, MARCO SCHUMANN, STEFAN STUERING
DEPARTMENT OF PLANNING AND VISUALIZATION TECHNIQUES – FRAUNHOFER IFF

The application of conventional training methods displays many disadvantages particularly for highly complex equipment. Significant improvements and cost reductions can be achieved by means of three-dimensional computer visualization and animation of technical scenarios. This paper identifies with a list of common problems which will be improved in the Virtual Training environment. The main idea is to develop a general modeling methodology that can be utilized in a wide variety of scenarios, while minimizing the need for programming simulation source code. The different layers of information used to define a training scenario are then described in detail. Both the author's view and the trainee's view of the developed prototype are presented. Finally, the paper concludes with a description of the goals of a most recent research project which will adapt these scenario structures for utilization in an Augmented Reality environment

FINITE-STATE GRAMMATICAL MODEL AND PARSER FOR AIR TRAFFIC CONTROLLER'S COMMANDS

Jorge L. Ortiz, Ph.D, PEElectrical & Computer Engineering Department, College of Engineering, University Of Puerto Rico

This paper presents a grammatical model for the air traffic controller's (ATC) commands using finite-state transition networks (FSTN). The grammatical representation is used by a syntactic parser and recognizer for the analysis of the grammatical structure of the commands. A grammatical description using FSTN is proposed for the ATC's commands assigning word categories and syntactic structure that can be followed by a syntactic parser for recognition and parsing. This paper, also, presents an innovative model using "skip loops" for the implementation of a syntactic parser using finite-state transition networks to delete and remove incorrect or out of syntax words. These words could be the effect of mixed streams of words or errors in the conversion from spoken language to characters. The skip loop is an arc that allows the finite-state transition automata (FSTA) to delete a word that does not match the grammatical structure of the sentence, and continue the recognition process without affecting the syntactical definition of the sentence. This particular approach is especially useful in areas such as the command language of the air traffic controller (ATC). The model uses FSTN with skip loops to model and recognize ATC's command language. The use of skip loops allows deleting words that may be present in the statement that are unrecognized or that do not fit into the grammatical structure of the ATC's language. This technique facilitates the recognition of the statement minimizing the possibility of declaring the statement as ill-formed. Two syntactic parser prototypes are implemented using Prolog and CLIPS. These techniques are useful in applications like military tactical environments that are exposed to rapidly changing commands, streams of information, and different sources of background noise. Many critical decisions have to be made extracting the correct information from multiple input streams making difficult and uncertain the selection of the correct input information. The method presented introduces a certain degree of intelligence using current AI techniques to obtain an intelligent syntactic parsing of the input information. The parser syntax can be defined to dynamically adjust its model to follow a particular stream of information that sounds or looks appropriate for the particular context. The purpose of the parser will be to model the process that resembles the human ability to follow a single dialog in an environment where there is many conversations and background noise.

A SPEECH-CONTROLLED INTERACTIVE VIRTUAL ENVIRONMENT FOR SHIP FAMILIARIZATION

Stephanie S. Everett, David L. Tate, Tucker Maney, Kenneth Wauchope
Naval Research Laboratory

This paper describes an interactive virtual environment (VE) designed to help Navy personnel become familiar with the layout of a ship. The system combines a 3D VE model of the ship with a spoken natural language interface that enables the user to issue verbal commands and queries to the model. By allowing the user to ask "Where am I?" or "Where is the Communications Center?", or tell the system to "Show me how to get to the Control Room from here" the virtual environment becomes more than just a passive representation of a 3D space – it becomes an active training aid that may help speed the learning process.

The paper also discusses the need for better integration of graphic representation and object identification information to support future interactive VE systems.

SPEECH RECOGNITION IN NOISY MILITARY TRAINING ENVIRONMENTS

Stephen G. Boemler, R. Bradley Cope,
Naval Air Warfare Center Training Systems Division, Orlando
Henry L. Pfister, SOS Inc., Shalimar, FL

A common problem using speech recognition in simulated training environments is that computer speech recognition often fails at even moderate noise levels. Although training realism is increased when simulated noise environments such as a carrier landing deck are incorporated, the intense noise from military activities makes speech recognition highly problematic. This research developed adaptive noise canceling digital filters to enhance computer speech recognition in high noise environments. This particular design is specific to the Landing Signal Officer Trainer (LSOT FY 99 Block Upgrade was initiated under Contract N61339-97-D-0003, Delivery Order 010, 7 April 1999 by NAWCTSD project manager Ron Cole), but the high noise speech recognition technology adaptation is applicable to a large number of training, simulation, and operational systems. The project focused on removing the additive noise in the environment with adaptive digital filters inside a speech recognition algorithm. The adaptive filter relies on a recursive algorithm that is self-adjusting, which allows the filter to perform in situations where complete knowledge of the signal is not available. It is a process where the parameters of the adaptive filter are updated from one iteration to the next, and the parameters become data dependent. The design of the adaptive filter employs two signal estimates, one for the noise and the other for the combined speech and noise signal. The adaptive filter identifies the noise signal and looks for similar spectra in the speech signal. It then removes any matching noise signal from the speech signal.The speech recognition algorithm source code was modified to incorporate the adaptive filter after the acoustic signal processing which consisted of a 256 speech sample (real part of the Fourier Transform). The recognition is triggered by a push to talk microphone and the initial signal period is used as the noise estimate (or in the case of the LSO trainer, the synthesized aircraft noise is used since the noise is known and does not require an estimation). A Least Mean Squared adaptive filter is performed and the noise reduced complex Fourier coefficients are processed by the speech recognition system. This avoids the distortion encountered when transforming the filtered data back to the time domain. The LSO trainer environment simulates an aircraft carrier landing deck with an ambient noise level of 80 dB. The speakers use handsets which feed into a PC based speech recognition system running the Entropic HTK speech recognition system. This system was modified to incorporate the adaptive filter in the frequency domain for noise cancellation. Examples of the LSO noise environment, speech input, and recognition performance are presented for this research. This research was funded by a combination of Small Business Innovation Research (SBIR) contracts from the Naval Air Warfare Center Training System Division in Orlando and the Air Force Research Laboratory. The NAWCTSD SBIR contract N61339-98-C-0017 was initiated by program manager Robert Seltzer and the Phase II effort was completed on 31 July 2000.

Previous Years Papers Available on CD

AGGREGATION OF ENTITIES FOR ENTITY-AGGREGATE SIMULATION INTEROPERABILITY

Mr. Lawrence A, Rieger, Mr. Emmett Beeker
HQ, TRADOC TPO OneSAF, GRC International, Inc., An AT & T Company

The continual evolution of military simulations has provided much of the technology for the exchange of entity data between the environments. In particular, the extensive development in the resolution and granularity of aggregate simulations, combined with the entity data and ownership transfer capabilities of the High Level Architecture (HLA), has broken much of the virtual to constructive barriers for meaningful and productive data exchanges. So much so that in simulations, the real division has changed to be between the entity and aggregate simulations environments. The real challenge is no longer moving entity data between the live, virtual and constructive environments, but rather the movement of entity data between the entity and aggregate environments. This paper discusses eliminating the artificiality of aggregate state casualty resolution and assessment tables and the aggregation and de-aggregation of entities when passing ownership between entity and aggregate simulations.

ON THE FIDELITY OF SAFs: CAN PERFORMANCE DATA HELP?

Amy Henninger, Avelino Gonzalez, William Gerber, Michael Georgiopoulos, and Ron DeMara
School of Electrical Engineering and Computer Science
University of Central Florida

A recent report developed by the National Research Council (NRC) for the Defense Modeling and Simulation Office (DMSO) encourages the use of real world, war-gaming, and laboratory data in support of the development and validation of human behavioral models for military simulations. Also encouraged in this report is the use of interdisciplinary teams embracing the disciplines of the psychological, computer, and military sciences to create such models. This paper describes the use of an artificial intelligence modeling framework, observational learning, to support these objectives. This framework combines the research methods of experimental psychology with the machine learning methods of computer science to develop behavioral models from data generated by military experts participating in live and/or simulated exercises. To date, research has demonstrated that behavioral models developed through this framework can be integrated into popular Semi-Automated Force (SAF) systems to enhance their performance. However, there has been no known investigation as to what the benefits of this approach are with respect to behavioral model fidelity. This paper introduces the interdisciplinary nature of observational learning by briefly surveying its history with respect to computer science and psychology and by illustrating how it can be used in conjunction with military experts. Next, this paper examines experimental evidence to determine whether a significant difference exists between SAF performance and human performance for a low-level, skill task. Finally, this paper demonstrates how behavioral models developed through human performance data generated by military SMEs can be used in conventional SAF systems to make SAF performance more "human-like".

Previous Years Papers Available on CD

USE OF ACTIVE NETWORK TECHNOLOGIES FOR DISTRIBUTED SIMULATION

Dr. Stephen Zabele
Litton-tasc, inc.

Thomas Stanzione
Litton-tasc, inc.

While distributed simulation infrastructures have evolved dramatically over the past several years to provide ever increasing levels of flexibility, abstraction, and interoperability, the scalability and performance of the simulation infrastructure continues to be a critical limiting factor. In particular, it is now becoming apparent that the limitations of the supporting networking technologies are a significant impediment to achieving needed levels of scalability and performance. Advancing the state-of-the-art for large-scale distributed simulations therefore requires significant advances both in the underlying network technologies and in the ability of simulations to exploit these new capabilities. Under the specialized active networking technologies for distributed simulation (sands) project sponsored by the information technology office (ITO) of the defense advanced research projects agency (DARPA), tasc and the university of Massachusetts, Amherst (UMASS) are developing active networks-based capabilities to improve significantly the performance of network-based distributed simulations . Our primary objective is reducing the substantial amounts of irrelevant network traffic delivered to simulation hosts in order to both improve bandwidth efficiency and to reduce the considerable overhead associated with reading and discarding unneeded data. Our approach involves installing dynamic packet filters within the network that act on behalf of each host to eliminate unneeded packets as early as possible. Our goal is a seamless integration with the high level architecture (HLA) declaration management (dm) and data distribution management (DDM) services. Use of active networks to provide interest management services offers several important benefits to large scale simulations: (i) because each entity can install its own filters, information filtering is accomplished in a "receiver-driven" manner, allowing each entity to customize its filters according to its own need. This decentralized approach allows active filtering to scale well as the number of entities grows large. (ii) because active filtering is performed at a routing point, filtering can also be dependent on the state (e.g., congestion-level) at that router. In particular, this allows both entities and network routers to determine which data should be shed in times of congestion overload, and provides an effective means for mediating among the conflicting demands of different entities.

HIGHER-LEVEL INTEGRATED TEAM TRAINING ENVIRONMENT FOR SPACE (HILITE)

Timothy Choate, John Friskie, Sytronics, Inc.
Eric Loomis, Ball Aerospace & Technology Corp.

Dr. Barbara Sorensen, Air Force Research Laboratory

As the Air Force continues the Expeditionary Aerospace Force (EAF) implementation, two factors are paramount to its employment: 1) training the geographically-separated, yet organizationally-related, EAF units for their area of responsibility prior to their on-call window, and 2) incorporating space-based systems into all EAF training and operations to gain the force enhancement effects fundamental to successful EAF employment. These two factors will yield the light, lean, and lethal force possible through the EAF concept. However, to realize the full combat potential of the aerospace team, the EAF plan requires units to train as they would fight, despite the limits imposed by financial constraints and geographic separation. Providing this training capability is Distributed Mission Training (DMT), the concept the Air Force is pursuing as the means to train aerospace teams using realistic synthetic battlespaces. DMT is an overarching approach applied to several domains – DMT-Air, DMT-Space, DMT-Special Operations, and DMT-Command and Control – with each domain having its own unique issues preventing a universal solution. This paper focuses on DMT-Space (DMT-S) and examines using DMT to conduct team training for space crews as part of the overarching EAF paradigm. We examine the team training requirements and system capabilities needed for such an approach, and present the results of our efforts to design and implement a prototype DMT-S training environment using the High Level Architecture and other distributed simulation technologies. Our prototype system provides the simulation assets that are needed to deploy a simulation environment for space operators involved in space missile warning activities. Further, the HILITE environment enables realistic, real time interaction between space-based system operators and dynamic digital threat environments. This allows operators to train effectively at any time and from any location. In addition, we examine the potential connectivity and interplay between the DMT-S and DMT-Air segments to determine the requirements and possible scenarios for a fully heterogeneous and multi-system battlespace capability. This information will be of significant interest to the I/ITSEC community as it focuses on strategic training initiatives and provides a unique and timely perspective on how DMT technologies can be applied to support space operator training requirements.

CLOSED-LOOP ADAPTIVE TRAINING - APPLICATIONS FOR SATELLITE OPERATOR TRAINING

John J. Morris, Dr. James E. McCarthy, Stephen P. Pacheco, Daniel L. Bowdler, Sonalysts, Inc.
Dr. Winston Bennett, Jr., Air Force Research Laboratory, Human Effectiveness Directorate

Closed-loop adaptive training is an emerging concept that integrates object-/objective-based adaptive interactive multimedia instruction (IMI), intelligent tutoring system (ITS), and modeling and simulation technologies. The result is an inherently learner-focused training approach that dynamically manages mastery of knowledge and skill learning objectives. This paper describes an application of closed-loop adaptive training concepts to Air Force satellite operator training. A generalized instructional design methodology is presented for creating a closed-loop, adaptive training system. This paper describes how the methodology was applied to the new three-phase Space Training concept for Satellite Command and Control Training at the 534th Training Squadron at Vandenberg AFB.A high-level architecture and design for a Satellite Operations Training System (SOTS) is presented. The SOTS design outlines training system configuration options, hardware and software architecture, and general software component descriptions. The modular architecture integrates two commercial-off-the-shelf (COTS) satellite simulation products with proven intelligent tutoring and advanced distributed learning (ADL) technologies. The architecture is scalable and extendable to large-scale training systems, simulation-based embedded trainers, and distributed mission training (DMT).

AN EMPIRICAL EVALUATION OF THE JAVA AND C++ PROGRAMMING LANGUAGES

David R. Pratt, Anthony J. Courtemanche, Jamie Moyers and Charles Campbell, Science Applications International Corporation

The scarcity of applicable empirical data on the issue of C++ versus Java performance led the authors to conduct their own series of performance studies. A performance comparison was made of Java and C++ in the implementation of a test system representative of those encountered in simulation systems. The algorithms chosen were deemed to be representative of both the algorithms used in simulation systems and those which consume the majority of the time-based computational load. They included a hull dynamics model, geometric intervisibility, and a scheduler / dispatcher. The exact same algorithms were implemented in both Java and C++. As with some developmental programs, execution speed was not the only item of concern in this study. Often programmer productivity and error rates are major factors in choosing a particular programming language. To capture information about these factors, productivity rates of each of the programmers were recorded as they developed code from scratch and ported the code to the new language. Subjective evaluations from each of the programmers concerning their opinions on the ease of using the language for the given applications was also collected. This paper describes the programming language study and presents empirical and subjective findings that both program managers and developers should be aware of when making programming language selections for future simulation systems. This is the second paper in a series of empirical studies the authors have conducted into the relative performance programming languages and their suitability to the Modeling and Simulation Domain.

DIRECT USE OF AVIONICS SOFTWARE IN TRAINERS

Dale H. Fawcett & Teresa Siegrist
Lockheed Martin Aeronautic Company

One of the historic problems of aircrew training simulators has been concurrency of the trainers with the aircraft. With aircraft systems being updated more rapidly with software operational flight programs instead of hardware changes, the concurrency problem is exacerbated. Lockheed Martin has successfully used the main mission computer Operational Flight Program (OFP) on commercial computer hardware in aircrew training simulators. Now with new trainers, and updates to existing training simulators, we are expanding the concept into other avionics software, starting with the Digital Terrain System (DTS). This paper describes the current work of developing and implementing the DTS OFP into the F-16 Mission Training Center for the United States Air Force and the Mid Life Update (MLU) aircrew trainers for the European Participating Air Forces. This development process takes advantage of the commonality of the software used in testing the avionics software in the Aircraft System Integration Lab and that used in implementing the avionics software in trainers. The common Ada Virtual Machine Interface (AVMI) plays a critical role in the trainer implementation by providing executive and input/output functional interfaces between the real OFP and the simulated environment. The AVMI methodology greatly assists in implementing avionics programs into trainers, and solves some of the problematic conditions of porting real OFPs into commercial computers in training simulation.

SIMULATOR COST REDUCTION USING A DISTRIBUTED I/O AND DISTRIBUTED POWER ARCHITECTURE

John McCrillis, Kevin Cahill, Joseph Kerkes, Clint Steffan
BAE SYSTEMS Flight Simulation and Training

A typical full flight simulator has 1,200 or more Input/Output (I/O) points, comprised of a combination of digital inputs (DIs), digital outputs (DOs), analog inputs (AIs), analog outputs (AOs), synchros, and resolvers. In a conventional I/O system, discrete wires are run to each I/O point through a series of connectors, cables, and distribution panels before arriving at an I/O cabinet where the signal is digitized and transferred via high-speed bus to the host computer. The system is complex and is a bottleneck for both hardware development and hardware/software integration (HSI). For example, when several panels share a common distribution panel, every panel must have its wire Assignments complete before the distribution panel can be complete and HSI cannot begin until all the connected systems are ready to be powered. To eliminate these bottlenecks and to reduce the overall complexity of the system, BAE SYSTEMS has investigated various embedded computer system products for decentralizing the I/O system. We have concluded that commercially available products can effectively meet the computational and networking requirements of a distributed I/O system for flight simulators and do so at lower cost than the typical centralized system. However, further analysis of this concept revealed additional savings by decentralizing the power distribution as well. The result was the development of a unique I/O-Power module that fundamentally alters simulator development. This paper discusses the analysis and development work conducted to draw this conclusion.

Previous Years Papers Available on CD

AUTOMATED LINEAR FEATURE EXTRACTION IN SUPPORT OF RAPID DATABASE GENERATION

Richard Ley, Steve Wallace and Nick Davies
Space Department, Defence Evaluation and Research Agency

Part of the UK Ministry of Defence element of the STOW programme investigated the time and cost drivers pertaining to the entire process of the rapid generation of Synthetic Natural Environments (SNE) databases. Data requirements, products, information and systems were analysed to identify bottlenecks and gaps. Traditionally, construction of SNE databases is a time consuming and very labour intensive exercise. It involves a very high degree of effort to generate the required source terrain and feature data, and significant further effort to convert source data into a compiled SNE database. Standard military datasets are typically used to provide the bulk of the data for a SNE database (e.g. DTED and DFAD). However, such datasets may not be available for the specific area of interest, they may be at an inappropriate scale, they require augmentation and they are likely to be based on out-of-date mapping sources. An alternative worldwide and up-to-date source is required. The new series of Earth Observing satellites are creating a large archive of up-to-date geospatial data. The major blockage has moved down the value-added chain and it is the conversion of data into information that has become the major time and cost driver. An approach to automated feature extraction from EO imagery is presented which uses an object-orientated geodata model as the framework to store contextual knowledge and to use this in the control of feature extraction routines. The problem of geographic extraction has proved complex and ideally requires the incorporation of contextual clues similar to those used by human interpreters of imagery. Often the feature recognition algorithms work at local levels and in a bottom-up fashion and lack the higher level control that would allow a more global understanding of parts of the image. The paper proposes a control strategy that incorporates both the global and local views. The geodata model comprises a class hierarchy representing the features under study and their likely relationships. Each class of object within this model contains criteria that need to be satisfied in order to strengthen the belief that an instance of that object type has been recognised. The criteria cannot be rigid and the system must be able to control partial recognition of objects and identify conflicts. The system described will apply these ideas to the problem of geographic object recognition, focusing on the specific requirements of linear feature extraction.

Previous Years Papers Available on CD

ENHANCING TRAINING SYSTEMS WITH TEXT-MINING

Kas Kasravi, C.Mfg.EEDS

The text-mining technology uncaps the vast of amount of information locked in documents. Using advanced computational linguistic techniques, text-mining solutions can read and comprehend the content of large amounts of documents. Once analyzed, the informational content of numerous documents can be categorized and accessed in multiple formats, such as summaries, key concepts and events, relationships among concepts, and visual relationship diagrams. Text-mining can be applied to many applications that require in-depth understanding of the information buried in documents; one such application is training. Using text-mining, courseware can be linguistically analyzed and represented in a manner suitable for rapid and organized access. Such systems can improve the training process by focusing the trainee on the right information, and efficiently navigating the trainee through the course material. In this manner, traditional computer-based training (CBT) systems can operate with a greater knowledge of the course content, automatically answer questions, shorten the training time, and present training material in a more customized fashion.

Previous Years Papers Available on CD

EXTENDING SIMULATION INTERFACES TO MOBILE COMPUTING PLATFORMS

Michael J. Sherman, Bryan S. Ware
DIGITAL SANDBOX, INC.

The hand-held Personal Digital Assistant (PDA) market has seen impressive growth over the last several years, with the application space expanding as fast as new uses are discovered. One area left mostly unexplored in this mobile yet powerful computing platform is that of mobile simulation applications. A large percentage of the simulation community uses simulation as a method of predicting the outcome of a given physical state coupled with certain external conditions. This could be in the form of an emergency response team needing to determine hazardous material flow or a military planner needing to resolve blast radius information for force protection. Given that simulation is needed to determine such numerically based results, there are two methods of employing hand-held PDA devices to help such decision-makers in their reasoning process. The first method involves carrying out simulation calculations on the PDA device itself. This requires that the actual computation is not CPU-intensive and can provide a reasonable approximation in a short amount of time. The PDA platform ensures ease of data input and information display because of the design of the PDA user interface and the need for efficiency and simplicity. The second method involves exploiting the newest area of PDA integration; namely that of a wireless data link with a network. In this manner, the PDA is simply a client in a client/server model, where the actual data computation of the simulation is carried out on a larger server, then the information is sent to the PDA via the network. This allows a simple and mobile interface to any number of powerful simulation tools. This paper presents an approach for using the aforementioned benefits of the mobile PDA to provide simulation data to a wider audience. This approach presents methods for providing simulation data on the PDA in the form of database look-ups, rendering physical phenomena through graphical displays, and connecting to a host computer for the client/server model of information retrieval. We will present example implementations of this approach that cover database table access, 2D/3D rendering, and client/server data flow in PDA applications that enable simulation-based reasoning.

Previous Years Papers Available on CD

IMPROVING SIMULATOR ACCURACY WITH INTEGRATED ANALYSIS OF FLIGHT DATA

Dennis J. Linse
Science Applications International Corporation

Increasing use of detailed physics-based models and the availability of large quantities of high accuracy theoretical (CFD), wind-tunnel, and flight test data have intensified the need for coordinated and automated techniques to gather and analyze data and to improve simulator accuracy with the results of the analysis. A major problem is that most of these data are not used to increase the fidelity of any simulator because the data reduction is too hard—it requires a highly trained engineer and complex system identification tools. Even data that are used may do more harm to a simulator than good if not correctly processed to ensure proper calibration and consistency.

Multiple steps are required to process any data for it to be useful in creating and adjusting a simulation math model. Appropriate maneuvers must be selected and extracted from all of the collected data. Sensor calibrations, axes transformations, and wind compensations must be calculated and applied. Even given calibrated and consistent aircraft data, the simulation math model depends on the flexibility and representation capabilities of the model, the power of the system identification procedure, and the effectiveness of the engineer. While each step can be performed separately, an integrated architecture enhances the capabilities of each piece by relieving the data handling burdens and emphasizing the engineering process.

The Integrated Data Evaluation and Analysis System (IDEAS) provides one architecture to bring all of these diverse data into a common environment for analysis. IDEAS is a networked client/server environment of high fidelity tools tailored for dynamic system modeling, particularly flight test data analysis and flight simulation. It includes a database management system designed specifically for flight test data, and both generic and specialized tools of data filtering, data calibration, modeling, system identification, and simulation update. Specialized user tools are easily added and have full access to the flight database and other IDEAS tools. Dynamic simulations hosted under IDEAS range from full operational flight trainers (OFT) to detailed subsystem components such as engines or landing gears. A recent addition to IDEAS is an expert system shell that can command and control all elements of the environment. Rule-bases are available or can be constructed to support all components of data analysis as well as simulator update and validation.

The power of the integrated architecture has been demonstrated on several recent programs. A preliminary examination of helicopter flight data and comparison to simulator response was performed on the tarmac after the test. A detailed system identification and simulator verification of aerodynamic, engine, and gear models with FAA comparisons were made of a large transport aircraft. Each was done at a greatly reduced engineering cost. Examples such as these show the efficacy of the integrated methods.

Previous Years Papers Available on CD

MILITARY MEDICAL MODELING AND SIMULATION IN THE 21^{ST} CENTURY

J. Harve Magee
SHERIKON, Inc., HQ U.S. Army Medical Research Materiel Command
Telemedicine and Advanced Technology Research Center

Gerald Moses, John J. Bauer, Robert Leitch
HQ U.S. Army Medical Research Materiel Command
Telemedicine and Advanced Technology Research Center

Steven L. Dawson, Massachusetts General Hospital

As we enter the 21^{st} century, military medicine struggles with critical issues. One of the most important issues is how we train medical personnel in peace for the realities of war. In April 1998, the General Accounting Office (GAO) reported, "military medical personnel have almost no chance during peacetime to practice battlefield trauma care skills. As a result, physicians both within and outside the Department of Defense (DOD) believe that military medical personnel are not prepared to provide trauma care to the severely injured soldiers in wartime...." With some of today's training methods disappearing, the challenge of providing both initial and sustainment training for almost 100,000 military medical personnel is becoming insurmountable. The "training gap" is huge, and impediments to training are mounting. For example, restrictions on animal use are increasing, and the cost of conducting live mass casualty exercises is prohibitive. Many medical simulation visionaries believe that four categories of medical simulation are emerging to address these challenges: PC-based multimedia, digital mannequins, virtual workbenches, and Total Immersion Virtual Reality (TIVR). TIVR is the most effective solution, although it is the most expensive and will take the longest time to develop. To address the TIVR challenge, the Medical Simulation Training Initiative (MSTI) is a visionary military program that seeks to develop a multi-functional simulation platform based on a Personal Computer, with 3-D holographic imaging of anatomic compartments and/or body structures. We envision the interface to be an exoskeletal robotic device, haptic gloves and other interactive surgical devices. Success requires several key components. First, a strategic plan. Second, single-agency integration of research efforts. Third, research in "enabling technologies", e.g., tissue modeling, haptics integration, physiological representations and overall systems architecture. This is necessary to develop realistic representations of medical procedures as a basis for simulation. Fourth, careful efforts among domain experts in their own fields, e.g., physicians, nurses and "combat medics", working side by side with engineers, computer scientists, designers, experts in education and training, human factors engineers, and managers, to ensure useful products for end users. MSTI will provide a risk-free, realistic learning environment for the spectrum of medical skills training, from buddy aid to trauma surgery procedures. This will, in turn, enhance limited hands-on training opportunities and revolutionize the way we train in peace...to deliver medicine in war. High fidelity modeling will permit manufacturers to prototype new devices before manufacture "…".

NEW COTS HARDWARE AND SOFTWARE REDUCE THE COST AND EFFORT IN REPLACING AGING FLIGHT SIMULATORS SUBSYSTEMS

David P. Spicer & Shaun B. Andrew
Naval Air Warfare Center Training Systems Division
Aviation In-Service Engineering Office

Many flight simulators, developed in the 1975 to 1985 time frame, are approaching the end of their supportable life cycle. The host computer systems on many older simulators, including the I/O, mass storage components, and visual components, have become virtually unsupportable. Spare parts are no longer available and software upgrades and enhancements are not easily achieved. New developments in Commercial-Off-The-Shelf (COTS) computer peripherals have yielded very flexible, and highly miniaturized, components, which result in lower cost and rapid hardware and software replacement. Until recently, many older hardware systems were too expensive and too time consuming to replace, because there were no COTS solutions that would directly replace the custom components and/or interfaces. Today, new hardware architecture exists in the form of "IndustryPacks" (IP). VITA Standards Organization (VSO) and SBS Greenspring Modular I/O prepared the IndustryPack standard. IndustryPacks use carrier board technology and support a wide application base. This architecture provides an exceptionally simple interface, high data rate, true bus independence, and an open specification. IndustryPacks are rapidly becoming the standard for real-time, embedded, critical I/O and "real world" functions. Individual functions of IndustryPacks do not require processor related bus features such as mastership, cache coherence, or split cycles. Carrier boards for the IndustryPacks have gained industry wide support. Many prominent companies are developing products that meet the IndustryPack specification. As military and aerospace budgets shrink, cost efficiency and time to market is becoming a major concern in the military and aerospace market. COTS IndustryPacks are playing a major role in systems development, which includes the efficient replacement of older technology. This paper examines the design approach, cost efficiency and time to market, for the replacement of hardware and software components of a typical aging flight simulator. The flight simulator to be examined consists of a host computer system and multiple I/O subsystems. The host computer has an I/O interface for each I/O subsystem. The new design will demonstrate the replacement of entire I/O subsystems, as well as the replacement of only the host I/O interfaces for other I/O subsystems, using IndustryPack technology. The replacement of I/O, and/or host I/O interface, will enable the replacement of the flight simulator's host computer with a new state-of-the-art computer system. A low cost COTS distributed computer system, using Linux, with its embedded network protocols, will upgrade the host computer. Windows NT will operate the replacement I/O subsystems and will be networked with the Linux host. IndustryPack technology will be utilized in both the new I/O subsystems and in the new host computer I/O interfaces. Design benefits include bus and processor independence and software portability.

REALISTIC MODELING OF CHEMICAL AND BIOLOGICAL AGENT TRANSPORT AND EFFECTS

Frank J. Wysocki, Matthew I. Hutton, and Michael O. Kierzewski
OptiMetrics, Inc.

Dr. John White
Edgewood Chemical Biological Center (ECBC)
US ARMY SBCCOM

Dr. John Mercurio
(ARL)

The challenges of modeling Chemical and Biological (CB) agent behaviors in a Virtual Environment are significant but are not insurmountable. Several of the challenges are endemic to the Modeling and Simulation (M&S) community at large, such as the building and manipulation of the urban terrain databases for neighborhoods and within the structures themselves. Micrometeorology for airflow predictions and specific dynamic features of the environment in which the agent behaviors occur are another challenge to be overcome. The agent behaviors of interest are release, transport, diffusion, persistence, interaction with active and passive sensors, and affects on human behavior (casualty and degradation). Current operational models for chemical and biological (CB) hazard predictions operate above the threshold of most likely terrorist or asymmetrical warfare releases. These models are driven by meso-scale meteorology models providing broad Gaussian plumes over top of the terrain database. Micro-scale meteorological models exist that will predict the hazard in the urban neighborhood domain level terrain database. Agent transport, diffusion and deposition must also be modeled within the architectural database of structures. This appropriate level of physical modeling will provide an agent behavior profile that sufficiently models the agent release, its deposition on the terrain/architectural database, the casualty affect on human avatars, and the interaction with sensors. These conditions will change over time relative to the agent's persistence and micrometeorological dynamics. The modeling and representation development will be arduous. Potential contributors are immature. The pay-off will be quality training conducted within the simulations using high fidelity physics models. The physical fidelity will enable trainee attention-to-detail for skill development in survey, detection, rapid forensics, information development, and communications resource allocations. The appropriate level of physics in the models and representations will enhance the emotional fidelity of a training system. This is a critical simulation feature in emergency responder preparation for the crisis conditions of a CB agent incident or weapons of mass destruction (WMD) terrorist event.

Previous Years Papers Available on CD

UCAV DISTRIBUTED MISSION TRAINING TESTBED: LESSONS LEARNED AND FUTURE CHALLENGES

Dr. Dutch Guckenberger & Matt Archer Michael R. Oakes
SDS International Inc. BMH Associates, Inc.

The UCAV DMT Testbed research will focus on technologies for: defining effective training strategies for UAV/UCAV operators; assessing the delta in training required for multiple vehicles; advanced displays driven from human factors design; integration of Geneva Aerospace s Variable Autonomy Control System; and integrating several UAV and UCAV Flight Model into the Testbed. Potential applications include direct linkage of UCAV Testbeds as Participants in DMT. This paper chronicles the development of the UCAV DMT Testbed from the perspective of lessons learned and details features planned to support the initial research efforts planned for 2000. Four successful UCAV DMT demonstrations and experiments are presented from a lessons learned perspective. Starting with the initial separately developed PC-Based UCAV simulations; evolving to the merging of the Simulations and initial DMT research experiments including DMTO&I testbed, I/ITSEC99 and planned AFRL Mesa UCAV DMT Demonstrations. Key testbed components included the LiteFlite Flight Simulator, JSAF and SOAR applications, and the Variable Autonomy Control System (VACS). The unique and innovative portions of this paper detail the components integration for UCAV missions and operational concepts, along with the human factors engineering on the VACS human-system interface design and LiteFlite researcher toolkit interfaces. Illustrative examples, are also included with sufficient details to support other government, industry and academic organizations participation in future UCAV DMT experiments and demonstrations. Participating organizations include but are not limited to AFRL Mesa, SDS International, Geneva Aerospace, Eglin 46 th Test Wing PRIMES, NASA Dryden Flight Research Center/Tuskegee University, Computer Science Corporation. Future participants may include Navy Pax River (MFS and Distributed Simulation Groups), AFRL Wright-Patterson and Naval Aerospace Medical Research Lab. Additional discussion includes related UCAV DMT Research topics of:

§ LiteFlite UCAV and Testbed Utilization of the Ordnance Server to ensure DMT Fair Fight

§ Innovations associated with a new Distributed Ordnance Server to insure Temporal Correlation of the Target/Counter-Measure/Weapon Triad

§ An Innovative new concept of handing off UCAV Ownership from the Virtual LiteFlite Host Simulation to the Constructive JSAF and SOAR Agents to automate tasks for the UCAV operators Results from three initial UCAV integration efforts are presented detailing DIS integration with existing DMT assets and HLA integration with planned DMT configurations I/ITSEC99, USAF Only DMTO&I Demonstration Jan2000, DMT UCAV Testbed development for AFRL/HEA and UAV 2000 Demonstration July 2000. An outline of planned research efforts that will utilize the DMT UCAV Testbed are presented along with Future Research Directions.

VERTS SYNTHETIC URBAN ENVIRONMENT DEVELOPMENT PROCESS – END TO END

Robert L. Clover
Institute for Defense Analyses, Simulation Center

In support of the Department of Defense (DoD) Virtual Emergency Response Training System (VERTS) program, the Institute for Defense Analyses (IDA) team is currently in the process of creating thirteen very dense and highly detailed virtual urban environments. This is a very new and different challenge from the terrain database creation present and past. Presently, we see larger and larger terrain databases being created, but the level of detail in geometry is not very high, except in small isolated areas. We also see some very high level of detail synthetic environments, but they are mainly for visualization, not for real-time, interactive immersion. Our VERTS environments are very dense (to include selected building interiors) and are intended for the immersion and real-time interaction of numerous participants. This is the first time that either the SEDRIS or the SAF communities have been confronted with synthetic environments of this level of complexity. We are all experiencing some pain in learning how to deal with these complex synthetic environments.The VERTS synthetic urban environments are created from a very wide variety of source data. These range from extremely accurate and well-managed geographic information system (GIS) files to in-house generated data where information was of poor quality, missing or not captured. This paper examines our process of obtaining and manipulating source data, creation of the run-time terrain databases, creation of a SEDRIS Transmittal, checking the data with some of the SEDRIS tools, and the creation of a compact terrain database for use with semi-automated forces. This review is a high-level beginning-to-end presentation of how we are getting there today, tomorrow; the use of various tools, and our experience with SEDRIS. We discuss the issues involved in collecting and processing urban data, and share some of the pitfalls we have encountered and some of the work-arounds being developed.

WEB-BASED SIMULATION AND THE VIRTUAL REALITY MODELING LANGUAGE

Rodney Long, U.S. Army Simulation, Training and Instrumentation Command

Robert Anschuetz, Veridian Engineering

The U.S. Army Simulation, Training and Instrumentation Command (STRICOM) is currently exploring web-based simulation technologies to support Advanced Distributed Learning (ADL) environments. One emerging industry standard is the Virtual Reality Modeling Language (VRML) which allows stunning three-dimensional images to be delivered over the World Wide Web (WWW). Leveraging the constantly increasing power of the personal computer (PC) and Internet communication technologies, these three dimensional simulation environments can be delivered *anytime-anywhere*. Several prototype VRML applications have been developed for STRICOM to demonstrate the benefits of three-dimensional modeling and simulation environments in support of ADL. This paper will outline the VRML applications developed thus far, including a simulator that uses VRML and the High Level Architecture (HLA) to allow multipled desktop PCs to engage in a virtual battle over the Internet. In addition, the paper will examine other emerging Internet standards from the Web3D Consortium and ADL's Sharable Courseware Object Reference Model (SCORM) to determine how they will impact the use of three dimensional simulations in future web-based training environments.

MENTORING THE DEVELOPMENT OF LOW COST, WEB-DELIVERABLE ELECTRONIC PERFORMANCE SUPPORT SYSTEMS (EPSS)

Commander Richard Arnold, USCGTraining Officer, Training Center
Ms. Julia Brandt, Training Systems Specialist, Performance Technology Center Yorktown

Electronic Performance Support Systems (EPSS) are fast becoming a key tool to enhance, augment or replace traditional Coast Guard training and performance support programs. The U.S. Coast Guard's Performance Technology Center (PTC) Yorktown is spearheading Coast Guard design, development, evaluation and implementation of cost-effective EPSS applications. The center has achieved excellent results by creating production processes that enable the PTC's technical staff to leverage their expertise by using a highly successful novice developer mentoring system. Novice developers are drawn from subject matter experts (SMEs) and accomplished performers (APs) and are provided with the tools, coaching, mentoring and technical assistance needed to produce a wide range of policy, doctrine, maintenance, operations and training EPSS.

This paper provides a broad definition of EPSS, defines EPSS generated by the PTC and explains why the Coast Guard is seeking to exploit EPSS as a key component of the service's workforce performance support system. PTC is spearheading cost–effective EPSS production within the Coast Guard by using a mentored production approach. Aps and SMEs drawn from operational, support and training center commands receive minimal training and continuous mentoring to help them produce web-deployable EPSS that support improved task performance from the typical user. The authors outline the mentoring program including tool selection and use, production process, process pros and cons, case study information and performance trial data.

DEVELOPMENT OF A LEARNING CONTINUUM FOR THE NAVY LEARNING NETWORK (NLN)

Conrad Bills, Richard Wray, Linda Brent, Richard Lubanovic
Lockheed Martin, Barbara Stankowski, Alpha Solutions

One of the benefits of Online Learning Networks is the capability to define and administer a continuum of learning that is tailored to each individual learner based on job task skill and knowledge requirements. This structure provides a method of linking learners to required organizational training and education requirements that will be key to any Return on Investment (ROI) strategy. This paper covers the steps that were followed to derive an initial curriculum continuum structure for the Navy Learning Network (NLN) supporting a potential audience of 1.2 million people. The lessons learned are addressed as well as long term vision and strategies to create individually tailor learning continua. The NLN implementation includes the structure for mapping a curriculum continuum to each learners career path. This structure allows individual learners a method for adding their own personal training and education goals. The short-term continuum structure is a starting point that has defined curricula mapped to a specific pay grade and job series. The initial structure for the NLN accounts for individual and group relationships of one-to-one and one-to-many curricula. College degree programs related to specific job requirements can be integrated into the short-term continuum. NLN design also provides for the addition of leader development and professional education. This comprehensive NLN vision builds a direct relationship to the organization long-term health and stability as well as to specific job skill development. As each variable is added to NLN, the level of complexity grows. Recommendations and strategies are presented to assist those who want to implement a similar approach.

LIVE WEB BASED TRAINING, IS SYNCRONOUS BETTER? PROTOYPE CASE STUDY RESULTS

Commander Richard Arnold, USCGTraining Officer, Training Center

This paper and presentation describes the U.S. Coast Guard's phased test and evaluation of live web based training (WBT) as an alternative delivery method for providing training and performance support to Coast Guard personnel located throughout the United States. The Coast Guard tested synchronous (live) WBT using typical courses and instructors, desktop computers, the Internet (home students) and Coast Guard's Intranet (at-work students) and a commercial off the shelf (COTS) WBT tool. The test objectively assessed if WBT, much hyped in the media but little used in the Coast Guard, is a suitable and cost-effective method to provide training and performance support for our workforce. The team also compared the method against other alternative technologies. Our results strongly indicate that live WBT is a good fit for the Coast Guard. Live WBT enables Coast Guard trainers to cost-effectively provide high-quality instruction direct to field personnel. The evaluation team measured no significant difference between resident and live WBT instructional methodologies. Live WBT also offers a return on investment (after costs) of over $200K per year for an annual throughput of 750 students. The team reached these conclusions by focusing on three primary goals. They were:

1. Identify if live WBT is a good fit for given our equipment and culture.
2. Determine any effectiveness differences between WBT and resident instruction.
3. Determine specific costs and benefits tied to this delivery method.

MITAS AND MENTOR – AUTHORING SYSTEMS FOR DEVELOPING COMPUTER BASED INSTRUCTION WITH 3D MICROWORLDS AND DIALOGUE

Beth Plott Principal Engineer, Micro Analysis and Design, Inc.

Dr. Jonathan Kaplan, Senior Psychologist, Program Manager
Advanced Concepts, Office of the Army Research Institute

Dr. Ron Laughery, President of Micro Analysis and Design, Inc.

The U.S. Army Research Institute sponsored the development of two advanced authoring and delivery systems entitled MITAS and Mentor. MITAS (Multimedia Instructional Tutoring and Authoring System) is a Windows-based tool for developing and presenting computer-based instruction. Among other features, it uses a unique approach to lesson development featuring 3D animation in a microworld environment. Mentor is a natural language understanding and problem-solving system in which the software simulates either a subject matter expert or conversational agent. Mentor uses dialogue to support informational and procedural lessons. This paper will describe MITAS and Mentor along with the approach used to make the microworld and dialogue capabilities authorable with minimal training and effort.

WHAT IS A CBT ELEMENT?

Rebecca Palmore
Performance Technology Center, United States Coast Guard

Clementina Siders, Douglas Samuel
Naval Air Warfare Center Training Systems Division

Courseware cost estimation is one of the most elusive and difficult tasks performed by training professionals. Typically these techniques are based on development and delivery time. Delivery time is commonly referred to as "CBT hours". An in-depth study of 25 experienced CBT developers was unable to clearly define or agree on what constitutes an hour of CBT. Common definitions include "average student contact time" or "online student interaction time". In one study, delivery time ranged from 45 to 420 minutes for a sample group of 886 learners. With such a wide range of delivery times one cannot expect to reliably predict development time as a function of delivery time. This paper introduces a "CBT element" and the methodology used to divide lessons into these elements. Interactive courseware lessons are comprised of many CBT elements. Unlike a CBT hour, a CBT element is based on complexity of programming (i.e. level of interactivity, branching, etc) rather than time. One benefit of implementing this unit of measure is the elimination of the student completion time as a variable. However the more significant benefit is that CBT elements can be used to more accurately estimate courseware costs.

IMPROVING CBT BY VR ELEMENTS

Dr. C. Meyer,
Competence Center Informatik GmbH, Simulation Dept.

H. B. Lotz
Bundesamt für Wehrtechnik und Beschaffung (BWB, FEI3)

Pushed forward by massive economical improvements in the realm of simulation, we currently observe an accretion of the Computer Based Training (CBT) sector with the simulation sector. The availability of low-cost systems for 3D visualization on the basis of PCs allows the incorporation of simulator components into classical CBT programs. This in effect makes it possible to use constructive learning theories as the simulation components allow for a very realistic interaction of the learner and the training object, so that quasi-free exploration techniques are within the reach of CBT. An operational field for coupling classical CBT with VR-techniques is the training of EOD-units within the German Navy. The trainees shall learn categorization and identification of all sorts of munitions and bombs. Further more they shall be trained in proper disarming and handling the explosives. At present these goals are taught by means of classical lessons. Teaching the construction of the objects is accomplished by means of visual instructions using structural models. Environmental effects which the trainee is confronted with in real life demand long and expensive preparations and are therefore rarely used in current lectures. CCI GmbH and the Bundesamt für Wehrtechnik und Beschaffung develop in close cooperation with the weapon diver battalion of the German Navy a CBT program based on a combination of classical CBT techniques and VR techniques. We use a stepwise explorative didactical approach. The program uses several VR-Visualization techniques based on a database containing 3D-models of bombs and munitions. The simulation of environmental effects as the reduced visibility under water and other influences are applied as well as a scenario editor to be used by instructors. This paper presents the current state of development.

BRIEFING ROOM INTERACTIVE (BRI): AN ASSESSMENT OF A WEB-BASED FLIGHT PREPARATION SYSTEM IN THE F-117A

LTC Mark R. Perusse, Kathryn P. Underwood, M. Ed., Aris Michael Christensen
Det 4, ACC Training Support Squadron

Briefing Room Interactive (BRI) is a web based mission preparation, briefing, and debriefing aircrew flying preparation system. Implementing the latest technologies, BRI is a powerful tool that consolidates many traditional briefing room resources and offers a variety of new ones. The F-117A BRI is a complementary training and briefing resource that replaces the simple, onscreen briefing guide of the 20th century. The result is a multimedia briefing system that is easy to use, portable, deployable, and end-user maintained. The BRI incorporates the Air Combat Command's software standards with existing Web site multimedia standards to produce a BRI Web site that is a suite of interactive briefing room utilities with user-friendly directories, file naming conventions, and customizable PowerPoint briefings. The BRI system is designed using the HTML frames approach and VGA content for easy delivery of compressed multimedia files to the Web site. It electronically encapsulates home station pullout boards, including fingertip access for aircrew briefing flexibility and ease in presenting elements common to every briefing. Web page links offer the briefer instant access to aircrew publications in an intuitive electronic format, to online weather sites, NOTAMS, imagery, and other required mission planning products viewed "just in time" and "just for me." In addition, BRI provides realistic graphics to enhance briefing room realism, accuracy and eliminates redundant preflight drawings. The goal being increased standardization and enhanced aircrew understanding and retention. The key to BRI is the use of high quality diagrams, animations, and interactivity. Aircrews conducting actual F-117A flight training accomplished BRI assessment using a survey of both instructors and students. The BRI system includes the development of three new and the revision of 12 lessons per fiscal year requiring a work effort of 1918 contractor "man" hours. BRI transforms the aircrew-briefing environment into the 21st century by putting multimedia technology at the aircrews' fingertips to produce accurate briefings that increase aircrews' learning and understanding.

Previous Years Papers Available on CD

DOD ADVANCED DISTRIBUTED LEARNING NETWORK

Mr. Gregory F. Knapp
US Joint Forces Command, Joint Warfighting Center

Consider this hypothetical scenario. Another major training exercise is beginning at the Joint Warfighting Center. This simulation-based exercise is designed to prepare a European-based Joint Task Force commander and his staff in warfighting operations within the combustible European theater. Over five hundred participants have been brought to Suffolk, Virginia to participate. Component staff response cells have been established as far as Fort Hood, Texas to the west and Ramstein AFB to the east. The exercise will result in participants being out of their operational area for over three weeks over a two-month period while planning the operation and executing the exercise. By all accounts this is a very cost effective way to train JTF commanders, but is it the most cost effective? As this exercise is unfolding political unrest in a nation in the US Central Command s Area of Responsibility has caused CENTCOM to go into an alert status. Although intelligence studies have provided the CINC a thumbnail sketch of what he will face should he have to move his troops in country, there is no way for him to model and rehearse potential courses of action in the days prior to deploying his forces. In-theater training and exercises coupled with a responsive mission rehearsal capability are just two of the major operational capabilities being addressed by the Advanced Distributed Learning Network (ADLN). Joint Vision 2010 clearly states the need for such a capability: Simulations must be interconnected globally – creating a near-real-time interactive simulation superhighway between our forces in every theater. Each CINC must be able to tap into this global network and connect forces worldwide that would be available for theater operations. The ADLN vision is to create a global architecture that integrates and shapes related DOD initiatives, programs, and operational requirements providing the capability for worldwide participation in advanced distributed learning on demand. Advanced Distributed Learning, with joint training applications and content riding on a high speed, robust network promises to be such a boon to cost effective training it is currently being investigated by every Service and a multitude of government agencies. To date, the result has been the creation of many stand alone and non-interoperable networks, services, and tools. This has led to duplication of effort and a waste of resources. The ADLN program will provide a comprehensive, cohesive, and requirements-based joint training and education capability for the CINCs, Services, and defense agencies. It will leverage existing stove-piped networks and ensure interoperability and seamless transfer of information in the joint battlespace. This paper will describe the overarching concepts of this global Advanced Distributed Learning Network and how it will be implemented for use by US forces and agencies to increase joint training readiness.

THE FIELD GUIDE TO VETERANS SERVICE REPRESENTATIVE (VSR) TRAINING: A WEB BASED TRAINING CASE STUDY

Gwen Palmer & Domenic DeStefano, Department of Veterans Affairs, Washington, DC
Suzanne Brandt, M.A.,
Department of Veterans Affairs, Orlando, FL

David J. Daly, Ph.D., Naval Air Warfare Center Training Systems Division,

With budget and trends toward case management, team focus, and customer service, it is common for two or more jobs to be combined into one consolidated job. Consolidated jobs require extensive cross-training for the additional tasks, which are often comprised of diverse knowledge, skills, and perspectives not associated with the previous, unconsolidated jobs. For instance, an organization may combine one customer interface-type job with an analysis-type job. This results in a considerable training challenge, as the knowledge and skills required are quite different. Often, the need for client service and immediate work activities continues through the reorganization, limiting training time. These needs are exacerbated when new employees are hired along with the requirement for cross-training of current employees. When this type of job merger occurs, there usually is not sufficient t time for the structured analysis and design required for training development. This situation arose in the Veterans Benefits Administration's need for Veterans Service Representative (VSR) training. There was an immediate need to cross train approximately 4,000 employees at 58 regional offices in the knowledge and skills required for the consolidated VSR job. Also, new employees were to be immediately hired. A short-term approach, using selected ISD principles was taken to support immediate training for the VSR while a structured ISD approach is being taken for the long-term. Web-based training was selected as the delivery medium for the short-term solution. This paper will address the lessons learned in the development of the short-term approach: *The VSR Field Guide Web site.* Over 1,000 learning outcomes were identified and organized into a taxonomy, curriculum outline, lesson plans, and resource library. This approach allowed for rapid deployment of a solution for the VSR training problem. Initial reaction to the Field Guide has been positive. We believe that the development process and the "lessons learned" from this project can be beneficial to others in both government and commercial industries, whenever training analysis has to be streamlined impending deadlines.

TACTICAL ACTION OFFICER INTELLIGENT TUTORING SYSTEM (TAO ITS)

Richard H. Stottler, Stottler Henke Associates, Inc.

LCDR Michael Vinkavich, Surface Warfare Officers School Command

The U.S. Navy's Surface Warfare Officers School (SWOS) in Rhode Island is pioneering the use of a low-cost simulation-based intelligent tutoring system (ITS) as part of its Tactical Action Officer (TAO) training program to train Navy officers in high-level tactical skills. This software was designed and built for SWOS for use on standard PCs, was introduced to the School in early 1999, and the Navy has a royalty-free license to use it. The software can be used both as a classroom aid and by individual students. A key objective of the software is to increase the active training that officers receive to improve their ability to apply their conceptual knowledge of tactics. Early results from its use with two classes are encouraging and indicate that the software will succeed in this goal by enabling as much as a ten-fold increase in hands-on training.

The software has three parts. First, there is a scenario generator, with which instructors, with limited assistance from a programmer, can create any number of simulated scenarios. These can be set in any part of the world, and populated with different surface and air platforms. Each individual platform is implemented as an "intelligent agent" and can be given its own performance characteristics and behaviors so it will act realistically. For example, a hostile plane will have its own mission (which the student can only surmise) but will react to challenges from the student's friendly platforms. Second, there is the intelligent tutoring system, which presents selected scenarios to the student to practice different tactical concepts. The software will adaptively select scenarios for individual students, that practice concepts he or she hasn't yet practiced or has recently failed, or enable a student to pick any scenario. As well as the intrinsic feedback that free-play simulations naturally provide a student, the TAO ITS provides detailed, useful extrinsic feedback to the student once a scenario is finished, which reviews all the concepts attempted and whether they were passed or failed. At this point, the student can review multimedia material about any concept, or see a replay of the scenario to review errors. The third part of the software is an instructor interface tool for instructor to review all the students' work with the tutoring system to assess their progress in detail.This paper describes the Tactical Action Officer Intelligent Tutoring System as an example of what ITSs can do and the benefits they can provide. It also includes an explanation of why the case-based reasoning technique was used in the software to reduce three problems commonly associated with intelligent tutoring systems: effective incorporation of subject expert knowledge in the software, cost, and development time. It also reviews SWOS's experience with the software since its introduction, students' opinions of the software, and suggests ways in which future simulation-based intelligent tutoring systems might be improved based on SWOS's experience.

A CONSTRUCTIVIST APPROACH TO DISTANCE LEARNING FOR COUNTERTERRORIST INTELLIGENCE ANALYSIS

Tamitha Carpenter, Daniel Fu, Phillip Michalak, Laurie Spencer
Stottler Henke Associates, Inc.

Luciano Iorizzo
US Army Intelligence Center & Fort Huachuca

The uncertainty of unconventional threats confounds the Military Intelligence community. Changing operational requirements and constraints exacerbate the capability to prepare soldiers for unexpected situations. Thus, complexity of a training requirement increases while conditions truncate the means to provide training. Training must also prepare a soldier to accept the challenge of the unknown rather than become overwhelmed. One way to use limited resources to develop a competency is to combine distance learning (DL) techniques with adaptive learning strategies. This paper will describe one approach to optimizing the use of DL techniques with Constructivist learning theory to train complex domains. We present a courseware system that trains students in the area of "Intelligence for Combating Terrorism" (ICT), and an associated authoring tool. This authoring tool supports course development both at the subject matter level and at the pedagogical level, allowing the author to create and update the course material and to develop and refine an instructional process that adapts to the learning styles of each individual student. We conclude the paper with a description of our generic programming framework for creating customized tutor authoring tools.

COACHING TECHNIQUES FOR ADAPTIVE THINKING

James W. Lussier, Ph.D., U.S. Army Research Institute

Karol G. Ross, Ph.D, U.S. Army Research Laboratory

Bob Mayes, Booz, Allen, and Hamilton

The Adaptive Thinking Training Methodology was developed in a cooperative effort between the U.S. Army Research Institute (ARI) and the U.S. Army Research Laboratory (ARL) as part of the Army Experiment 6 program. It was successfully tested in 1999 in an experimental program of instruction as part of the Advanced Tactics Elective at the Command and General Staff College (CGSC) at Fort Leavenworth. The following year the methodology was applied in the Medium Brigade Course at CGSC under the auspices of the Training and Doctrine Command's (TRADOC) Army Transformation program. The methodology was also used in the Staff Leader Course provided by TRADOC to key personnel in the Initial Brigade Combat Team. The term Adaptive Thinking is used in both courses to describe the cognitive behavior of an officer who is confronted by unanticipated circumstances during the execution of a planned military operation. The training methodology involves performance-oriented, case-based training designed to promote the development of expert habits of thought, i.e., teaching the students "how to think like experts." Repetitive performance under varying conditions is used along with carefully designed probes, which are inserted to set the conditions for student performance and to facilitate observation and measurement. A key element of the training program employs theme-based coaching, in which the coaches, alert for evidence of the student's adherence to the course themes, provide just enough guidance to facilitate student development while still leaving the performance requirement to the students. This aspect of coaching is termed scaffolding. ARI and ARL scientists combined to present training sessions for the military experts who served as coaches. Their approach to coaching presented a challenge to several traditions of Army training, especially for those who had served as observer/controllers (O/Cs) at a combat training center (CTC). The scaffolding process was in distinct contrast to hands-off observation style characteristic of CTC O/Cs. The Army maxim "Tell them what you're going to tell them, tell them, tell them what you've told them" is contrary to the constructivist spirit of the coaching in which students must learn to guide their own activities with the least possible prompting. "Train as you fight" is another Army philosophy that is not strictly adhered to as the methodology is based on deliberate practice concepts with focus on normally unconscious elements of performance and frequent repetition. The culmination of the effort to identify coaching techniques is documented in the Army Transformation product, Leader's Guide for Mentoring Adaptive Thinking that was disseminated 2000 Convention of the Association of United States Army.

COGNITIVE TRAINING INITIATIVES: A CASE STUDY OF AIRCREW TRAINING

David A. DuBois Psychological Systems and Research, Inc.
Constance A. Gillan, CMNDR Sea Control Wing, U.S. Pacific Fleet

Recent advances in training, performance measurement, and feedback have emerged from scientific developments in understanding situation awareness, problem solving, and decision making. Using a case study from a naval aviation command, we describe strategies, methods, issues, and lessons learned in integrating multiple cognitive initiatives into an existing procedures-based training system. These initiatives originated from organizational goals to reduce the aviation mishap rate and to improve mission effectiveness by integrating crew resource management (CRM) as a core competency throughout the training curriculum. These initiatives include: cognitive task analyses to identify critical cognitive skills, incorporation of cognitive skills into training objectives and training content, the use of event-based scenarios for classroom discussion and simulator exercises, assessment of cognitive skills, the use of cockpit video and automated analyses of flight skills in simulators to diagnose and debrief performance. These initiatives are compared to previous methodology and to a vision of a state-of-the-art training system that incorporates scenario-based, cognitive training methods. Implementation issues are discussed extensively.

Previous Years Papers Available on CD

TECHNOLOGY INFUSION CHANGE MANAGEMENT: FROM TECHNOLOGY FRENZY TO TRANSFORMATION

Dr. Marcia Murawski, President, Intelligent Decision Systems, Inc.

The current trends for infusing technology often leave the potential users feeling as if they are in the midst of a "technology frenzy" that does not take into consideration their critical operational, organizational, or special learning needs. Those who are spearheading the technology infusion initiatives cannot understand why the potential users do not embrace their visions acknowledging and expressing gratitude for all the potential being offered. The military training environments and supporting documentation are built upon a behavioral learning model that is subject matter expert (SME) and instructor-centered and is based on engineering principles. The optimal use of technology for learning is more eclectic, is dependent upon the use of many learning models (including cognitive models), is instructional designer and learner-centered, and is based on both engineering and scientific principles. These factors alone suggest very significant shifts in how business is conducted. Yet, every environment has its own traditions, history, and unique needs to complicate the issue. Significant investments in technology to improve learning and performance can easily be lost if the environment is not prepared to embrace the potential. Preparation, in this case, means using smart change management principles. While we all know this intellectually, it can be very difficult to achieve. Several conditions exist that make practical change management concepts critical to the success of technology infusion initiatives. A model is presented for consideration to aid in identifying the differences in the leadership and users' perspectives so acceptance can be predicted. The user will go through key phases (from entry level to transformation) as they adopt technology to understand the user environment and plan the infusion process. Once these factors are understood, strategies can be applied for assisting the users through these phases.

MAXIMIZING TECHNOLOGY INTEGRATION EFFORTS USING A RESEARCH-BASED APPROACH

Dr. Susan L. Coleman, Dr. Ellen S. Menaker, Dr. Marcia N. Murawski,
INTELLIGENT DECISION SYSTEMS, INC.

Integrating technology into a curriculum can increase the efficiency and effectiveness of the curriculum; however, technology integration represents a formidable instructional problem. A deliberate analysis must precede integration efforts to understand this problem and determine how to optimize the potential learning gains of technology integration. This analysis should examine how the learning system will affect the integrated technology and how the technology will affect the system. This paper describes an approach called Technology Integration Analysis (TIA). The TIA is an approach for analyzing a learning system to identify the most effective and efficient way to integrate technology. The TIA represents a different way of thinking about integrating technology into a curriculum. The TIA treats technology integration as more than overlaying hardware and courseware onto existing course structures. Successful technology integration requires a complex analysis of the interrelated components of the learning system leading to purposeful recommendations for effective and efficient technology integration to maximize the learning system. Basing the TIA approach on a research model allows flexibility to customize the analysis for every environment rather than prescribe a lockstep procedure that may not work well in all situations. The TIA is an inductive, empirically based research approach for conducting an analysis. This approach ensures the critical variables that impact the effectiveness of technology integration are explored. This paper will describe the TIA approach including the principles guiding the analysis, the research goal, and some of the research questions used to meet that goal. The learning system examined during the analysis will also be defined and applications of the TIA in military environments will be described. This paper concludes with a summary of the advantages of using a research-based approach for conducting an analysis in preparation for technology infusion.

Previous Years Papers Available on CD

BUILDING AN AFFECTIVE COMPONENT TO ENHANCE AN INTELLIGENT TUTORING SYSTEM FOR SHIPHANDLING

Elizabeth Sheldon, Linda Malone, Ph.D.,University of Central Florida
Robert Breaux, Ph.D., Denise Lyons, Ph.D., Naval Air Warfare Center Training Systems Division,

Cognitive and learning theories that support Aptitude Treatment Interaction (ATI), Locus of Control, and self-efficacy suggest that a student's individual motivation, abilities, and self-efficacy are significant design considerations of instructional strategy. Specifically, the learning process would be optimized by dynamically evaluating the student's individual learning state during the training session, then adjusting the instructional intervention to increase the student's confidence and decrease anxiety. A model for dynamically tailoring instructional intervention in real-time based upon his/her individual learning characteristics and affective responses is proposed. This model describes the use of an affective component for such factors as anxiety, to be monitored and adjusted throughout the training session. The affective component interfaces with the instructor model to optimize the student-instructor interaction process (i.e. frequency of feedback, directive/reflective feedback, tone of voice). Data collection and evaluation is planned for the Conning Officer Virtual Environment (COVE), a prototypical shiphandling VE training simulator located at the Naval Air Warfare Center Training Systems Division. COVE's Intelligent Tutoring System (ITS) would benefit from the capability to provide real-time, tailored instructional intervention to the student for a variety of shiphandling tasks, students ranging from initial training for novice Ensigns to skill refreshment and mission rehearsal for expert shiphandlers, such as Commanding Officers (COs), Department Head Officers, and Division Officers. In addition, the model will be tested for the interaction of the CO with the junior officer for possible use as an affect feedback generator to the CO.

Previous Years Papers Available on CD

INTELLIGENT TUTORING SYSTEM FOR TACTICAL AIRCRAFT TRAINING (ITS-AIR): LESSONS LEARNED & FUTURE CHALLENGES

Dr. Dutch Guckenberger, Dale Jewell and Frank Luongo
SDS International, Inc

The Intelligent Tutoring System for Tactical Aircraft (ITS-AIR) is designed to enhance pilot learning while reducing lifecycle costs associated with on-site simulation operators and instructors. ITS-AIR is envisioned as an add-on system for future, existing and legacy simulators. SDS's rationale in producing the ITS-AIR system is based upon a divide and conquer methodology utilizing COTS & GOTS DIS/HLA resources coupled with simple small cooperative intelligent agents. The prototype ITS-AIR system presented in this paper can be logically viewed as two cooperative main modules. **SAM** the **S**ystems **A**utomation **M**odule that replaces the on-site simulation operators and **HIT** the **H**ierarchical **I**ntelligent **T**utor module that reduces the on-site instructor requirements.

SAM is an intelligent agent that provides the pilots with a simple Graphical User Interface (GUI) that starts and synchronizes all the ITS-AIR System components. For example, in the NAWC/TSD funded SDS, BMH and SOAR ITS-AIR Testbed (See Figure 2) SAM currently starts two LiteFlite™ Simulators, JSAF, SOAR, SOAR-Speak, ModIOS™, I-Matrix™, Academix™ and HIT. SAM also freezes, restarts and stops the components in a synchronous manner. Additionally, SAM is used by HIT to load and control lessons. SAM also contains **TCIA** the **T**emporal **C**ontrol **I**ntelligent **A**gent the controls the flow of simulated time throughout the distributed simulation architecture. TCIA services provide the HIT with the capacity to slow the pace of events for early skill acquisition phases, or present learning events in "slow motion" emphasizing the details that may not be easily perceived at normal real-time rates. TCIA services also provide the HIT with Above Real-Time Training (ARTT) Capabilities. ARTT has demonstrated to produce large training benefits (Guckenberger, Lane, Stanney 1992; Guckenberger and Crane 1997) and is envisioned to have even higher performance benefits when used in conjunction with HIT.

SAM provides the pilots with a simple GUI to log-in, select curriculum lessons, free-play or mission rehearsal modes. SAM and HIT allow the pilots to train in a user-friendly, non-threatening environment in which the student can be guided through training scenarios based on instructor defaults or dynamic configuration by the student. Performance data can be recorded into the students' HIT database records via XML based on the preferences of the instructor and / or student. HIT supports:

- Expert Review – Presentation of experts doing tasks, monitor differences between current pilot performance and different levels of experts corresponding performance
- Intelligent tutoring options based upon pilot performance and pilot questions

HIT is actually composed of multiple components and simple cooperative intelligent agents utilizing XML resources. The ITS-AIR Testbed will allow for the full integration and testing of various modular components of the ITS-AIR system. The Testbed will be fully utilized for experimentation and validation of the various Pedagogical Intelligent Agent technologies related to Intelligent Tutoring.It is anticipated that ITS-AIR will successfully address numerous requirements for Warfighters, utilizing products of PMA205, USAF DMT and NASA's Aviation Safety and Capacity programs.

INTELLIGENT TUTORING SYSTEMS FOR PROCEDURAL TASK TRAINING OF REMOTE PAYLOAD OPERATIONS AT NASA

James C. Ong, Stottler Henke Associates, Inc.
Steven R. Noneman, Operations Training Group,NASA Marshall Space Flight Center

Intelligent Tutoring Systems (ITSs) complement training simulators by providing automated instruction when it is not economical or feasible to dedicate an instructor to each student during training simulations. To lower the cost and difficulty of creating scenario-based intelligent tutoring systems for procedural task training, we developed the Task Tutor Toolkit (T 3), a generic tutoring system shell and scenario authoring tool. The Task Tutor Toolkit employs a case-based reasoning approach where the instructor creates a procedure template that specifies the range of student actions that are "correct" within each scenario. The system enables a non-programmer to specify task knowledge quickly and easily by via graphical user interface, using a "demonstrate, generalize, and annotate" paradigm, that recognizes the range of possible valid actions and infers general principles that are understood (or misunderstood) by the student when those actions are carried out. The annotated procedure template also enables the Task Tutor Toolkit to provide hints requested by the student during scenarios, such as What do I do now? And Why do I do that? At the end of each scenario, RPOT displays the principles correctly or incorrectly demonstrated by the student, along with explanations and background information. The Task Tutor Toolkit was designed to be modular and general so that it can be interfaced with a wide range of training simulators and support a variety of training domains. We used the Task Tutor Toolkit to create the Remote Payload Operations Tutor (RPOT), a tutoring system application which lets scientists who are new to space mission operations learn to monitor and control their experiments aboard the International Space Station according to NASA payload regulations, guidelines, and procedures. NASA is currently evaluating the effectiveness of RPOT and the Task Tutor Toolkit and is exploring other potential training applications for the Task Tutor Toolkit.

GUIDELINES FOR EVALUATION OF INTERNET-BASED INSTRUCTION

Cheryl J. Hamel, Institute for Simulation and Training, University of Central Florida, David L. Ryan-Jones, Robert T. Hays,Naval Air Warfare Center, Training Systems Division

The Department of Defense (DoD) established the Joint Advanced Distributed Learning (ADL) Co-Laboratory to support the implementation of ADL within DoD. As part of this initiative, the Joint Co-Laboratory is to provide technical assistance to program managers responsible for the development and fielding of ADL systems. This paper describes one of the efforts under this initiative. The goal of this project is to establish documented guidelines for the design and evaluation of Internet-based training and performance aiding. These guidelines are being developed for the Joint ADL Co-Laboratory by the University of Central Florida's Institute for Simulation and Training. The guidelines are being identified by reviewing the literature on development of web-based instructional environments, web-site development and computer-based training, including issues relating to content, format, instructional support features, standards compliance, learning management, tutoring, usability, hardware, and instructor and trainee skill requirements. Procedures for evaluation of ADL materials are discussed, and a sample of the preliminary guidelines is provided.

DISTRIBUTED DIGITAL SKILLS LABORATORY: A VIRTUAL COACHING ENVIRONMENT FOR INFORMATION SYSTEMS TRAINING

Major Michael W. Freeman, EdD, Robert A. Wisher, PhD
U.S. Army Forces Command U.S. Army Research Institute

Christina K. Curnow, Major Kenneth L. Morris
George Washington University, Battle Command

Much of the training requirements for fielding and sustaining digital capabilities in military units demand real time interaction and coaching by subject matter experts or instructors. The preferred method of training users in a face-to-face computer classroom is prohibitively slow and costly due to the wide geographic dispersion of the student load. Current military distance learning programs do not provide the capability to distribute hands-on interactive, real time, instructor coached digital training. In the present experiment using T.120 standard data collaboration tools over packet switched Internet connections, the primary instructor's screen was replicated to each distributed classroom and student's screens were replicated back to the coaches station. Audio communications were provided through conference telephones and a multipoint bridge. Video cues of the instructor, coaches and students were provided through point-to-point videophones using the H.324 standard. In addition to the shared audio, computer graphics and motion video, instructors, coaches and students were able to interact on demand using an instant messaging application. This paper explores the need for Distributed Digital Skills Laboratories and describes a study comparing the performance of groups of soldiers and marines taking an introductory course on the Common Message Processor face-to-face in a traditional computer classroom and via the Distributed Digital Skills Laboratory. The study results suggest there is no difference in student learning performance between the Distributed Digital Skills Laboratory mode of instruction and the traditional classroom for the hands on Common Message Processor course. The results also suggest that student satisfaction with the technical aspects of the Distributed Digital Skills Laboratory is higher than for most other modes of synchronous distance learning as evidenced by baseline studies of the Army Research Institute.

USING THE THEORY OF EQUIVALENCY TO BRING ON-SITE AND ONLINE LEARNING TOGETHER

Suzanne Queen Hoffman, Ph.D.
Principal Scientist, Intelligent Decision Systems, Inc.

John Edward Jackson, CAPT, SC, USN (Ret)
Director, College of Continuing Education, U.S. Naval War College

Michael S. Martin
Research Analyst, Intelligent Decision Systems, Inc.

James J. Stukel (1997), president of the University of Illinois, has credited the technology revolution of the 21st Century with extending access to education beyond the limits of time and place. Even the most skeptical among us has to admit that distributed learning, long considered by many to be a "poor excuse for the real thing," (McIsaac, 1998) is assuming an increasingly respected place within the education arena. Distributed learning and its associated Web applications will continue to evolve more rapidly and dynamically than most of us can even imagine, and much of the credit for this expansion is due to the ever-increasing capabilities of technology. Historically, the purpose of distance education has been to provide greater access to education rather than to enhance educational outcomes (Gay, 1997). However, to ignore the potential of Web-supported/Web-based instruction to improve educational outcomes would be to miss a significant opportunity to foster improved performance and achievement of online learners. As Dodge (1996) says, it was not until the Web that truly ground-breaking changes in teaching, training, and self-directed learning began to occur. Nonetheless, an aura of suspicion regarding how well distributed education courses can approximate their on-site counterparts lingers. Even the most strident detractors of distributed learning must concede that what may have begun as a questionable and sometimes experimental exercise has quickly become a readily accepted practice. That equivalent learning outcomes can be achieved for both scenarios through the application of appropriate instructional strategies and technology is the argument put forth in this paper. The paper is based on a project on which the Naval War College and private industry collaborated to produce an online, Web-supported version of a correspondence course based on a residence course given at the Naval War College. It will focus on the measures taken to ensure the integrity of both the content and the learning experience and is grounded in Simonson, Schlosser, and Hanson's (1999) Theory of Equivalency. Equivalency Theory aligns the learning experiences of online learners with those of on-site learners and maintains that the learning that takes place under either scenario should yield the same learning outcomes. The responsibility for creating equivalent learning environments for online learners lies with the instructional designer and is in no way the responsibility of the student.

Simonson et al. (1999) predict that distance learning will become mainstream in the U.S. if those involved in the educational process perceive the value derived from on-site and online learning to be the same. The application of technology-driven interactive telecommunications can minimize any differences in learning outcomes between on-site and online learning scenarios. This paper provides background information to illustrate how that can be accomplished.

DISTRIBUTED LEARNING IN SUPPORT OF ENHANCED REGIONAL SECURITY

Mr. Walter Christman
Office of the Undersecretary of Defense for Policy

Throughout the previous decade, US military experiences in places as diverse as Kosovo, Bosnia, East Timor, Haiti, Rwanda, Somalia and Iraq have repeatedly reaffirmed that interoperability with Allies and coalition partners is an area for improvement. In a post-Cold War era characterized by the emergence of complex contingencies, the requirement for effective multinational and civil-military cooperation has become increasingly apparent. It is equally clear that the inability of coalition partners to rapidly plan and coordinate with each other results in a default situation whereby the United States must very often become the lead responder in order to ensure success. This situation places a heavy operational burden upon resources and US military personnel. But what is the remedy?

One approach in helping to reduce the burden on US forces, while also promoting regional security Cooperation among nations, is the development of distributed learning approaches in support of coalition-based education and training. Finding effective tools to this end has become a top priority within the Department of Defense. In support, the US Joint Forces Command is investigating the feasibility of establishing a global distributed learning, data services network. Among its purposes would be to enhance ongoing theater-level strategies of engagement that serve to "shape" the strategic environment and prevent conflict. The effort is focused on three primary initiatives that are in various stages of development in each of the major geographic regions: coalition-based information networks; simulation networks; and advanced distributed learning tools and services.

This global effort is building upon initial successes in the European region, where some promising Preliminary efforts are underway, primarily under the auspices of US participation in the Partnership for Peace (PfP) program (PfP is a NATO initiative to develop constructive ties with the armed forces and civilian defense Communities of the former Warsaw Pact countries and as well with as European nations that have traditionally been non-aligned). Proceeding from the European model as an initial template, it is believed that these concepts can be tailored and adapted to the other regions of the world. This paper will examine the strategic context behind this new approach to the employment of information technology, inform the reader about recent developments in establishing new programmatic authorities, and review on a region-by-region basis some of the most promising near-term possibilities.

Previous Years Papers Available on CD

DATABASE-MANAGED TRAININGSYSTEM FOR CUSTOMER-SPECIFIC TRAINING

Marco Plack
Department of Computer Science, Otto-von-Guericke-University

Many small and medium-sized enterprises manufacture highly complex and customer-specific products. Due to increasing competition and declining profit margins, a lot of enterprises depend on revenues from the after-sales service. The education of customers becomes increasingly more important. Traditionally established methods of training show significant disadvantages not only for the manufacturer but also for the customer. One of the major disadvantages of traditional training classes being held in a training center at the manufacturer's site is often the unavailability of the customer specific configuration of the product. On the one side, this even complicates the training of the customer and on the other side it is also very expensive for the manufacturer since the equipment used in training centers ties up money. An alternative would be to perform the training at the customer's site. This would, however, cause an interruption of the running production process due to machines needed for training purposes or workers being trained. Both alternatives are undesirable. Thus, major improvements can be achieved with a system that provides machine- and customer-specific training online. Classes are generated automatically from a database-managed set of documents. This approach saves time for the development of training material and, at the same time, increases the quality of education since classes are adapted to the customer's needs. In addition, it does not tie up money for training equipment and the training material can be easily reused. The article presents aims and solutions of a system which limits costs since it can be implemented using standard PC components. The architecture of the system was developed regarding various requirements from the fields of education, training, engineering, and computer science. Specifically, the following requirements were taken into account:

- Trainees have to be supported by a human trainer
- Communication between trainee and trainer must take place synchronously and asynchronously from multiple remote locations
- Multimedia documents can be supplied via Internet by the manufacturer
- Trainees can be tested using interactive questionnaires
- Trainees can remotely follow a session (guided training)
- Trainees can actively influence the progression of a training lesson or the system adapts itself to the trainees
- The system supports the author of the training material using a document management system with content-based retrieval of technical documents and learning material
- Automatic adaptation of a training lesson according to the training object
- Platform-independence of the trainer- and trainee-client
- Implementation using standard hard- and software
- Integration of multilevel security techniques

The article will demonstrate how manufactures of complex equipment can benefit from the system to significantly cut training costs and achieve a customer- and product-specific training.

GUIDELINES FOR DESIGNING ONLINE LEARNING

Katharine Golas, Ph.D., Southwest Research Institute

Throughout America, demands to reduce training costs have led many corporations, government agencies, and educational institutions to invest in interactive distance learning technology. Traditional classroom courses are rapidly giving way to online learning over the Internet, arguably the largest and most diverse information resource in the world today. It is now possible to incorporate the wealth of information available on the "net" into online courses. Students can be linked around the world in interactive exercises and instructional materials can be accessed via web browsers on any platform. There is no longer a need to author a program specifically for a particular platform. Web browser software and Internet connections are widely available; worldwide distribution is inexpensive; content can be instantly updated; and there is no need to bring remote employees to a centralized location. In addition, online courses can provide course takers with feedback that traditional computer-based training cannot. For example, statistics can be derived from practice exercises and tests, providing course takers with a better feel of their understanding in relation to how others have perceived the course. Online learning is convenient for students, as they can proceed at their own pace and at their own place. Facilitated online learning strategies can reduce dropout rates normally encountered with traditional correspondence courses. In evaluating online courses, Harasim (1997) found that learners identified the following aspects of online education as beneficial: increased interaction in terms of both quantity and intensity; better access to group knowledge and support; a more democratic learning environment; convenience of access; and increased motivation. Challenges include overcoming slow connection speeds and long download times due to limited bandwidths.

This paper presents guidelines for designing online learning courses. Emerging technologies, tools, processes and instructional strategies are addressed. Specific interactive design strategies unique to online learning are described.

Previous Years Papers Available on CD

TRAINING THE MARINE CORPS WITH TACTICAL DECISION GAMES

W. Katz
Mak Technologies, Inc.

Continually increasing computing power and low-cost rendering power in the commercial video game market has led to some very sophisticated PC-based video games. Over the last few years, the military has begun to adapt these games, or develop similar products, in an effort to reduce the cost of virtual training. This paper presents:

1. A Tactical Decision Game (TDG) overview
2. An overview of Marine Corps PC-based TDG efforts
3. Discusses advantages of using Commercial Game Technology for web based distance learning, and
4. Identifies interoperability among DOD TDGs using HLA.

STRUCTURING TRAINING FOR SIMULATIONS

Billy L. Burnside
U. S. Army Research Institute

Kathleen A. Quinkert
U. S. Army Research Institute

Years of experience in the development of structured simulation-based training methods and prototype training support packages have led to the identification of needs for user-oriented support tools. These tools should provide access to available training support packages, as well as to methods for modifying them and developing similar ones. Leaders of training units will then be able to access and tailor simulation-based training packages to meet their needs. The Commanders' Integrated Training Tool (CITT) for the Close Combat Tactical Trainer (CCTT) is a prototype of trainers' tools needed for future simulations. The CITT is a user-focused software application that is currently available in standalone and distributed forms. It is scheduled to be incorporated into the CCTT baseline system sustained by the Project Manager for the Combined Arms Tactical Trainer in the very near future. This paper provides key findings relating to users' needs for structured simulation-based training tools, followed by an overview of the development and key components of the CITT. Future directions and key issues in the application of CITT-like tools to various simulation environments are then addressed.

SOLDIERS AS DISTANCE LEARNERS: WHAT ARMY TRAINERS NEED TO KNOW

Millie Abell, Futures Training Division
U.S. Army Headquarters Training and Doctrine Command

Army distance learning courseware must address the diverse needs of adult learners, to include those of Generation X and Y learners as well as distance learners. Their needs include the requirements to: 1) know why learning the knowledge or skill is necessary, 2) direct their own learning, 3) contribute their experiences to the learning situation 4) apply what they have learned in solving real world problems, and 5) feel competent and experience success throughout the training program. In addition to needs of adult learners, trainers must also consider characteristics of Generations X and Y such as the following: their inclination for independent learning experiences that incorporate fast-paced and visually intensive instruction, their need for frequent interactions with corresponding feedback, and their strong desire to experience a sense of accomplishment. Trainers must address barriers inherent in distance learning by incorporating the following into at-distance instruction: increased student-to-instructor feedback, more interactivity, highly structured learning activities to ensure distance learners do not lose track of where they are, and highly visual presentations. Army research has demonstrated that soldiers perform statistically significantly better when trainers incorporate these four features into instruction, an activity that is imperative in light of today's trend toward proliferation of reusable courseware. Army distance learning courseware designers must be trained in instructional design techniques that address these needs. The paper goes on to discuss special challenges for multimedia delivered through CD-ROM and via the Internet.

NETWORKED SIMULATORS: EFFECTS ON THE PERCEPTUAL VALIDITY OF TRAFFIC IN DRIVING SIMULATORS

Dr. B. Kappé, Dr. S.C. de Vries, TNO Human Factors

The present study investigates the effect of network parameters on the representation of networked entities. An accurate representation of such entities is important for the perceptual validity of networked simulations. Due to network delay and dead reckoning, networked entities can exhibit erroneous behavior (e.g. jittery movements, overshoots). The central question in this study is when this erroneous behavior affects the perceptual validity of the simulation. We will determine the network properties that are required for acceptable presentation of networked entities. In the TNO-Human Factors low-cost driving simulator, the driving behavior of traffic participants was judged. The traffic data was subject to network delay and dead reckoning before it was presented in the computer generated image of the driving simulator. The results show that drivers are very sensitive to errors due to a too large dead reckoning threshold, and less sensitive to errors due to a large network delay. When the dead reckoning threshold exceeds 3-4 cm, the movements of the traffic participants become jittery. Such unnatural jittery movements are highly detrimental for the perceptual validity of the traffic simulation. The effect of delay, i.e., an overshoot in the trajectory of a vehicle, can be observed in normal traffic (at least in theory) and were found to be less detrimental for the perceptual validity. It is concluded that the perceptual validity of vehicles in traffic is very sensitive to errors due to network communication, but it is possible to present such traffic with a high perceptual validity, provided that the dead reckoning threshold is set at a low value.

Previous Years Papers Available on CD

THE DEVELOPMENT OF INFORMATION VISUALIZATION DESIGN GUIDELINES

Leah Reeves, Kay Stanney, Ph.D.
University of Central Florida

LT Jim Patrey, Ph.D., Robert Breaux, Ph.D.
Naval Air Warfare Center Training Systems Division

The current objective of Information Visualization (IV) research is to transform vast amounts of information into decision-supportable knowledge structures and patterns that capitalize on the way humans process information through perception and action. In general, the aim is to assist users in finding appropriate task information by presenting this information in a comprehensible manner through interactive computer graphics displays that present underlying relationships of concrete and/or abstract information in easily identifiable perceptual forms. New trends in IV are emerging, likely driven by the explosive growth of the internet, the computerization of business and defense sectors, the deployment of data warehouses, and use of virtual environment (VE) and advanced distributed learning (ADL) technology for entertainment, educational, and training applications. Although many commercial tools are now available for creating visualizations for both concrete and abstract information, there are few, if any, theoretically-based or empirically-validated guidelines provided to developers or users regarding which technique(s) is most appropriate for a given domain context, user, or task. The objective of the present research is to identify the need to develop effective visualization design guidelines from the perspective of human information processing, visual display, and problem solving theories. Information processing theories suggest that to achieve comprehension of visual displays they must be developed such that they are readily perceived, interpreted, and acted upon. Visual display theories suggest that information should be organized and displayed in such a way that it is congruent with the methods in which one scans the environment. Research on integrating such theories with how people solve problems can be used to build principle-driven design guidelines that may assist visualization designers in successfully transforming information into the appropriate perceptual form for their users' domain task/goal(s). As a future objective of this research, critical issues to be addressed include determining: how to best characterize the existing knowledge of human perception and presentation design to develop theoretically-based visualization design guidelines; how to categorize and classify domain contexts, users, and tasks/goals; how to extend and augment principles developed for 2D visualizations to 3D; how immersion may enhance visualizations; and whether design principles will be generalizable or domain/task specific. Empirical testing and validation of future proposed design guidelines will be conducted in the shiphandling testbed of the Virtual Environment Training Technology (VETT) project, located at the Naval Air Warfare Center Training Systems Division (NAWCTSD). In this paper, the results of a preliminary study provide empirical evidence for the utility of visualizations in communicating human performance of an underway replenishment (UNREP) task.

FIGHTER AIRCREW VISUAL CUE ANALYSIS IN AIRCREW TERMS

Thomas R. Griffith, NLX Corporation, William D. Kosnik, PhD, LITTON/TASC,
Craig D. Siefert, ASC/YWIT, Wright-Patterson AFB

The visual systems incorporated with flight simulators and weapon system trainers being used for training by fighter aircrews today must be improved to allow the aircrews to participate in the Distributed Mission Training (DMT) environment. DMT will require visual systems that display all the visual cues used by pilots and weapon system officers (WSOs) to perform every task necessary to accomplish their missions. These visual cues must be presented exactly as the pilots and WSOs see them when performing the same tasks in the aircraft. As examples, terrain features must have the same texture, man-made features must have the same levels of contrast and targets must come into view at realistic ranges. Further, the visual cues used by all the aircrews networked together for a DMT mission should be presented at the same level of fidelity and resolution to each aircrew. The characteristics of all the features and objects the pilots and WSOs can see outside the cockpit must be the identical. For the DMT training to be truly effective, the aircrews must believe that the time they are spending in the flight simulators is worthwhile. Providing the pilots and WSOs with high-quality, high-fidelity visual systems that replicate the same visual cues they use when flying their aircraft will be extremely important in the effectiveness of training in the DMT environment. This team collected data from fighter pilots and WSOs to determine what visual cues they use to perform the tasks required to accomplish their missions. After compiling the data into a database, they analyzed the data to determine how the aircrews used the visual cues to accomplish their tasks. This project is part of an ongoing effort initiated in 1992 by ASC/YW to conduct operationally oriented evaluations of state-of-the-art visual systems with the goal of providing Air Combat Command with improved training capabilities. This program known as Vis-Eval has expanded to include the collection of data from aircrews and reported in pilot terms, not engineering or technical terms. Vis-Eval evaluated various visual display systems and technology to determine what fighter visual tasks used in multi-role fighters could be supported by technologies used and/or that specific system. The F-15C VIDS Vis-Eval was limited in scope to evaluate what visual training tasks used in the FTU environment could be supported by that system. The concept of this program is to conduct data collection and analyses for the purpose of creating databases that include as much information as possible about the visual cues used by fighter aircrews. These databases can be made available to industry, government and academia. The initial effort in this latest phase of Vis-Eval was to collect data and develop a database for F-15C air-to-air tasks. In this second effort, the emphasis was placed on air-to-ground missions. Data was collected from over 100 pilots and WSOs representing four different fighter aircraft. Emphasis was place on outside the cockpit visual cues used in air-to-ground missions. The data was analyzed and placed in a database that lists tasks the aircrews are required to perform, and the visual cues they need to perform those tasks. The database also displays the visual cues the aircrews use to perform their tasks in order of their relative importance. Analysis of the data also revealed several findings of significant importance. The results of the interviews and questionnaires showed that the effects of weather and shadows are extremely important to how fighter aircrews acquire and use visual cues. The effects of bright lights and explosions at night produced additional valuable information. One area that had never been addressed before this project was the visual cues used by WSOs. This study showed that WSOs use basically the same visual cues that pilots use. The importance of peripheral vision, especially from experienced aircrews, emerged as one of the most vital sets of visual cues needed in the overall performance of their missions. Ranges at which aircrews predicted they could detect various targets under differing conditions were also determined.Visual cues used by fighter pilots and WSOs in performing their tasks show a degree of commonality. Differences in the visual cues used are apparent in the different missions assigned to each weapon system, the avionics capabilities of each weapon system and the experience levels and background of the aircrews.

A GENERIC ASSESSMENT TOOL FOR EVALUATING C2 EXERCISES

Marcel van Berlo & Jan Maarten Schraagen
Netherlands Organization for Applied Scientific Research (TNO)
TNO Human Factors (TNO HF)

The commander of the Royal Netherlands Airbase Volkel has commissioned a study to obtain a clear insight into the process of command and control (C2), with the objective of assuring the quality of the output of C2. To enable this goal, TNO HF developed a generic assessment tool for evaluating the performance of C2 teams: the Command & Control Process Measurement Tool (C2PMT). The C2PMT comprises concrete and clearly observable performance indicators on the basis of which the process of C2 teams can be assessed. These specific performance indicators are based on interviews with key commanders of Airbase Volkel, and on a review of the relevant literature. A prototype of the C2PMT was successfully tested during a three-day exercise. In this paper, the development of the C2PMT will be described. First, the problems and questions of the Airbase will be presented. Secondly, team performance and performance indicators, as identified by the literature and field studies that have been conducted, will be commented upon. Thirdly, the development and prototyping of the C2PMT will be discussed. The final section concludes with future research and development issues.

GUIDELINES FOR DEVELOPING A HAND-HELD, CONFIGURABLE SET OF TEAM PERFORMANCE MEASUREMENT TOOLS

Denise M. Lyons and Robert C. Allen.Naval Air Warfare Center Training Systems Division

Researchers at the Naval Air Warfare Center Training Systems Division (NAWCTSD) have developed multiple instructor aides for performance measurement hosted on hand-held computers. The initial prototype, Shipboard Mobile Aide for Training and Evaluation (ShipMATE), provides instructors with an automated tool for presenting pre-brief information, collecting data and conducting a debrief utilizing the Team Dimensional Training strategy. This tool was originally presented in 1997. Since then, additional training and evaluation software applications have been developed for Air, Surface, Ground, and Sub-Surface domains in both classroom and operational settings. We refer to the set of available performance measurement tools, which can be loaded onto a hand-held device in any combination, as MATE. The applications on MATE have been tailored to accommodate various performance measurement methodologies, including outcome and process measures, aimed at capturing individual and team performance. Examples of screen designs will illustrate how each software tool is a unique combination of tools such as embedded checklists, a scrolling scenario script window, data tagging buttons, organizational tabs, voice recording, digital handwriting, instructor cueing, links to embedded systems and networking of multiple hand-held devices. This paper will review the multiple tools that have been developed and present suggested utilization of the optional screen functions. The value added by each function will be discussed as well as the viability of this technology in various operational settings including sea trials aboard AEGIS ships and field operations during Army exercises. Finally, guidelines for developing hand-held instructor aides for future training systems will be summarized.

THE APPLICATION OF A VALIDATED HUMAN PERFORMANCE MODEL TO SUPPORT PREDICTIONS OF FUTURE MILITARY SYSTEM CAPABILITY

Shelly Scott-Nash, Tom Carolan, Christine Humenick, Christy Lorenzen, Micro Analysis and Design, Inc.

James Pharmer, Naval Air Warfare Center, Training Systems Division

Throughout the entire design process of any future military system, from function analysis through system operation testing, a key human factors question will be, "Will warfighters meet required performance criteria on demanding operational scenarios?" Although experimentation with real warfighters is essential, it may be too expensive to for all possible equipment and team design options. The Integrated Performance Modeling Environment (IPME) focuses on simulation of humans in complex environments and allows us to evaluate system concepts, designs, and team structures with simulation at a far lower cost than with real humans. For the Office of Naval Research Science & Technology Manning Affordability Initiative, the IPME was used to model human processes and human interactions with current consoles, as well as internal and external communications networks. The model is based on a demanding air defense warfare scenario containing in excess of 80 air tracks, 1160 scenario events and 150 human tasks. Modeled processes include air track detection and identification, escort, queries, warnings, and threat evaluation and mitigation. Some measures that can be provided by the model include the time to first identification, wait time associated with various tasks, and crewmember workload parameters. In parallel with model development, experimental data were collected aboard ship from eight intact crews using the same demanding operational scenario. This paper describes a multiple-step process in which the model is validated and calibrated, and discusses progress to date in this area. Then, the paper discusses how the project will modify the timing and function allocation rules in the model to allow experimentation with alternate team designs, automation and alternate human machine interfaces. This cycle of model validation and model-based design evaluation provides a powerful way to integrate human factors engineering into the design of future systems.

USING HUMAN PERFORMANCE PREDICTION TO ASSESS MANNING REQUIREMENTS

Tim Bowden
Micro Analysis and Design, Inc.

The AN/WLD (v) 1 represents the future of mine warfare technology. This remotely operated vehicle holds the promise of increased capability in detecting and classifying mines in ocean waters. The AN/WLD is a complex set of sensors mounted in a semi-submersible vehicle designed to sweep littoral waters in support of mine Reconnaissance. The advantages of this type of uninhabited long range sensing capability are vast and innumerable. But, these impressive capabilities are accompanied by equally impressive implications for maintenance and upkeep of the system. With deployment of the vehicle not scheduled until 2004 the question arises as to how to plan for these maintenance needs in a system that does not yet exist. The answer to this question in part lies in the maintenance modeling effort that accompanies the design of the vehicle. Using the Improved Performance Research integration Tool, IMPRINT, component level data were compiled and run through two scenarios to simulate actual usage of the AN/WLD system. The preliminary analysis covered only certain subsystems of the overall AN/WLD.

Results indicate that this impressive new technology can be deployed with only minimal impacts on maintenance manpower requirements. In fact, the five subsystems modeled in the initial effort indicate only 333.49 maintenance man-hours per year would be necessary to deploy this vehicle. This prophetic look into the manning impacts of the vehicle makes its costs justifiable and will allow for adequate planning prior to deployment. This paper outlines the maintenance modeling process along with the IMPRINT tool and other possible applications of maintenance simulation.

A BRIDGE BETWEEN COCKPIT/CREW RESOURCE MANAGEMENT AND DISTRIBUTED MISSION TRAINING FOR FIGHTER PILOTS

Robert T. Nullmeyer, Peter Crane, and Glenn D. Cicero
Warfighter Training Research Division
Air Force Research Laboratory

V. Alan Spiker
ISERA Group

Well-coordinated tactical teams are essential for mission success. Distributed mission training (DMT) has significant potential for improving this coordination. A parallel team training approach, cockpit resource management (CRM) training can provide valuable lessons learned regarding interactive crew processes that promote this coordination. Although, by definition, single-seat fighters do not have crews, pilots in a four-ship of F-16s, together with their weapons director, do form a tactical team, making CRM processes relevant. DMT provides scenario control that is not available in aircraft training. This control provides the capability to identify key behaviors exhibited by the most (and least) effective tactical teams. These behaviors can be translated into well-defined training objectives and associated measures of training effectiveness, which in turn will enable comparisons among alternative DMT training practices. Characteristics of effective CRM training across the services are summarized, including the need for concrete training objectives, a high degree of operational relevance, and instruction that is tailored to the needs of the participants. The key behaviors that are most consistently linked with effective crews in CRM research are compared and contrasted with behaviors that appear to affect mission effectiveness in DMT air-to-air, 4 v X scenarios. The latter behaviors were derived from observations made over the past 18 months as F-16 pilots received flight leader upgrade training at our Mesa Arizona DMT facility. Electronic Combat (EC) training was found to be a particularly fertile domain in earlier CRM research. The same holds true for DMT. Tactical behaviors for EC are also identified. Military researchers have made substantial progress over the past few years toward developing reliable measures of CRM. We conclude with a research plan to systematically capture more detailed quantitative and qualitative CRM data from DMT scenarios. The initial goal is to identify the CRM behaviors exhibited by the most (and least) effective fighter teams. Ultimately, these behaviors will be translated into well-defined training objectives from which process and outcome measures can be developed to enable comparisons among alternative DMT training practices.

SUPPORTING SHIPBOARD NETWORK OPERATIONS THROUGH ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

Janet J. Cichelli, Performance Support Services Division, SI International, Inc.

The Navy's IT-21 program (Information Technology for the 21st Century) will modernize fleet operations by integrating advanced information technology capabilities into ships, battle groups, and shore facilities. A primary goal of IT-21 is to provide a smooth flow of information between operational units, allowing warfighters to instantly exchange tactical or non-tactical information, thereby improving warfighting capability, combat support, and quality of life. IT-21 presents a considerable training challenge in preparing the shipboard Network Administrators who will be responsible for maintaining smooth network operations and preventing system failures. Currently, training is not standardized and is not consistently available. Even when training has been provided, the IT personnel on these newly outfitted ships have been overwhelmed by the sheer volume of what they need to know in order to do. As knowledge decay statistics show, the rate at which we forget means that only 10 to 15 percent of what sailors are taught in preparatory training is retained as they transition to performing their jobs (Lippincott, 1997). To counter this problem, the Navy is moving to modernize its training approach along with its IT infrastructure. Future training design and delivery efforts will be directed toward the goal of performing rather than learning how to perform. To demonstrate an implementation of this approach, a prototype electronic performance support system (EPSS) has been developed for the DDG-51 ship platform. This EPSS provides an intuitive, task- and goal-based user interface to focus and filter access to a knowledge base. The DDG EPSS supports troubleshooting and analytical decision making, displays and explains networking configurations, houses critical policies and guidance, allows platform-specific customization, and provides "just in time" learning for networking concepts and procedures. The fully developed EPSS will provide a continuum of support, being used initially to facilitate and enhance instructor-led training, and then becoming available to administrators as part of the standard shipboard software load. This paper will present an overview of electronic performance support, how it can be applied to complex work processes, and the benefits that can be achieved through this approach. The paper will also discuss the specifics of the DDG EPSS project, and will discuss how the prototype will be leveraged across remaining ship classes to reduce subsequent EPSS development costs and shorten its implementation.

KNOWLEDGE REPRESENTATION AS THE CORE FACTOR FOR DEVELOPING COMPUTER GENERATED SKILLED PERFORMERS

Barry Peterson and Rudolph P. Darken, MOVES Academic Group, Naval Postgraduate School

Because the characteristics of the knowledge representation influence both the instructional design and knowledge elicitation processes, its selection is the core of the training system design process. To assist the selection, this investigation considers the interaction of three system development components, knowledge elicitation, knowledge representation, and learning environments, within the context of the domain characteristics and the overarching theoretical framework. Following our description of these interactions, we apply the model to tactical land navigation, a domain representative of one class of skilled military performance. This application then leads to a description of our selection criteria and a brief evaluation of two candidate knowledge representations.

Previous Years Papers Available on CD

REALTIME MODIFICATION OF LARGE SCALE EXERCISES: SUPPORTING THE MANAGEMENT OF HUMAN TRAINER RESOURCES

Randall Oser, Michael R. McCluskey, Elizabeth Blickensderfer, Gwendolyn E. Campbell, & Denise M. Lyons
Naval Air Warfare Center Training Systems Division

Joint Vision 2010 and Joint Vision 2020 suggest that future military success will largely be a function of the military's capability to respond to dynamic changes in the environment. The capability is not likely to happen by chance; it must be trained. One approach is to provide practice opportunities in large-scale simulations where the training audience is presented with situations that require adaptation based on changing environmental conditions. While this type of training places challenging demands on the training audience, it also places demands on the training system. That is, the training system itself will have to be adaptive in response to the training audience. Advancements in modeling and simulation (M&S) have provided an ever increasing capability to conduct distributed, large-scale exercises in synthetic environments, however, there has not been a commensurate level of effort to develop technologies to support real-time modification of these exercises when changes are required. Currently, exercise modification is largely unaided and resource intensive. Exercise controllers must manually determine when changes are required during a scenario, assess the impact of those changes on the exercise, and then implement those changes. Without the capability to rapidly modify the scenario in response to these situations, important training opportunities may be missed, critical training objectives may not be achieved, and valuable training resources may be wasted. As pressures to reduce training resource requirements and maintain training effectiveness continue, the need for methods and technologies to support learning will become even more acute. Fortunately, recent developments in learning methods and technologies have considerable potential for enhancing the effectiveness and efficiency of M&S exercises. This paper will describe an effort that is exploiting advances in emerging training methods and technology to support real-time modification of M&S exercises based on trainee performance. The project goals are to demonstrate: (1) enhanced achievement of training objectives, (2) improved effectiveness of training by tailoring to the training audience's needs, and (3) reduced human resources to support exercise execution. This paper will describe: (1) the operational need, (2) current training requirements and issues, (3) promising component methods and technologies, and (4) the advanced development research effort.

CONSIDERING HUMAN REQUIREMENTS IN TRAINING SYSTEM DESIGN: A VISION FOR THE 21^{ST} CENTURY

Janis Cannon-Bowers, J. Robert Bost, Scott C. Truver, Patricia Hamburger

The United States Navy views the future in terms of asymmetric threats, which can impede its access to the littorals. To counter these threats, the Navy seeks to exploit modern digital information technology to establish knowledge superiority over potential adversaries thus maintaining the tactical advantage. To date, there has been little discussion about the role of human operators and decision makers in these strategic and operational constructs aside form vague references to the "knowledgeable warfighter" and "reach back" knowledge centers that augment the on-scene tactical view. Moreover, the standard practice of combat systems and training systems design – thinking about the human last – almost inevitably results in sub-optimal performance, and can potentially lead to disaster during crisis or conflicts (particularly given the complexity just described).This paper describes how the current vision for future naval warfare translates into specific human performance requirements. We then describe several emerging training technologies that will be useful in meeting the unprecedented demands that our warfighters will confront. We conclude with recommendations for science and technology investments in training and human performance that we believe are crucial for success in the 21^{st} century.

Previous Years Papers Available on CD

MODELING ARCHITECTURE TO SUPPORT GOAL ORIENTED HUMAN PERFORMANCE

Susan Archer and Nils LaVine
Micro Analysis and Design, Inc.

Traditional human performance models have often been criticized for failing to represent and predict goal-oriented behaviors, and for failing to predict measures that are meaningful to other training and equipment simulations. To address this criticism, in 1999 the Air Force Human Research Laboratory began an effort to develop a human performance modeling environment that could interact with other simulations using an HLA-compatible protocol. One element of that environment is a model development tool that enables users to create a detailed simulation of a goal-oriented human agent, operating in a complex environment. In this context, the simulation predicts what the human is likely to do next based on the currently relevant goals, and on the status of other parallel simulations. A practical example is a combat pilot who has a primary mission to conduct reconnaissance of a target area. Therefore, the pilot's original goal is to fly a well-defined path and to use a variety of sensors to collect data. However, if during that flight the pilot identifies an incoming threat (from a parallel radar simulation), the goal will change immediately to "evade and survive." This dictates a change in tasks as the pilot suspends his execution of the pre-planned flight path and begins new tasks to dump chaff and to conduct high-speed maneuvers.

This is an extremely dynamic and demanding modeling challenge, because goal states change based on events in the scenario as well as on occurrences experienced by agents in other linked simulations. For this reason, they cannot be scripted. The problem is also complicated by the interaction between goals, in which a high priority goal can suspend, halt, or restart a lower priority goal. This must be accomplished with as little burden on the user as possible through the automatic exchange of data and the implementation of sophisticated algorithms to mediate competition between active goals.

COURSE OF ACTION TRAINING FOR HELICOPTER PILOTS

Rick Archer and Brett Walters
Micro Analysis & Design, Inc.
Boulder, Colorado

Jay Shively and Lynne Martin
Aeroflightdynamics (AMRDEC)
US Army Aviation and Missile Command
Ames Research Center
Moffett Field, CA

A number of studies by various helicopter safety organizations have concluded that pilot error in decision-making is a root cause in a significant percentage of helicopter accidents. The studies have also indicated that instruction and practice in critical decision-making is not a part of many helicopter pilot training programs. To address this problem, a project to develop a low-cost simulator for pilot decision training was initiated. The decision training tool is a combination of computer-based simulation, full motion video, still photography, audio, and feedback. For the purpose of developing robust and realistic mission scenarios for the simulation tool, 17 emergency medical service pilots participated in interviews to identify events that require critical decision-making. This paper describes the development of the first mission scenario, formative evaluation, and implementation plans for fielding the decision trainer.

OPTIMIZING THE TRANSFER BETWEEN GENERIC AND TYPE-SPECIFIC SIMULATORS IN INDIVIDUAL AND TEAM TRAINING

Michael Bots
Alma Schaafstal, Ph.D.
TNO Human Factors

Nowadays, many individual and team training trajectories include multiple simulators and training environments that differ in functionality, appearance and interface from each other and from the working environment. The use of different training environments within one training trajectory requires from students the transfer of knowledge and skills learned from one learning situation to a 'new' (learning or working) situation. This paper discusses a research study aimed at identifying transfer problems between generic and type-specific simulators for the RNLN Operational School. Using a combination of qualitative and experimental research methods, this study shows that there are many factors contributing to the large relapse students experience when moving from generic to type-specific simulators. Recommendations include, amongst others, a change in training strategy and a different design and organization of the training trajectory.

Previous Years Papers Available on CD

MODALITY PREFERENCE AND SHORT TERM MEMORY

Denise Garcia Epp, Senior System Engineer
Raytheon Company

Many researchers and educators suggest learning may be enhanced if the specific learning style of a person is known and then matched to a complementary instructional style. The assumption is that, due to such stylistic differences, each person may require instructional techniques matched to his particular style. Past studies are mixed in their support of this assumption.This study investigates the effect of matching modality preference with presentation modality (auditory vs. visual in both cases) upon memory. In the author's recent investigation, both auditory and visual participants were presented with simultaneous visual and auditory stimuli, followed at random by an auditory suffix. The relation of the preferred modality to the presented modality did not affect recall. Instead, performance was most affected by the interfering effects of the suffix. Moreover, different measures of modality preference failed to agree with one another. Fifteen auditory and 15 visual participants were defined on the basis of the Productivity Environmental Preference Survey (PEPS, Dunn, Dunn, & Price, 1982). However, only one participant preferred the visual modality according to Broadbent's (1956) bisensory digit-span criterion, and only one subject preferred the auditory modality when asked for a preference directly. The inconsistency of defining preferred modality suggests that future research should not continue to emphasize the learning style and teaching style interactions. Instead, insight is needed on the different variables and the different methods of assessing these variables. If learning styles do not exist, or if they exist but we have no reliable measurement of style, the question of matching learning and teaching styles is irrelevant.

THE ADVANCED TECHNOLOGY CREW STATION (ATCS) DESIGN METHODOLOGY: A CREW-CENTERED APPROACH

Stephanie P. Riddle, Naval Air Systems Team

Stan Olejniczak, Veridian Engineering

The Advanced Technology Crew Station (ATCS) methodology outlines a crew-centered approach to the design of modern tactical aircraft crew stations. It was completed under the ATCS program, a Navy sponsored program funded through the Crew System Science and Technology Program Office. Currently, there is an inconsistency of crew station design philosophy across the services, a lack of a formalized approach to incorporate and integrate state-of-the-art technologies into crew station designs. The goal of the ATCS design methodology application is to design a crew station that will optimize the performance of the crew and enhance their mission effectiveness. The ATCS design methodology will also identify potential near term transition of subsystem designs to platforms. This methodology can be described as a "crew-centered system design" where the emphasis is on the needs of the aircrew in order to enhance the performance of the entire weapons system. Specifically, the ATCS design methodology consists of three major tasks: 1) requirements analysis, 2) concept generation and evaluation, and 3) configuration development and evaluation. Requirements analysis starts with a concept of operations development. Next mission scenarios, threat assessments, and mission descriptions are developed in sequence. Development of function and task timelines, task analysis, and information requirements complete the task. The second major task of the ATCS methodology is concept generation and evaluation. This task includes technology concept development and assessment, technology concept development, subsystem and system concept development, engineering analysis, and qualitative and quantitative evaluation. The last major task is configuration development and evaluation. Here, one or more concepts are selected and a preliminary configuration is developed. This task includes pilot/vehicle interface definition, detailed configuration design and evaluation. Tools such as Quality Function Deployment (QFD) are used as part of the ATCS methodology. The ATCS design methodology has already been transitioned to industry and the government. This paper will include a detailed description of the ATCS methodology and its application. An example will be given. Transitions and future work will also be discussed.

ENVIRONMENTAL DATA MODELING FOR SIMULATION SYSTEM REQUIREMENTS SPECIFICATION

Dale D. Miller, Annette Janett, Mary Kruck, Richard Schaffer
Lockheed Martin Information Systems, Advanced Simulation Center
Paul A. Birkel, The MITRE Corporation, Bernard Gajkowski, Pamela Woodard, (STRICOM)

An environmental data model (EDM) explicitly captures the phenomena (e.g., features) in the natural environment, the qualifying attributes of those phenomena, and the implicit relationships among phenomena. As such, the environmental data model is a key element of a simulation system – at the program specific level, it describes the geospatial environment in which the simulation takes place and with which all entities interact. These interactions serve as a compelling reason to establish the program environmental data model early in the development process, i.e., during system requirements analysis. In practice, it is best to define the data model as one of the first requirements analysis activities due to its broad impact throughout the overall system. Important system elements affected are the behavioral and dynamic models and hence the overall effectiveness of the system in providing the required capabilities, be they training, analysis, or acquisition based. Historically, requirements analysis has involved analysis of a system's intended operational use and the entities to be modeled. Complex systems might characterize hundreds of unique entity types. Ideally, all entities to be modeled will have a consistent representation of the world. The ability to achieve this is facilitated by the EDM. Additionally, system development efforts will be better focused if the program EDM is developed early in the system lifecycle. Until recently, environmental data modeling has been ad hoc, with the data models captured only in implicit fashions such as in source code or data files, if at all. The Army Warfighter Simulation (WARSIM) 2000, a component of the Joint Simulation System (JSIMS), defined a Terrain Common Data Model (TCDM) for use throughout the JSIMS Alliance. The Army Synthetic Natural Environment (SNE) Science and Technology Objective (STO) has developed a Common Data Model Framework (CDMF) to promote the comparison of program specific EDMs and support the higher resolution requirements of the OneSAF Test Bed and the Close Combat Tactical Trainer (CCTT). The Reference EDM which will ultimately result from the unification of these program-specific EDMs will provide an important infrastructure for achieving environmental interoperability within the community of land combat simulations. Additionally, the SNE STO is addressing critical system-of-systems interoperability issues by developing explicit data modeling technology to support the concept of representing environmental phenomena at multiple levels of resolution. In a related activity, the Defense Modeling and Simulation Office (DMSO) is extending the CDMF concept from terrain to the ocean and atmosphere domains. Creating these EDMs for Ocean and for Atmosphere supports the overall goal of establishing a general Environmental Data Model composed of environmental sub-domain EDMs (terrain, ocean, atmosphere and space) from which user community Reference EDMs and program specific EDMs would be generated as profiles. This paper provides an overview of the environmental data models developed to date, focusing on the importance of developing such a model early in the simulation system development process.

EXTENDING THE TERRAIN COMMON DATA MODEL TO TRAINING SIMULATIONS ON LOW-COST VISUAL SYSTEMS

A. Schiavone and Brian Goldiez
Institute for Simulation and Training, University of Central Florida

Most current training simulation systems employ custom generated, ad hoc approaches to building terrain models. Recently, the DARPA STOW Worldwide Terrain Database generation effort, the Joint Simulation System (JSIMS) Synthetic Natural Environment (SNE), and the Joint Warfighting Simulation (JWARS) SNE have cooperatively defined a Terrain Common Data Model (TCDM) for low and medium resolution simulations. The U.S. Army STRICOM Synthetic Natural Environment Science and Technology Objective (SNE STO) seeks to extend the TCDM to other important classes of simulations, thus improving overall interoperability between networked simulation, as well as defining the basis for terrain data production requirements, terrain integration constraints and expectations, SEDRIS transmittal contents, and runtime terrain data use. At IST, our efforts are concentrated on extending the TCDM to low-cost visual systems. Our approach is to develop a detailed specification of terrain database requirements based on tasks commonly performed using low-cost visual systems. In this paper, we chart a course for accomplishing this goal, including describing the development of a structured database of design elements, the definition of a multi-systems view to include multiple resolutions and sensors, a plan for being consistent with initiatives by others working on the TCDM, and our plans for future work in this area.

PROPAGATION MODELS AND ANTI-SUBMARINE WARFARE (ASW) TRAINERS

Robert J. Howard & Doug Clark, Analysis&Technology/Anteon

One of the key elements of an acoustic trainer is the wave propagation model(s) used to model the propagation of a signal through the enironment to the receiving system. The type of model implemented has a significant impact on the trainer design from many aspects including hardware and software needs, fidelity, computational speed, database structure, run time and off line calculations, and complexity. This paper will provide an overview of the most common wave propagation models used in current acoustic training devices. The differences between models, their strengths and weaknesses will be described and the impact on the trainer design will be discussed. It will be shown that no existing, single models, satisfies all the needs of the acoustic trainer and attempts to cobble together models to meet the needs have been unsuccessful. The difficulties in developing hybrid models will be described. As part of the discussion we will describe the different approximations and software architecture design strategies that are necessary to satisfy application specific needs. Today there is a major emphasis on federating trainers together into federations. The impact of differing propagation models used by different trainers will be discussed from the standpoint of interoperability and consistency.

Previous Years Papers Available on CD

COMMUNICATION WITH INTELLIGENT AGENTS

Paul Nielsen, Frank Koss, Glenn Taylor, Randolph M. Jones
Soar Technology, Inc.

Combat effectiveness requires coordination, and the most critical component of coordination is communication.This paper describes methods for communication with and among intelligent constructive forces (IFORs). It explores a number of different approaches to communication and their implementation in the TacAir-Soar behavior system. Because TacAir-Soar entities are intended to be indistinguishable from human combatants within the simulation environment, communication may occur between IFORs, between humans and IFORs, and between IFORs and other constructive forces. This places a number of constraints on the possible forms of communication. They must be natural for human interaction, yet well structured for communication with other constructive forces. TacAir-Soar s approach to communication is to model mechanisms used in the real world rather than to create simulation-specific versions. For example, radio messages are text representations of the same, doctrinally correct, English utterances spoken by human pilots and controllers. The resultant system makes it comparably easy to interchange roles between humans and IFORs. This approach also facilitates interaction with other constructive forces because of well-defined communication templates and optional translation to the Command and Control Simulation Interface Language (CCSIL) [Salisbury, 1995]. TacAir-Soar includes a range of communication methods, including explicit and implicit forms of communication. The methods presented here include natural language communication over simulated radios; a communication panel and radio log for graphically driven communication; SoarSpeak, for real-time speech recognition and generation; distributed goal and status reports for communication with controllers; data links; non-verbal communication; and translation methods for CCSIL. This paper examines how these various modes are implemented, and their benefits and drawbacks. Specifically, it shows how the implementations enable humans to easily immerse themselves into a simulation involving IFORs. It also includes several examples drawn from technology demonstrations and operational exercises where human communicated with IFORs serving as command and control entities, friendly forces, and wingmen.

DESIGN OF AN OBSERVATION-BASED AUTONOMOUS RE-PLANNING CAPABILITY IN A SYNTHETIC UNIT

Michael D. Proctor, University of Central Florida, John S. Kolasheski, Major, US Army

Conduct of Command and Control (C2) training for commanders and staffs of United States Army battalions often relies on simulation. Within one simulation paradigm, company commanders play an important role during the conduct of a simulation training exercise by interacting and maneuvering the battalion's elements based on guidance given to them by the battalion commander and staff. This approach is clearly beneficial to training the units' leaders and staff, but may be biased due to unrealistic artificialities present in the simulation framework. One such artificiality rests in the actual use of the company commanders. Specifically during simulation play company commanders often find themselves performing the functions that in actual tactical situations subordinates would perform. Having it occur in the simulation may bias the results toward success since the company commander is able to directly control the behavior of his subordinate elements based on the greater information and experience he/she possesses. One approach to resolving this situation is to utilize Artificial Intelligence (AI) in the simulation to model the behavior of the company commander's subordinates. This research considers the analysis and design of a polymorphic re-planning model for an Armor platoon that leverages both Command Agent (CA) and Combat Instruction Set (CIS) technology. The outline of this design is provided along with conclusions and recommended future research.

FORCE XXI BATTLE COMMAND BRIGADE AND BELOW DIGITIZATION OF CCTT

Cynthia P. Rahaim, Peggy A. Hughley, Marcus L. HillScience Applications International Corporation, John Foster, US Army Simulation Training and Instrumentation Command

As the growth of a more digitized battlefield emerges, it necessitates the need of existing training simulation systems to communicate with newly developed digital devices. The Force XXI Battle Command Brigade and Below (FBCB2) information system is a key component of the Army Battle Command System. FBCB2 enhances force effectiveness by providing automated tools to facilitate the battle command process. Force XXI's goal is to provide a training battlefield that can be used to train or conduct mission rehearsals for the battlefields of tomorrow. Our objective is to integrate digital communication training into the Close Combat Tactical Trainer (CCTT). The CCTT Semi-Automated Forces (SAF) Workstation provides the capability to supplement manned modules with sufficient friendly and enemy forces to complete a simulated battlefield that contributes to a realistic training environment. The Computer Generated Forces (CGF) units, directed by the SAF operators, interact in a physically and tactically realistic manner with the manned modules on a simulated battlefield. When CCTT is integrated with FBCB2, the CGF units will generate Situational Awareness (SA) information to the FBCB2, as well as, Command and Control (C2) messages and orders as actual troops in the field. The soldier will receive the information on the FBCB2 in the manned module. The CGF units will also react to SA and C2 messages received from soldiers via FBCB2. This is the first step in digital device training of the Army Battle Command Systems.This paper reports on the motivation, architecture, and design approach of the integration of the FBCB2 into CCTT SAF. It details how the architectural design of CCTT SAF allowed for ease of addition of FBCB2 messaging. In addition, it discusses the method of communication with external digital devices.

Previous Years Papers Available on CD

A TEMPORAL DATABASE APPROACH TO SIMULATION DATA COLLECTION AND ANALYSIS

Thom McLean, Leo Mark
College of Computing, Georgia Institute of Technology

The High Level Architecture (HLA) for distributed simulations was proposed by the Defense Modeling and Simulation Office of the Department of Defense (DOD) in order to support interoperability among simulations as well as reuse of simulation models. One aspect of reusability is the ability to collect and analyze data from simulation executions, including a record of events that occur during the execution, and the states of the simulation objects. HLA presents an interesting new paradigm within which to design effective data collection and analysis techniques. The capabilities of the Run-Time Infrastructure (RTI) can be exploited to design efficient and flexible data collection tools. Moreover, recent research on the efficient log-based implementations of temporal databases may enable more efficient collection and analysis of data from simulation executions. Using a distributed real-time temporal database approach, we may be able to expand run-time analysis opportunities. In this paper we propose log-based event databases as a means of efficiently storing and retrieving data from distributed interactive simulations. In particular we focus on operations on event-logs, including querying, merging/splitting and VCR-like features, as a means for supporting reusability of simulation results. Such a database-centric perspective can be useful in designing efficient, on-line real-time analysis mechanisms that are not feasible with current logging techniques. This paper presents work-in-progress towards that end.

COMPETING CONTEXT CONCEPT: EXPERIMENTAL RESULTS

Shinya Saeki
Mitsubishi Research Institute, Inc.

Avelino J. Gonzalez
School of Electrical Engineering and Computer Science
University of Central Florida

This article describes an innovative approach for implementing tactical decision-making for Computer Generated Forces (CGF). It is called the competing context concept, and it is associated with the Context-Based Reasoning (CxBR) Paradigm. CxBR is uniquely suited to represent tactical decision-making. It facilitates the simple and effective representation of human tactical behavior by using an intuitive identifier called a Context. In CxBR, there are three kinds of Contexts that are hierarchically defined: (1) Mission Context, (2) Main Context and (3) Sub-Context. The Main Contexts and Sub-Contexts provide intelligent control functions for an Autonomous Intelligent Platform (AIP) in a simulation, and address all conditions in current situation. When the situation changes, this Main Context searches for a possible next Main Context that addresses all conditions in the new situation. Upon finding such a new Main Context, it deactivates itself and activates this newly found one. No matter how the situation changes, an AIP can be controlled intelligently through a sequence of transitions among various Contexts, from the current Context to another appropriate Context. In many cases, it can be easy as well as appropriate to predefine the Context transitions based on one event. However, it can be difficult to predefine (i.e., "hardcode") these transitions in more complex tactical situations such as those typically involving military tactics as they depend on several variables. Therefore, there may be more than one viable context to which the control of the AIP can transition. This can be difficult to predefine without a multitude of rules. In such cases, it is beneficial to define the current situation as set of needs to be addressed by the AIP in order to accomplish its mission and/or survive. Likewise, the Contexts to which the control of the AIP can potentially transition are designed to address some or all of these needs. The contexts then can be said to compete for the right to become the next activated Context to control the AIP. The successful Context would ideally be the one that best addresses the identified needs of the situation currently faced by the AIP. To implement the competing context concept, we have proposed a constraint-based approach. This approach consists of four processes: (1) Situation interpretation metrics generation, (2) Relevant context group selection, (3) Context attribute matching and (4) Time-warp simulation. This article describes our continuing effort to realize the situation interpretation and soft-coding function in order to generalize the competing context concept. Experimental data, which supports the revised prototype's performance, are described.

DEVELOPMENT OF AN ABSTRACT USER INTERFACE TO SUPPORT MULTI-MODAL INTERACTION

David R. Pratt, Anthony J. Courtemanche and Mary Ann Pigora
Science Applications International Corporation

It is well known that there is no single optimal, universal user interface (UI) paradigm that can accommodate all the tasks a computer generated forces (CGF) user might be expected to perform. Plan view displays and buttons on two dimensional graphical user interfaces are common UIs for many CGF systems. However, other CGF users may require more diverse UIs such as three dimensional views, text message sending and receipt capabilities, and verbal interactions with the system. An abstract UI model can be used to provide flexible multi-modal support for various UI paradigms. It also isolates the interaction mode from the remainder of the system and thus contributes to system modularity and composability. Both of these abstract UI features are needed for future CGF systems that must satisfy multiple user needs. The authors have investigated the usefulness of the abstract UI concept by developing an entity-based CGF system that uses an abstract UI to support a combination of graphical, textual and voice/speech synthesis UIs concurrently. Through the abstract UI, the most appropriate of the three UI paradigms for any given task can be selected. The abstraction was achieved by the use of a UI framework that supports all the user interactions within the CGF infrastructure. Specific UI classes were derived from the base abstract UI class using inheritance. Methods of the appropriate derived UI classes were invoked through polymorphism. Through the use of inheritance and polymorphism, the CGF infrastructure has a consistent view of the abstract UI component. To further abstract the UI component, all user interface communications were carried out via a series of messages. Using this implementation of the Command Pattern, we were able to extend the functionality of one of the interface paradigms without affecting the implementation of the others. This allows for added flexibility of the user interactions and the construction of paradigm specific interactions. This paper covers the development of the abstract UI. It discusses the base and derived UI classes and describes the use of messages. The benefits and limitations of this approach are presented as a foundation for future work.

HOW HARD IS IT TO MAKE A VISUAL SIMULATION DATABASE?

Serge J. Olszanskyj
Evans & Sutherland Computer Corporation

We discuss the complexity of making a synthetic environment (i.e., a database) suitable for man-in-the-loop visual simulation systems. Performance of a training simulation is often discussed from a hardware or a display point-of-view, e.g., the number of polygons rendered per frame, the number of pixels displayed, etc. Far less talked about is the complexity of making the *content* to be displayed by the simulator and interacted with by the user. There are very few metrics for the complexity of constructing a simulation database (the most common one – "How fast can you make a geocell?" – is completely useless!). Not having good metrics for quantifying the complexity of our databases may make us, as an industry, miss the key issues to accomplishing effective content creation for our training systems. With the tremendous growth in graphics hardware performance in recent years, this may yield a troubling imbalance in our overall technology, with the technology for content creation lagging significantly behind.

To help clarify the issues, we first attempt to "de-mystify" synthetic environment construction complexity, and enumerate the key steps involved in such content creation. Second, we will abstract out the essential complexity of this process. Third, we will attempt to distill this information into a set of metrics that can be used to measure the complexity of a synthetic environment database before it is made, based on its requirements and general characteristics.

Two critical overall points we hope the reader will obtain from this paper are that

- geographic size and other traditional source data complexity metrics do not accurately predict the complexity of making a visual simulation database, and
- linear increases in graphics hardware rendering performance implies a *greater-than-linear* increase in the complexity of making a simulation database to run on such hardware.

We conclude by discussing the impact of these two points as well as other related open issues facing the simulation modeling community.

REPRESENTATION OF URBAN/SUBURBAN SPRAWL THROUGH REAL-TIME GENERATION OF PSEUDO-RANDOM CULTURAL FEATURE ENTITIES

Gregory B. Tackett, Christy Hochberger Bates
U S Army Aviation & Missile Command Research, Development, and Engineering Center (AMRDEC)

The Department of Defense (DoD) has identified the need for simulation representations of urban sprawl, and has open actions reviewing urban sprawl simulation capabilities. The essence of the problem is the large terrain database development and subsequent terrain complexity that is required for representation of large urban and suburban areas. A further complexity is the need to simulate the interior structure of a large number of buildings for dismounted combat. This need for suburban representations impacts directly upon the ability of the Department to simulate urban combat and unconventional warfare. One approach to creating generic suburban terrain is to generate, in real-time, a feature set representing realistic suburban cultural entities in the immediate vicinity of player entities in a distributed simulation. A server could distribute these features as objects to client machines across High Level Architecture (HLA) or Distributed Interactive Simulation (DIS) interfaces. These features would include an assortment of houses, fences, utility buildings, pavement, trees, and other vegetation, objects, and structures combined to form an if-you've-seen-one-you've-seen-them-all-type subdivision of mathematically infinite dimensions. This same approach can also instantiate the internal structure of buildings when player entities come within immediate range, to allow entry and interaction between the interested entities and the internal features. The internal building layouts, exterior features, and variation in color and structure of these features could be large enough to be realistic but small enough to load the individual model representations onto legacy image generators. The entities themselves could be generated using an approach that ensures that instantiation of features will be totally repeatable but variable. AMRDEC is developing the Pseudo-Random Urban Feature Entity Server (PRUFES) to demonstrate this approach. PRUFES uses a model set and rule set which together generate a generic suburbs known as "Protoville", an infinitely large suburb which contains a pseudo-randomly generated and complex network of streets, signs, lots, houses, vegetation, fences, parked vehicles, and other outdoor objects, as well as interior walls generated as needed for every house. PRUFES can supply suburban cultural entities across a DIS network for legacy terrain databases. This paper discusses the use of cultural entities for suburban representation, PRUFES design, and interoperability issues between cultural entities and legacy manned simulators and Semi-Automated Forces (SAFOR).

Previous Years Papers Available on CD

OPEN FLIGHT DATABASE CONVERSION FOR DISTRIBUTED MISSION TRAINING PC-BASED IMAGE GENERATORS

Budimir Zvolanek, Training and Support Systems, Donna N. Allen, Helicopter Flight Simulation–The Boeing Company
William Paone, PureLogix Division, Westar Corporation, Richard Clark, Terrain Experts, Inc

Distributed Mission Training (DMT) F-15C Program has been underway to augment existing USAF joint training capabilities. Each DMT F-15C site consists of four full-field-of-view Visual Integrated Display Systems (VIDS's) driven by high-end ESIG-4530GT image generators (Igs). Also parts of each DMT F-15C site are desktop PC-based IGs networked with the ESIGs. The challenge is to achieve visual correlation using IGs and databases (DBs) of such widely differing performance levels and architectures.This paper describes a DB conversion process jointly developed by Boeing, Westar, Evans and Sutherland (E&S), and Terrain Experts. One of several challenges was polygon co-planarity, however, cutting co-planar polygons into the underlying layers by an Automated Database Generation and Reconstruction Tool solved the problem. Excellent degree of correlation, accuracy, and PC-based IG update rates have been achieved for the Eglin, Nellis, Langley, and Southwest Asia databases, indicating a significant potential for cost-saving re-use of existing databases by PC-based image generators.

MODELING PLATFORM BEHAVIORS UNDER DEGRADED STATES USING CONTEXT-BASED REASONING

Anthony Gallagher, Avelino Gonzalez, and Ronald DeMara
University of Central Florida

The goal of military training simulators is to portray the realities of combat situations as closely as possible. During combat situations, the performance of military vehicles can sustain progressive degradation induced by a variety of factors that range from enemy fire to crew fatigue. Training simulators should model these degraded states in order to provide military personnel with realistic training environments. Unfortunately, current simulators use less than optimal techniques to model platform degradation. The current techniques are mostly based on a probability of kill (PK). As an example, the performance degradation of a tank is modeled by three states: mobility kill, firepower kill, and catastrophic kill. This model does not leave room for the myriad of degradation conditions that lie somewhere in between these three states, as well as not taking into account other system components, such as communication equipment, nor the degraded performance that can result from human factors unrelated to the state of the equipment such as crew stress and fatigue. Researchers at the Army Materiel Systems Analysis Activity (AMSAA) have developed a new model that proposes a vulnerability and lethality taxonomy (V/LT). This taxonomy serves as a much more realistically metric to describe platform degradation and its resulting consequences. Other researchers, principally Industrial/Organizational (I/O) psychologists, have been employed by the military to determine the influence of human factors in degraded platform behavior.

The purpose of this paper is to examine how to modify the behavior of autonomous intelligent agents (AIPs) given their current degraded state. The proposed method uses the Context-Based Reasoning (CxBR) paradigm to model AIP behavior. The AMSAA V/L taxonomy is incorporated into the model, and performance- degrading human factors are taken into account. To incorporate degraded state behavior into the CxBR paradigm, the current CxBR implementation was modified to incorporate the AIP's degraded state into its reasoning. The modifications changed the CxBR structure by including degraded state knowledge in the AIP fact database, and by altering the reasoning that CxBR uses to choose the appropriate next context. This reasoning is modified by adding weights to each context and functions that calculate these weights. The current context in the proposed implementation is chosen as the context that has received the highest weight. The proposed approach was tested using a small-scale tank warfare scenario with satisfactory results. Future work should implement the concepts presented in this thesis on a larger-scale scenario, and refine implementation details, such as finding optimal functions to calculate the context weights.

SIMULATING HUMAN COGNITIVE PROCESSES: EXPLORING AGGREGATE BEHAVIORS IN TACTICAL SIMULATIONS

Major Mark B. Tanner, TRADOC Analysis Center Monterey

Since the 1970s, rate-based attrition algorithms have driven the realism, or analytical accuracy, of most DOD simulation models. Current rate-based attrition algorithms have accurately and successfully modeled the physics, ballistics and stochastic line of sight components of military conflict. In the past, simulations systems analyzed a problem using a set of canned random behaviors through a thousand runs. After statistically plotting the results, a study of the outliers yields a better understanding of a course of action's great success or mortal failure.

Increasing processor speeds will be the impetus for the development of a new paradigm of agent-based simulations. This new paradigm will allow military leaders and planners to incorporate into play many of the intangible and uncertain attributes of military conflict that are not wholly captured in contemporary models. In order to speed the development of the next generation of flexible, modular, and insightful analytical tools, rate-based attrition paradigms must be shifted into a system that can integrate the uncertainties of real life. How does one model leadership? How does one model fear? How does one model the psychological aspects of the battlefield? How does one address the myriad issues of unit sustainability, such as individual health or sleep deprivation? If one does design a way to model these nebulous concepts, how far should it go? The synthesis of these paradigms will be the launch pad for the next generation of both DOD and civilian simulation technologies. Agent-driven systems will allow more insightful statistical analysis with a broader range of uncertainty, taking advantage of scenarios that evolve into ways not yet imagined. Agent-driven systems will allow further exploration of adaptive behaviors, battlefield synchronization and synergy, emerging doctrine, leadership and many more intangible combat multipliers.

DEVELOPMENT OF A 2ND GENERATION SEMI AUTOMATED FORCES (SAF) WORKSTATION

Henry Marshall, Us Army Stricom
Richard Dunn-Roberts, Peggy Hughley, SAIC Corporation

A redesigned SAF workstation will provide significant cost savings by lowering the operator hours required to create exercises and increase operator effectiveness in commanding units during an exercise. Current SAF workstations, such as Close Combat Tactical Trainer (CCTT) SAF and Modular Semi Automated Forces (ModSAF), date back to a SIMulation NETwork (SIMNET) design legacy of the late 1980's and have had few improvements since then. STRICOM has funded an effort, "CCTT PC Visualization", under the "CCTT SAF Environments" contract, which starts the process of redesign. This paper reviews many of the problems with current SAF Workstation designs and past improvement efforts. The paper describes the trade studies performed and selection criteria used to select a low cost Image Generation (IG) system for the prototype that will provide the SAF Operator a 3D view. To take advantage of a 3D view, it is important the system allows the operator to move and place control measures in the 2D view while monitoring the accuracy of the position in the 3D view. The paper details the architecture of the system that will provide this link making a very powerful planning and monitoring workstation for the SAF operator. Other issues that affect the SAF operators are also discussed and possible solutions are provided.

MODELING AND SIMULATION AUGMENTS V-22 OPERATIONAL TESTING

Lynn Huntt, Avionics Branch Head, Amy Markowich, Aircraft Stimulation Division Head, Naval Air Warfare Center Aircraft Division

Lynn Michelletti, Simulation Engineer, J. F. Taylor, Inc.

Employing M&S throughout the acquisition process improves warfighter satisfaction by allowing end users to test and evaluate design solutions. By augmenting flight testing with an integrated M&S solution, testers can effectively obtain mission related data only available in a full-combat environment. ACETEF support of V-22 operational testing is a prime example of M&S enhancement of a final product by generating scenarios that are otherwise impractical or unaffordable to test at an open air range (OAR). ACETEF created an accredited HWIL and MIL test environment that placed end users in a high threat simulated warfare environment demanding full use of pilot and aircraft capabilities. The most critical aspects of this environment were the stimulation of the electronic warfare system and the simulation of the environment. The test generated data on survivability, human factors, and crew coordination; as well as providing mission rehearsal and tactics. This paper discusses the ACETEF-provided threat scenario, stimulation of the aircraft electronic warfare sensors and systems, data acquisition, and presentation of threat information to pilots in the loop in the full fidelity simulation. Opportunities that this test demonstrates for combined testing and training are discussed in terms of improved warfighter satisfaction, as well as the STEP concepts involved in feeding OAR test results back into the M&S environment, generating better products and services.

A CASE STUDY ON MODEL INTEGRATION, USING SUPPRESSOR

Gregory L. Douglas

L-3 Communications Corporation, Link Simulation & Training Division

In an effort to create a reusable Computer Generated Forces (CGF) model that would be useful in supporting Simulated Based Acquisition (SBA) environments, an opportunity was presented to modify interfaces to Suppressor in order for it to operate in such an environment. Using real-time modifications to Suppressor as a baseline, it was desired to further create a CGF that would support the integration of multiple models and simulations. The desired outcome was to develop a model that would allow a combination of other models and simulations to play together, sharing data and commands, to represent one entity in Suppressor (i.e., an aggregate of the parts simulated in various simulations and Command, Control, Communication, Computers, and Intelligence (C^4I) systems). At the same time, the infrastructure of this system had to be flexible to the point that no specific external model and no specific number of external models had to be present in the exercise in order for the entire entity to exist. It was determined that a flexible system such as this would be beneficial to those pursuing SBA activities because it would provide a means of piecing together a variety of systems until the user came up with a workable solution that was capable of meeting all of their design goals. This paper will give a brief overview of Suppressor and the underlying real-time infrastructure. It will explain the different variations of subsystems that can now be used to create a "configurable" entity within Suppressor, describe how this type of approach could be beneficial in a dynamically changing SBA environment, and present major lessons learned.

GOMS MODELING APPLICATION TO WATCHSTATION DESIGN USING THE GLEAN TOOL

T. P. Santoro
Naval Submarine Medical Research Laboratory

E. Kieras
University of Michigan,

G. E. Campbell
Naval Air Warfare Center Training Systems Division,

The GOMS (Goals, Operators, Methods, and Selection rules) methodology was developed by Card, Moran, and Newell, (1983) as a means of representing human sensory-motor and cognitive behavior in a systematic fashion. A programming language, GOMSL, and the GOMS Language Evaluation and Analysis (GLEAN) tool for using it (Kieras, 1998), support the application of GOMS in simulations of human behavior for the purpose of interface design. The resulting simulated user is based on a human reference architecture that includes visual, auditory, cognitive, and motor processes capable of interacting with a simulated human-computer interface and generating sequences of timed actions and decisions in response to events in a simulated task environment. Example analyses are presented for an interface design that consists of a tactical situation display, a close control read out window, a mouse, and variable action buttons as would be found on a typical combat information center watchstation. Simulated actions are generated at a millisecond time grain, and statistics are taken for series of events in a scenario that can be of several hours duration. This paper presents examples of a design issue that was analyzed using GLEAN GOMS models.

SIMULATION META-ARCHITECTURE

James Hunt, Models and Simulations Manager,National Missile Defense Joint Program Office, Richard A. Esslinger, Models and Simulations Engineering, Axiom Corporation

The National Missile Defense (NMD) Joint Program Office (JPO) is developing a single flexible architecture to facilitate reuse of its various legacy models and simulations and for guiding new simulation development. The need for this architecture became apparent when the requirement arose to integrate and inter-operate those models and simulations for conducting performance analyses, design validations, wargames, tests and evaluations in support of NMD acquisition events and decisions. No ready solution existed for integrating legacy models and simulations having object models with differing resolutions, attributes and data models into a coherent representation of the NMD system and its mission space. This paper examines the requirements for a meta-architecture for models and simulations, discusses the problems the NMD program found with integrating the legacy models and simulations, and discloses the implementation issues and benefits gained. The paper discusses the concept and rationale NMD developed for obtaining a common set of object models, attributes and interactions, and addresses solutions to the areas of incompatibility across those object models, threat definitions, synthetic natural environments and their data models. Also examined are the cultural and policy issues NMD encountered and the benefits realized near term and expected for the future.

Previous Years Papers Available on CD

DMT "FAIR FIGHT" TEMPORAL TRIAD: WEAPON, COUNTER-MEASURES, TARGET VIA DISTRIBUTED ORDNANCE SERVERS

Dr. Dutch Guckenberger, SDS International, Inc.

Michael R. Oakes, BMH Associates, Inc.

"Kill More, and Die Less" Description of Distributed Mission Training benefits from a current USAF F-16 Pilot. Distributed Mission Training (DMT) is one of the key innovative modeling and simulation (M&S) systems focused on increasing and maintaining warfighter skills in the combat airforces. DMT is a rapidly evolving technology with many Air Force organizations and contractors working to provide the best training obtainable. However, to achieve Gen. Hawley's challenge for DMT Training to have a "Fair Fight with Sweaty, Smiling Pilots emerging from the simulator cockpits" some technological challenges still exist. This paper presents a Distributed Ordnance Server potential solution for providing DMT "Fair Fight" that overcomes the kill/miss errors induced by long-haul physics/network latencies. Further, the Distributed Ordnance Server solution also provides standards for munitions performance that overcome the plethora of different fidelity weapons models built into simulation hosts over many years by many different engineers. AFRL demonstrated through the ROADRUNNER and COYOTE exercises the benefits of a single common Ordnance Server and identified other problems yet to be solved. The initial AFRL single Ordnance Server Solution solves all of the munition standards technical problems as long as all the shooter and targets are in the same temporal space. However, when long-haul latencies become too large, disparities in the spatial positioning adversely affect the accuracy of the kill/miss outcomes. This paper's key hypothesis investigated is, "Fair Fight" can be achieved insuring the weapon models, the target model and any countermeasure models interact in the same temporal space. The same temporal space is achieved by a "local" Distributed Ordnance Server positioned at long-haul locations that exceed the acceptable latency tolerances. The new phase "Temporal Triad" was coined to describe these critical temporal interactions between target, weapon and counter measures. This paper presents solutions to critical problems associated with the DMT simulated "kill" inaccuracies that can occur due to network latencies. McKee (1997/98) utilized a elegant series of live fire experiments as a basis for DMT type testing with live and constructive models and found latencies of greater than 70ms too great for accurate weapon outcomes against a maneuvering target. The unique and innovative portion of this paper is, by architecturally adding distributed ordnance servers and transfer of ownership of weapons between Ordnance Servers, latencies of greater than 70ms can still accurately model "fair fight" outcomes. Details of the Experimental Design and the subsequent Results are presented. Of particular use to the simulation and training communities are graphics that illustrate Network Induced latency of greater than 70ms weapon to target is too great for "fair fight". Further, the successful results mitigating the long haul latencies via multiple Distributed Ordnance Servers is presented. Conclusions and Future Research Directions are presented with current and anticipated benefits for future Fire & Forget, Directed Energy, Kinetic Energy, and GPS weapons.

A KNOWLEDGE-BASED SIMULATION ARCHITECTURE FOR ASSESSING AND MANAGING RISK

Bryan S. Ware, Linwood D. Hudson, Robert S. Kerr, Digital Sandbox, Inc.

This paper describes an architecture designed to integrate knowledge, user and subject matter expert observations, and models and simulations to support risk management and planning. The Combating Terrorism Technology Support Office (CTTSO) has licensed this software architecture for the Joint Vulnerability Assessment Tool (JVAT) Program. The JVAT program will be used by all DoD organizations and installations for anti-terrorism risk assessment and planning, beginning February 2001.Managing the risks posed by terrorists to US military installations is a challenging task. In order to understand the relative risks posed by various organizations, weapon systems, and tactics, a tremendous and dissimilar body of information is needed. While modeling and simulation are important tools for considering terrorist threats, traditional simulation architectures were not designed to deal with the incomplete, imprecise, and highly variable data available to decision makers. The authors discuss the motivations and issues associated with developing a single object model that supports all computational operations in a complex decision support software application. This model supports all user interface, 3D visualization, computation, data storage, and reporting applications directly, simplifying application development and maintenance.

DATA-DRIVEN KNOWLEDGE ENGINERING

Anthony T.C. Cowden, Dr. John J. Burns, Sonalysts, Inc

One of the challenges in developing an intelligent tutoring system (ITS) is the understanding and representation of expert performance. This representation is required to evaluate student performance and support remediation and coaching of the student. The traditional approach to gaining this understanding is through a top-down process of knowledge engineering. In this process, a knowledge engineer observes expert performance, conducts a task analysis, and interviews one or more subject matter experts. However, this process is lengthy and error prone, especially for complex tasks. A significant cost and time mitigation step for the KE process is to create a virtual environment to support the observation of SMEs performing the task. An added benefit is the generation of detailed digital data representing a wide range of output relative to the performance of the task at hand. The Virtual Environment for Training Technologies (VETT) immersive training simulation has been developed by NAWC-TSD, and has initially been used to support the conning officer shiphandling task of underway replenishment (UNREP). Utilizing students from the Surface Warfare Officer School Command (SWOSCOLCOM), a database of UNREP performance has been developed. Using traditional data mining techniques, it is possible to develop an understanding of system (that is, student conning a ship) performance from the data generated in the training environment. Data mining is the process of discovering relationships within the data. Depending on the approach, the data mining process itself can result in the creation of a software model of the system. By using a fuzzy logic-based approach, this process also results in a semantic representation of that performance. An additional advantage of a fuzzy logic approach is that the semantic representation can be reviewed by the knowledge engineer and the SME, and easily understood, edited, and re-tested. This allows for better understanding of system dynamics, as well as a much quicker review, test, and validation process. Unlike black box approaches to data mining such as neural nets, the fuzzy expert model is eminently traceable. Not only does it report a degree of match between observed and trained performance, it allows for traceability of system operation.

Previous Years Papers Available on CD

DEVELOPMENT OF TASK-AWARE SIMULATION SYSTEMS

Lawrence H. O'Brien, PH.D
Dynamics Research Corporation

The primary objective of training systems is to train individuals or organizations in performing specific tasks. In fact, training requirements are often stated in terms of "missions or tasks to be trained." Yet, simulation systems typically have little or no "knowledge" of which tasks are being performed by the training audiences during the execution of the simulation. The objective of this paper is to outline a concept for developing "task-aware" simulation systems that have such knowledge. Utilization of a task-aware simulation would begin by specifying or selecting the mission(s) and tasks to be trained during the training event. The tasks would be selected from a common or pre-defined list of mission and tasks such as the Universal Joint Task List (UJTL). The scenario generation system would "recognize" the mission and tasks, and based on this recognition would produce templates of scenario events [sometimes called Master Scenario Event Lists or (MSELS)], scripted Computer-Generated Forces (CGF) behaviors, and mission/task performance measures. Analysts at the simulation site would review and update the templates to reflect the unique circumstances of a particular training situation. During execution of the simulation, an automated data collection management system would collect data on the mission/task performance measures. These systems could be supplemented by assessments made by human data collectors on more subjective measures. To guide the assessments, an automated collection management plan would be generated for the mission/task measures. Also during the simulation, the CGF system would have "knowledge" of the tasks being performed during the simulation. That is, the CGF system would know the attributes that signified the start and end of target audience tasks and the measures that indicated how well the tasks were being performed. The CGF could use this information to dynamically adapt its behavior to the responses of the target audience. At the conclusion of the training event, mission/task performance measures could be automatically collated. Results would be presented in terms that are directly relevant to trainers; namely, how well did the target audiences do in performing the mission and/or tasks to be trained. A task-aware simulation would provide several benefits including the: (1) automated generation of a training scenario (scripted CGF behaviors and order of battle, master scenario event lists, pre-selection of automated performance measures) based on a set of tasks to be trained; (2) automated collection of appropriate task performance measures during the simulation; (3) automated adjustment of CGF behaviors to reflect training task goals; and (4) automated after action review of mission/task performance.

DEVELOPMENT AND APPLICATION OF A CB WEAPONS EFFECTS AND SENSOR TOOLSET

Walter Zimmers
Defense Threat Reduction Agency

Dennis L. Jones, Michael J. O'Connor
ITT Industries

The Defense Threat Reduction Agency s (DTRA) Counterproliferation Support and Operations Directorate has been the principal member of a chemical and biological (CB) modeling and simulation consortium. This consortium has developed a broad capability based in high-fidelity physics to perform real-time simulation of weapons effects. The DoD is using the suite to support analysis, research and development, test and evaluation, and tactics, techniques, and procedures (TTP) development, education and training, realizing the DoD s initiative in simulation-based acquisition. In this paper we will discuss the CB simulation architecture, its components, and how the suite was used in support of a major experimental exercise series by providing realistic weapons of mass destruction simulation support to the exercise. Specifically DTRA supported the exercise with simulation support to the time-critical targeting phase. This exercise utilized advanced distributed simulation to represent counterforce attacks on theoretical chemical production and storage facilities and the subsequent downwind threat and chemical sensing and detection. Federation components modeled strategic/tactical weapon attacks on and damage to suspected chemical agent production and storage facilities, the subsequent downwind threat hazards, and a generic UAV-based point and standoff detection system. Experiment personnel fed the detection data developed by the simulation to military personnel manning the weapons of mass destruction (WMD) cell for the exercise, providing simulation-based training stimuli for WMD cell personnel and Tactics, Techniques and Procedures (TTP) development at the same time. DoD personnel investigated several means of stimulating the WMD cell with detection data derived in the simulated environment. The paper will discuss the principal findings lessons learned in the use of WMD simulation in support of a major exercise.

SATELLITE COMMAND AND CONTROL TRAINING FOR THE 21ST CENTURY

Captain M. Lane Gilchrist, Jr.
381st Training Group, Standardization & Evaluation, Vandenberg AFB

Major Steven F. Gottschalk
Headquarters Air Education and Training Command, Plans and Programs Directorate Randolph Air Force Base

Providing high-fidelity, interactive training programs to limit risk to personnel and resources operating satellite missions around the world requires a well-defined, standardized training plan that clearly documents the "cradle to grave" process for developing a qualified satellite operator for the 21st Century. Well-publicized mishaps involving satellites and ground operating systems are becoming commonplace; and in almost all cases, an improved training plan and program would have reduced these mishaps and their ultimate impact on the public. However, in reality, little time is spent on improving satellite command and control training programs even though this training is the likely key to preventing a future mishap. The impact of these mishaps is not fully appreciated because the public does not yet understand their ever-growing dependence on civil, commercial, intelligence, and military satellite systems. Ultimately, satellite command and control training needs to be improved to reduce the risk of a major mishap that could lead to loss of the mission, personnel, or resources. After describing the research that shows training as the key to preventing mishaps in the commercial, civil, intelligence, and military organizations; this paper will recommend standards for training in all satellite command and control organizations. Following this, it will describe a training plan to meet those standards. Lastly, the paper will define the process and outline a program under which such a training plan would operate. Developing this training plan will result in highly qualified satellite operators who provide seamless, safe, and efficient satellite operations to people around the globe.

CRISIS PLANNING AND RESPONSE (CPR) WEB PORTAL: OPENING THE DOORS BETWEEN INTERAGENCY AND COALITION COMMUNITIES

Marcy Stahl, Julia Loughran
ThoughtLink, Inc.

The end of the Cold War has increased US involvement in crises that stop short of war, including humanitarian assistance (HA), disaster relief (DR), and peacekeeping (PK) operations. These crises are often multi-dimensional, with security, political, economic, environmental, and humanitarian dimensions. Developing a comprehensive solution to these crises requires collaborative planning, coordination, and execution by multiple US government (USG) agencies, international organizations (IOs), and/or coalition partners. Many cultural problems must be overcome before these disparate communities can truly integrate planning and execution, but technology can help improve opportunities for, and the speed of, collaboration and information sharing. Web portals – sites that combine content with collaboration tools and serve as an entry point into information from multiple related sites – constitute a promising solution to this challenge. Vertical portals focus on a specific domain of interest and can promote virtual (distributed) communities of people with similar interests. This paper will discuss the need for, and characteristics of, a proposed Crisis Planning and Response (CPR) portal that will provide access to information relevant to HA, DR, PK, and other contingencies while customizing information for individual users based on user profiles. Interested, globally dispersed communities can use the proposed portal for information sharing and dissemination, planning, and training. In short, by providing a common virtual meeting place, it will promote a fuller understanding of each community's culture. A robust CPR portal will serve as an information resource, support collaboration among multiple distributed users, and provide just-in-time training and education ranging from passive to active to experiential via access to simulation and role-playing. Ultimately, the CPR portal will allow us to contribute more fully to the world by being more responsive to issues facing us as a nation.

COST EFFECTIVENESS OF EMBEDDED TRAINING ON ARMY GROUND VEHICLES

L. Bruce McDonald, Ph.D.
McDonald Research Associates, Inc.

Hubert Bahr
U.S. Army Simulation, Training, and Instrumentation Command

Claude Abate
Madison Research Corporation

This paper describes the cost and operational effectiveness analyses being conducted on the STRICOM Embedded Simulation program. The program is developing Embedded Simulation (ES) to support Embedded Training (ET) and Embedded Operations (EO) for Army ground vehicles. The near term target for this program is the M1A2 SEP Abrams main battle tank. The basic approach to this cost effectiveness analysis is to determine the costs of various live training exercises and compare these costs to those that would be incurred using ET technology. Live training costs include operation and maintenance costs for the trainees' vehicles, other blue forces (BLUFOR) vehicles and for the opposing force (OPFOR) vehicles, as well as for range operation costs. The authors have gathered data on miles driven for various training exercises (e.g. Hasty Attack) as well as detailed operating costs (e.g. O&S Class IX Parts, Petroleum, Oil and Lubricants (POL), and Intermediate Maintenance) for the Abrams Tank and Bradley Fighting Vehicles. These data were derived from the OSMIS (Operating and Support Management Information System) database. OSMIS is the U.S. Army's source of historical operating and support cost information for tactical units. With this information, we were able to calculate the costs of various live training exercises. We then calculated the costs of equivalent exercises using ET technology. During embedded training exercises, some vehicle components are active and other components are not. Consequently, we were able to calculate the operating costs of vehicles during various types of embedded training exercises (moving, vehicle stationary, turret stationary). This allows us to predict the relative cost effectiveness of embedded vs. full-up live exercises without making the naïve assumption that embedded training costs nothing. These cost savings are compared to ET acquisition costs to determine the payback period. These costs are expected to decline over time as the state-of-the-art produces smaller, faster and cheaper computers and displays. This paper discusses the results of this cost effectiveness analysis.

ALWAYS READY TO LEARN THE COAST GUARD ADVANCED DISTRIBUTED LEARNING INITIATIVE

Mike McCloughan, CDR, USCG (re), RWD Technologies
CDR Richard Arnold USCG, Training Officer, USCG Training Center

"Behind every saved life, enforced fisheries treaty, foiled drug smuggling attempt, and safe port are high-performing Coast Guard people." Coast Guard 2020. The Coast Guard's Advanced Distributed Learning Strategy (CGADLS) sets forth a new paradigm intended to provide access to the highest quality education and training that can be tailored to individual needs and delivered cost effectively, whenever and wherever it is required. The Coast Guards vision harnesses the power of the Internet and other virtual or private wide-area networks to deliver high quality learning. The CGADLP employs a low cost, hybrid approach to using technology by bringing together intelligent tutors, distributed subject matter experts, real time, in-depth learning management, and a diverse array of support tools to ensure a responsive, high quality "learner-centric" system. To make best use of the technologically advanced equipment the service is deploying on its boats, ships and aircraft, the Coast Guard must have personnel who are just as technically sophisticated and who can access the information they need to operate and maintain this equipment to its best advantage. The Coast Guard's Advanced Distributed Learning Plan is its response to the challenge of providing the information and learning its personnel expect and deserve as they confront their future operational challenges.

MERGING RESIDENT ND NON-RESIDENT CURRICULA THROUGH MANAGEMENT, INNOVATION, AND ADL INITIATIVES

Dr. Donald A. MacCuish, Professor
Air Command and Staff College, Maxwell AFB
COL Edd P. Chenoweth, J-36, EUCOM

Last year's I/ITSEC paper about ACSC's Fifty Years of Lessons Learned in Distance Learning had two purposes. First was to inform others of practices to avoid in the design, development, and implementation of distance education, or non-resident educational programs. Our second purpose was to provide a frame of reference for this and future I/ITSEC presentations. Over the past twelve months, we have made significant changes to our non-resident program. For example, substantively, we have increased the rigor of our non-resident program and, in so doing we have reduced the delta between it and the resident program. This change brings us closer to the notion of one ACSC Curriculum. We have also more keenly integrated the use of current technology, especially in the area of war gaming, and have set the stage for conversion of existing multi-media presentations to more interactive formats. Although proper media mix is less glamorous than war games and multi-media presentations it does, however, represent a significant pedagogical change.Esthetics is the other area of significant change. Impression can make the difference between perception of user-friendliness and user rejection of any program. The impact of this impression is the decision to enjoy the learning experience or to go through the motions and fill the PME block to get promoted. During our presentation, we will demonstrate many of the changes we have made to our program. Unfortunately, the printed word limits us to a written synopsis of these changes.Significance: what is the significance of these efforts to the Federal Government's Advanced Distributed Learning Initiative? It means ACSC is a key ADL practitioner.

ADVANCED DISTRIBUTED LEARNING CO-LABORATORY NETWORK

Janet Weisenford
JOINT ADL Co-Laboratory

Paul Jesukiewicz
Advanced Distributed Learning Co-Laboratory

Judy Brown
Academic ADL Co-Laboratory

The Advanced Distributed Learning Initiative (ADL) was launched in November 1997 by the Secretary of Defense. The ADL Initiative will allow for high quality learning available anytime, anywhere, tailored to individual needs. It will enable global access and reuse of learning tools and content through the iterative development of industry supported guidelines and specifications. A key component of the ADL Initiative is collaboration. Collaboration is necessary for the establishment of common specifications and for the sharing of tools and learning content. It will also enable achievement of cost-savings by re-use, thus avoiding duplication of many instructional objects. The rapid pace of technological change, combined with limited DoD investments in learning technology research, suggests a need to reinvent how the Department conducts and implements research and development activities. The ADL Co-Laboratory network was initiated by the Office of the Secretary of Defense (OSD) Readiness & Training Office in 1999 and has subsequently become an important resource for the military services and the joint community. The ADL Co-Lab hub is located in Alexandria, Virginia and focuses on policy-level issues, development of common tools and specifications, development of compliance testing software, interagency coordination, and advanced research. The ADL interservice node was established in Orlando to promote collaboration in ADL systems development, prototyping, and acquisition across the Department of Defense. An Academic ADL Co-Lab node was also established at the University of Wisconsin as a first step in leveraging the tremendous knowledge resources available in the nation's universities and community colleges. This paper will provide an overview of the ADL Co-Laboratory network, including a description of its objectives and structure. This paper will also provide information on the current and future initiatives, including information on the ADL prototypes and status of the development of common specifications.

BEYOND OUR BORDERS: THE FUTURE OF COALITION SIMULATION

Mr. David Stewart, LTC Stephen L. Rust
Simulation, Training, and Instrumentation Command (STRICOM)
Product Manager for Simulation Technology Distribution (PM STI)

With the expansion of NATO and the Warsaw Pact Initiative, the U.S. must be able to train with numerous new countries. This provides opportunities for coordinated distributive training facilities, which are inter-operable between multiple countries. Consequently, countries are developing new modeling and simulation facilities to inter-operate and train with NATO and U.S. forces. These countries have training and exercise requirements similar to U.S. requirements but with country unique tactics and equipment. The establishment of a new simulation center or the enhancement of an existing one creates numerous implementation problems. The myriad of equipment, simulation tools, and virtual simulators that are available often force managers to study the problem before any action is attempted. Then, technical performance issues and tradeoffs create a paralysis due to the complexity of the issues and their eventual ramifications. One must thoroughly understand the inter-relationships between tools, hardware, formats, databases, and interoperability for these decisions to be sound over the long term. After the equipment and tools are resolved, one must then consider the issue of training necessary for competent staff performance.

For example, choosing a particular hardware solution for one reason often creates problems with software applications or formats. Further, if software is chosen, problems may develop due to formats, database issues, or a requirement for more expensive hardware. The sobering fact is that hardware, software tools and applications, as well as site performance requirements must all be considered concurrently before any decisions are made. In general, some commercial tools offer the lowest cost, while others offer the highest performance; still, others tout their interoperability or user-friendliness. Hence, contractor-provided input invariably focuses on a small segment of simulation issues and offers their own products as solutions – instead of an unbiased approach. This further confuses the manager when simulation experts from different companies have reasonable approaches that are different and incompatible. The site developer must minimize problems for all site operations.

This paper considers a standardized approach to developing a simulation center. The intent is to identify a relatively easy method for developing a new facility with a short supply of time and funds, and large amounts of requirements. Ideally, any new facility should be flexible, leverage from previous development efforts, handle multiple simulation types, and provide an evolutionary path through evolving simulations. Additionally, a new facility should allow multiple paths for evolution where numerous commercial products can be incorporated with the benefits of competition...

Previous Years Papers Available on CD

BUILDING SIMULATION CENTERS FOR NATO AND PFP COUNTRIES

Colonel Vaclav Prenosil, Czech Military Academy
John Abernathy, Ben Blood, and Philip W. Holden
Science Applications International Corporation

The US Government's Partnership for Peace (PfP) program provides US assistance to countries willing to enhance their interoperability with US and Allied nations. The primary focus is on Central and Eastern European countries and allows these countries to use US Foreign Military Financing (FMF) funds for projects such as building simulation centers that improve training and interoperability. The PfP and FMF programs have been instrumental in building European Simulation Centers through the STRICOM/ADST II contract as part of a Foreign Military Sale (FMS). The Simulation Center at the Czech Military Academy follows this plan, using primarily US grant money, with additional host nation funds as available. A similar center is being installed in the Slovak Republic.

This paper describes the process for foreign countries to use these programs to build a Simulation Center under the auspices of the US Government. Typically the work is phased, with the first phase being the start-up of a new center. This includes the design, acquisition and installation of the network infrastructure and computer workstations, the installation and configuration of the simulation software and training of the host country personnel. The second phase is to expand the capabilities, adding manned (Virtual) simulators, desktop simulators, additional After Action Review (AAR) Capability, and working with the host nation to integrate computer assisted exercises into their training program or curriculum, and to participate in Joint and multi-national exercises. The paper includes lessons learned on the implementation of the Simulation Center in the Czech Republic.

SYNTHETIC ENVIRONMENTS – A VITAL TOOL FOR UK DEFENCE

Bharat Patel, Assistant Director Simulation and Synthetic Environments
Defence Evaluation and Research Agency

Synthetic environments (SEs) are a major advance but a natural progression on conventional modeling and simulation: their significance is that they not only combine models, simulations, people and real equipment in shared access to a common synthetic world, they cater for interactions between players and with the environment of which they are part. Enabled by advances in computing, visualization and information technology, models, simulations and their users can come together in a synthetic environment that can explore problems and issues of great complexity to provide a scope for exploitation that has barely yet been realized. But already impressive applications in defence, such as the Air Defence SE and exercises Purple Link/Purple Sound, have provided experience and proved much of the underlying technology. Synthetic environments can improve the effectiveness and efficiency of defence capability by enabling things to be done better, faster, cheaper and together. They have a particularly valuable role in improving: combat readiness through collective training, campaign planning and mission rehearsal; equipment procurement through synthetic environment based acquisition; and digitization of the joint battlespace. Synthetic environments will deliver significant benefits but only if they deliver credible answers through sound verification and validation. They must not be a panacea and must be applied where cost-effective. The potential is recognized at the highest levels in the Ministry of Defence and industry, and is seen as an essential tool for implementing the Smart Procurement Initiative and the Joint Training and War-fighting Initiative.

DETERMINING RETURN ON INVESTMENT IN TERMS OF READINESS

Captain Robert "Buddha" Snyder, US Navy, CNO (N889B)

In recent years, the documented decline of Fleet aviation readiness during the Inter-Deployment Training Cycle (IDTC) has become a major concern with Navy leadership. Plans to reverse the IDTC readiness decline include the increased use of simulators; however, Navy aircrew trainers in use today were acquired to support the Fleet Readiness Squadrons (FRS). FRS trainer fidelity (IE. visual, tactile, and motion) and capacity requirements were defined by both FRS curriculum and newly winged aviator needs. Fleet aviators are afforded simulator time based on FRS excess capacity and availability. Today's technology can provide affordable, Fleet-centric simulation training with expanded mission training/rehearsal capability and a multitude of visual enhancements and sensor cues. The Chief of Naval Operations (OPNAV) N889 Naval Aviation Training mission is to resource aviation manpower and training at the appropriate time and level to sustain optimum Naval Aviation readiness. Readiness attainment and tracking is most critical during the IDTC. N889 responded to the IDTC "lost readiness" challenge with a multidisciplinary team formed from government and industry representatives. The result was AIRPLAN 21, a strategy composed of eight focus areas: Aviation Maintenance Supply Readiness (AMSR), Aircrew Combat Training Continuum (ACTC), Flight Hour Program (FHP), Aircrew Career Continuation Pay (ACCP) Program, DEPOT Maintenance, Joint Tactical Combat Training System (JTCTS), Navy Aviation Pilot Production Improvement (NAPPI) Program and Fleet Aviation Simulation Training (FAST) Plan. These eight focus areas were developed to identify and track OPNAV programs that would directly impact IDTC readiness. The first seven elements were funded and are producing positive results. N889 and the Naval Aviation Training Strategic Advisory Group (NATSAG) are aggressively championing the unfunded FAST plan. These AIRPLAN 21 focus areas provide Navy Aviation's first attempt to gauge resource allocation success and provide a finite measurement of return on investment (ROI) in terms of readiness. The FAST plan is based on the individual aircraft communities' Training and Readiness Matrix (T&RM) which, in turn, is tied to their individual Primary Mission Area (PMA) training requirements. The T&RM documents define specific training tasks along with their associated PMA readiness values. Completed training events, along with their resultant readiness values, are rolled up and closely tracked throughout the IDTC. Annual FAST technology assessments provide the requirements and acquisition communities with current aircrew training device technologies information that shows potential to improve readiness. OPNAV requirement officers, Fleet operations and training personnel, acquisition program managers, and simulator industry technical representatives all contribute to the development and update of the FAST Plan. An ongoing effort by the two major air type commanders, Commander Naval Air Force U S Atlantic Fleet (CNAL) and Commander Naval Air Force U S Pacific Fleet (CNAP), is the mapping of the Joint Mission Essential Task List (JMETL) to T&RM training events. This effort will further validate the T&RM and continue to refine simulator training devise fidelity requirements. Naval Aviation is now uniquely positioned to lead the Navy's overall effort to define the resource allocation strategies necessary to achieve and maintain optimal warfighting readiness. Technology evolution and real world events move faster than the DoD budgetary process can accommodate. In reality, it may take years for a new simulator product or training capability to reach the individual aviator. However, AIRPLAN 21 and, in particular, the FAST plan for Fleet aircrew simulators provide the foundation to recapture "readiness lost," and the first viable metrics to measure ROI in terms of readiness for Naval Aviation resourcing decisions.

U.S. NAVY'S FLEET AVIATION READINESS ASSESSMENT AND RESOURCE OPTIMIZATION: A CASE STUDY

Mark G. Burgunder, InnovaSystems International, LLC

LCDR Brian Bowden, USN, Code N836, COMNAVAIRPAC

What readiness impact does a reduced availability of gravity bombs have on a Carrier Air Wing 15 months into the inter-deployment training cycle (IDTC)? What impact will a reduction of flight hours or number of aircraft have on readiness? What training events are accomplished on a specific range? What contributions do those range events make to unit readiness and the Universal Naval Task List (UNTL)? What contribution are available resources making towards reduced Status of Resources and Training System (SORTS) training levels? What contribution are simulators making towards readiness?

These are a few of the questions asked daily at all levels of Naval Aviation: from squadrons and detachments to Type Commanders to Fleet Commanders to the Chief of Naval Operations. Resource availability is at the core of these questions. The Navy's Atlantic and Pacific Fleet Type Commanders identified the essential resources that contribute to readiness as: People, Parts, Planes, Petroleum, Weapons, Adversaries, Ranges, Temporary Assigned Duty (TAD) dollars, and Simulators (P4+WARTS). The overall readiness objective of Pacific/Atlantic Fleet Air Wings and Squadrons is to sustain the highest level of training feasible, recognizing that balancing resources is a constant challenge.

Information captured at the deckplate forms the basis of making readiness decisions. The Navy has aggressively moved to employ the means to access the information. The aviation TYCOMs have recently funded and installed the infrastructure to collect, store, and access the information from the deckplate and other databases for analysis, assessment, and optimization of resources at all levels of the Navy's organization. This "warehouse" of information is creating a synergistic environment where the "whole story" is told: operations data is compared with maintenance and logistic data, training events are optimized and trend analysis conducted that enable commanders at all levels to make decisions improving readiness.

This paper describes the challenges of Navy leadership's efforts to maximize readiness on deployment date with the resources available. Discussed are:

- Fleet readiness requirements and how they are determined.
- Contributions of each of the P4+WARTS resource areas towards readiness.
- Unique complex tracking requirements in each of the Navy's Type/Model/Series (T/M/Ss).
- Descriptions of automation tools employed to capture, store, and query information expended at the deckplate.
- Examples of query results and how those results assist all levels the Navy's aviation community to assess readiness and optimize resources.

THE IMPACT OF ADVANCED DISTRIBUTED LEARNING (ADL) ON JOINT READINESS: AN OPERATIONAL VIEW

Mr. Joe Camacho
Joint Distributed Learning Information and Technical Services, TRW Inc.,
U.S. Joint Forces Command, Joint Warfighting Center Support Team

"The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government"As generally defined in the Unified Command Plan (UCP), one of the principal missions of the United States Joint Forces Command (USJFCOM) and the Joint Warfighting Center (JWFC) is to provide high-fidelity operational level Joint training to potential Joint Task Force Commanders and their staffs, globally. To successfully accomplish this mission, USJFCOM currently employs several mechanisms, chief among them are major computer assisted (CAX) distributed exercises (Unified Endeavor), Deployable Training Teams (DTTs) consisting of a hand picked cadre of O4-O6 level Observer Trainers (OTs), and other specifically tailored joint interoperability events. During these and other joint training evolutions, a myriad of tactics, techniques, procedures, planning strategies and other critical Joint warfighting skills and information is developed, exchanged, employed and learned. The aforementioned skills and information pieces are defined in this paper as Joint warfighting "content". Capturing the essence of this critical joint warfighting content and making it available to Joint warfighters globally, anytime anywhere is a concept that has been recently embraced by the senior leadership in USJFCOM and the JWFC. This paper will describe background, rationale and key concepts behind the development of the current process used by the JWFC to capture, develop, certify and make this content available to Joint operators via the Navy Internet Protocol Routing Network (NIPRNET) and Secret Internet Protocol Routing Network (SIPRNET)----and provide an operator's view of its anticipated impact on joint readiness.

SPECIFYING THE BOWMAN SIMULATOR USING THE SYSTEMS ENGINEERING APPROACH TO TRAINING

Major Chris Lewis-Cooper AGC(ETS)
Officer Commanding Training Systems Group
Directorate of Individual Training Policy (Army)

BOWMAN is the British Army's programme to replace the aging Clansman radio system with secure voice and data communications capable of supporting the future digital battlespace. The pace of change in the operational requirement and the range of potential solutions make the business of specifying training equipment and estimating training costs in a timely fashion very difficult. Preliminary task analysis identified a probable requirement for a simulator to train BOWMAN System Managers and a specification was requested at short notice. Conventional training options analysis techniques would have been too slow and unresponsive for this task, and a new systems engineering approach was adopted. The method, referred to as the Systems Engineering Approach to Training (SEAT), encouraged all stakeholders to collaborate in modeling the specification and through-life management of the training system within which the simulator will operate. The paper describes the case study in detail and goes on to comment on the potential for the SEAT approach to save up to one half of the time and cost of future changes to this training system specification.

Previous Years Papers Available on CD

STANDARDISED DEVELOPMENT OF A NEEDS STATEMENT FOR ADVANCED TRAINING MEANS

D.M.L. Verstegen M.Sc. (TNO Human Factors)
& Dr. A.H. van der Hulst (TNO Fysics and Electronic Laboratory)
TNO Human Factors

The first phase in the acquisition of advanced training means –such as simulators, CBT and Virtual Environments- is the development of a needs statement: a rough description of the training means that must be acquired and a first estimate of the costs involved. For an organization, needs statements are the basis for the planning of financial, and other resources. This paper describes a methodology for the development of needs statements for advanced training systems that was developed for the Royal Netherlands Army. At present, needs statements for advanced training means are often written in an ad hoc way, not based on training needs but purely on physical fidelity. In other cases, the acquisition of training means is postponed until the new operational systems have arrived, which leads to unacceptable delays in personnel training. The goal of our project is to specify a way to determine the present and future training needs within a limited time span, based on information that can be incomplete or insecure, and to motivate whether and why the acquisition of advanced training means is necessary and make a rough estimate of the resources that should be reserved for this purpose.

Based on available knowledge and experience, e.g. from the MASTER and the BOOT projects, and frequent discussions with domain experts and future users, we have developed a methodology that leads users step by step through the process of developing a needs statement. The methodology offers a structured and standardized way to develop a needs statement. This does, however, not mean the development process will always be the same: depending on, for example the complexity of the domain and the amount of information available, steps will take more or less time, some steps will sometimes get less emphasis or will be partly executed only.

The proposed methodology consists of three main phases, each with a number of steps and decision points:

I. Decide whether or not to start the development of a needs statement for advanced training means

II. Select (a combination of) training means and develop global training programs

III. Estimate costs and organizational, personnel and logistic consequences

Developing a complete and thorough needs statement takes time and manpower. Therefore, the methodology starts with an inventory of the situation in order to decide whether it is worthwhile to invest in such an undertaking. For this first phase, we develop a checklist that can be completed within a short amount of time. In phase II and III the training needs are further analyzed. The intention at this stage is not to develop final and fine grained training programs, but to start thinking about how training will probably take place or should take place and which kind of training systems will probably be used. On this basis a more realistic cost estimation can be made, taking several alternatives into account.

PROCURING A MILITARY TRAINING SYSTEM IN THE COMMERCIAL MARKET: LESSONS LEARNED

Eric M Branum, Cynthia H. Himes
Training Systems Product Group,Wright-Patterson AFB, Ohio

This paper will describe the experiences and lessons learned of the C-130J Maintenance & Aircrew Training System (MATS) team in procuring a military training system in the commercial market. When procuring military products that are similar to those offered on the commercial marketplace, using a commercial contract can save the government time and money. However, the benefits of using commercial procedures to buy a training system must be weighed against the risks of purchasing items that require modification or do not exactly meet the customers needs. The lessons learned by the C-130J MATS team have wide application across other military training system acquisitions in the commercial market. Procuring a training system as a commercial item can be particularly difficult because the system can be composed of many dissimilar elements such as training devices, courseware, and operations that may or may not have a commercial equivalent. The commercial designation has presented several unique challenges for the C-130J MATS team. The commercial market provides similar products for portions of the training system, especially aircraft flight simulators. However, it is much more difficult to find commercial equivalents to military maintenance training devices. While the C-130J MATS will reap some benefits of a commercial acquisition, not all expected benefits will be realized. The pros and cons of acquiring a typical military training system on the commercial market will be discussed, along with lessons learned and recommendations for improvement.

EVALUATING TRAINING MANAGEMENT SOFTWARE PRODUCTS: A CASE STUDY

Patricia K. Lawlis, Ph.D., and Kathryn E. Mark, C.J. Kemp Systems, Inc., Fairborn, OH

Deborah A. Thomas CCP, and Terry L. Courtheyn, Jacobs Antonio, TX

The ability to determine software product quality and suitability for training management systems has become increasingly more important to the government as it becomes more dependent upon commercial off-the-shelf software products. An effective software product evaluation can determine product quality and suitability prior to purchase. There are no established rules for a software product evaluation, so organizations usually define their own processes. These processes are often defined and/or followed very loosely. While many good pioneering efforts in this area have increased the body of knowledge of product evaluation, the lack of a standard, well-defined process has led to many processes of questionable validity. The result has been that many government organizations have made large investments in poor product choices, and they are now suffering the consequences. This paper provides a definition for a software product evaluation process that is grounded in the scientific method and in decision theory. It then goes on to describe a case study where the application of this process resulted in the selection of a product that will become a part of a large component-based training management system for Air Education and Training Command. The software product evaluation process defined in this paper starts with a trade study to narrow the list of candidate products. The trade study relies on vendor responses to a questionnaire asking about support for the requirements that have been established for the product to be selected. Those products that support an adequate number of requirements are recommended for a closer look, and these recommended products are subjected to a hands-on evaluation. This hands-on evaluation is much more intense, with evaluators looking at both the requirements satisfied by each product and the quality of the product's support for these requirements, represented by evaluation criteria. The combination of the two – requirements and criteria – provides the basis for the final analysis of the evaluation results. The overall analysis uses a number of partial analyses of the evaluation data collected. First, the overall requirements coverage and the criteria ratings are captured in overall Analysis Requirements Coverage Matrices and Analysis Criteria Matrices. This provides a good picture of the results, but it is just the beginning of an in-depth analysis. To determine different dimensions of the evaluations, other factors that can partition the results are also used. For each partition, the same calculations are performed for both the requirements and the criteria. The primary emphasis of the analysis is on the criteria. The requirements coverage is a rough indication of how suitable a product *may be*, based on how well it addresses the needs of the expected users. However, the criteria determine the quality of the product with respect to how well it implements the requirements.

A DECISION SUPPORT SYSTEM FOR EVALUATING TRAINING SYSTEM IMPROVEMENTSAND ENSURING RETURN ON INVESTMENT

Sarah Aust, ProcessModel, Inc.

Scott Dunlap, Chief of Naval Education and Training

Steve Broussard, Dynamics Research Corporation

The Chief of Naval Education and Training (CNET) is improving training decision support processes and systems through the innovative application of current business modeling and simulation practices. This effort is being conducted under CNET's Training Business Modeling and Simulation (TBMS) program. Through the development and implementation of a standardized architecture and methodology, CNET is incrementally developing a training decision support capability anchored by a foundation of computer simulation models that provide "ground-truth" information.

This maturing decision support capability will allow decision-makers to "Fly Before They Buy" new training technology or process improvements. The end-state of the TBMS program is envisioned to be a web-based Training Business Area Resource Repository (TBARR). Decision-makers will be able to use this repository to quickly test simplistic or complex improvements to underlying business processes or information technology systems in support of the training continuum, and also evaluate the consequences of such actions in simulation before implementation. The tested and validated scenarios will provide critical metrics to the training community, such as cost, resource requirements, and student time-to-train (to include Under Instruction (UI), Awaiting Instruction, (AI), Interrupted Instruction (II), and Awaiting Transfer (AT)). The simulated consequences can then be compared to the cost of implementation to compute Return on Investment to the Navy.

This paper will describe the TBMS architecture and standardized methodology for executing TBMS efforts. Leveraging High-Level Architecture (HLA) concepts, this architecture is developed for the use and re-use of business process models created using commercial-off-the-shelf (COTS) applications. The architecture purposefully sacrifices complete interoperability in an open system with open standards to gain the benefits of rapid model development in a structured architecture with standard methodologies for development, modification, and analysis.

This paper will also present a real-world application of this methodology for Navy Training. A short demonstration of the simulation model will be presented with a summary of how the model was used to provide cost benefit analysis of information technology and support process modifications.

The sharing of information that is fostered by the TBMS architecture will increase capability and cost-effectiveness by increased interoperability and reuse of business process models and business simulations. Participants in the CNET TBMS project will have the benefit of using a one-stop shopping location for all modeling and simulation related materials. Common standards, methodology, ROI requirements, and validation and verification policies and procedures will also mark the architecture and will provide substantial payback. A system level view of business processes will be documented, validated, and available for future reference and training applications. Ultimately, the Navy will spend fewer resources on training process simulation development and analysis, and will benefit by more informed decisions through a robust training decision support system.

Previous Years Papers Available on CD

PARTNERING WITH HIGH SCHOOLS TO BUILD A GREATER AMERICA: A CASE STUDY

Hank Okraski, National Center for Simulation

Anna Diaz, University High School

This paper describes the partnership established between the National Center for Simulation (NCS), its industry, academic and government members, and University High School (UHS) of Orlando, Florida. The objective of this "Partners in Education Program" is to develop a secondary school curriculum with a focus on modeling and simulation to prepare students for further education or training and/or careers in an exciting, challenging high technology field Introducing modeling and simulation into the high school program requires not only support but a commitment by all parties. Military organizations in the area and NASA were quick to endorse the focus school concept, recognizing that some graduates enter the military, others go on to college and might also go into the service later, or there are those who enter the simulation workforce and contribute to the nation's overall simulation capability. The cooperation and resources provided by the Naval Air Warfare Center Training Systems Division, US Army Simulation, Training and Instrumentation Command, Air Force Agency for Modeling and Simulation and the University of Central Florida, including its Institute for Simulation and Training, have been outstanding. All of these organizations are in or adjacent to the Central Florida Research Park, making it very convenient for tours, demonstrations and student work opportunities.The program to date has been very successful, serving as a template for other secondary schools and educational institutions of all levels. Teacher training, which includes classroom instruction, tours and demonstrations, has energized the faculty and fostered an exceptional interest in technology by the students. Approximately 100 students are enrolled in the program for this first year of its existence. The demand is expected to grow as the program progresses. The program expects to produce graduates who are familiar with the high technologies that will influence and even shape their lives through a cutting-edge curriculum and, perhaps more importantly, through exposure to industry professionals who have taken an interest in their Development and future.

USING DISTRIBUTED MISSION TRAINING TO AUGMENT FLIGHT LEAD UPGRADE TRAINING

Peter Crane
Air Force Research Laboratory, Warfighter Training Research Division

Robert Robbins
L3 Communications, Inc., Link Simulation and Training Division,

Winston Bennett, Jr
Air Force Research Laboratory, Warfighter Training Research Division

Previous research on Distributed Mission Training (DMT) has shown that pilots and AWACS Weapons Directors rate DMT as highly effective for training multi-ship, multi-bogey air combat. DMT exercises have also been utilized as opportunities for pilots participating in Flight Lead Upgrade (FLUG) training to gain experience in planning, briefing, leading, and debriefing four-ship missions in an intensive air-to-air threat environment. A four-phase research program to assess the effectiveness of using DMT to augment FLUG training was undertaken in Apr 99 by the Air Force Research Laboratory, Warfighter Training Research Division. First, training records were reviewed to identify four-ship FLUG missions that would most benefit from DMT experience and to establish baseline rates for sorties that were repeated due to non-effective upgrading pilot proficiency. These data indicated that among four-ship training missions, the highest refly rates are for Dissimilar Air Combat Tactics, and Low-Altitude Surface Attack Tactics. Second, a five-day DMT–FLUG protocol was developed targeting these missions. Third, DMT–FLUG training exercises were conducted over a one-year period. During these exercises, upgrading pilots lead several missions of increasing complexity using the Air Force Research Laboratory four-ship DMT testbed located in Mesa, AZ with AWACS weapons controllers participating from AFRL's research facility at Brooks AFB, TX. DMT-FLUG exercises were conducted in Jun, Aug, and Oct 99, and Feb 00. Fourth, transfer to aircraft training was assessed through review of training records and interviews with both upgrading pilots and their instructors. As of 1 Sep 00, eight out of twelve upgrading pilots who participated in DMT-FLUG have successfully completed the FLUG program without any repeated missions, one pilot repeated one mission, two transferred out of fighters, and the remaining pilot is still in training. Performance of pilots and AWACS weapons directors within DMT exercises is discussed with emphasis on identifying the mission tasks that are most appropriate for DMT.

THE ROAD TO DMT

Randy Olson, ASC/YWI, USAF, Wright Patterson Air Force Base

Distributed Mission Training (DMT) for the warfighter is now a reality with two F-15C Mission Training Centers (MTC) in operation. The next increase in capability are on the horizon with the F-16C MTC and AWACS MTC being on contract. An Operations and Integration (O&I) contractor will be selected to coordinate communications and interfaces between MTCs.

An innovative contracting type, Fee for Service, is used with DMT. Here only services used are purchased, rather than buying the equipment. This takes the risk from the government and puts it on the contractor.

The focus of the training is on teaching pilots individual and team tasks from the Master Training Task List. These tasks include tactical training and procedure training such as navigation and responding to emergencies. Current capabilities include individual training for up to four students each at two locations to two four-ships networked together as a team against manned and constructive threats. These two four-ships are at Eglin and Langley AFB. The AWACS MTC is expected to long haul network with the F-15C MTC this summer as part of an operational evaluation.

Current status of the F-16C MTC is the first DMT trainer will come on-line fourth quarter of 2001. The key to making DMT work is the various MTC's ability to interface together. Interface specification will be the responsibility of the O&I contractor. To facilitate networking the F-15C and F-16C MTCs have been designed with a large amount of commonality in the areas required for compatibility.

This paper describes the current status of the DMT program. The paper will discuss the development and integration of the F-15C MTC at Eglin AFB FL and Langley AFB, VA. The primary focus of the paper will be upon lessons learned in the acquisition, development and fielding of the F-15C MTC.

EVOLUTION OF THE PROCESSES USED TO EVALUATE AIRCREW TRAINING DEVICES IN A DISTRIBUTED ENVIRONMENT

R.H. Taylor
Dynetics, Inc.

With technological advancements allowing for the networking of multiple aircrew training devices (ATDs) and the implementation of the Distributed Mission Training (DMT) initiative, the processes used to assess the capability of ATDs to provide accurate and credible training has evolved into a graduated, multi-level approach. Unit-level Mission Training Centers (MTCs) with linked high fidelity simulators are the core of the DMT system. These components are envisioned to operate as independent devices (i.e., single ship) or within a networked environment (local and long haul) with both homogeneous and heterogeneous systems. As executor of the Combat Air Forces (CAF) Simulator Certification (SIMCERT) program, the 29th Training Systems Squadron (29TSS) of the 53D Wing, USAF Air Warfare Center, will initiate SIMCERT activities at the initial F-15C MTC sites. In addition, 29TSS will conduct a systems evaluation (SYSEVAL) with respect to DMT operational requirements.

Following brief overviews of ATDs employed by the CAF and of the DMT initiative, the SIMCERT process is discussed at length. The scope and specific objectives associated with Phase I, Phase II, and Phase III SIMCERT activities are described, with examples of assessments conducted at each level provided. The importance of early identification and (if possible) isolation of anomalies during the SIMCERT process is stressed, and the use of both objective and subjective assessments to determine certification status is discussed. The need for SYSEVAL is discussed and the Critical Operational Issues (COIs) are provided. The paper concludes with lessons learned during 29TSS's involvement with the acquisition and assessments of the initial DMT assets and a discussion of how these lessons have influenced the SIMCERT processes.

A COMPLEX SYNTHETIC ENVIRONMENT FOR AIRCREW TRAINING RESEARCH

Ian Greig, Edward Mayo & Daran Crush, Defence Evaluation & Research Agency, UK

During February 2000, DERA, a research and technology agency of the UK MoD, conducted the first in a series of simulation trials to investigate the potential of a collective environment for aircrew training. The trial involved simulating a mixed package of air-to-air and air-to-ground manned simulators, with additional friendly forces provided by computer generated forces (CGF) and human role-players. Hostile forces were also provided using air-to-air manned simulators, CGF and human role-players. The simulated operational environment was designed to be as realistic as possible. Front-line crews manned the simulators, while other military personnel took the roles of the command chain for both friendly and hostile forces. This allowed the simulated missions to be run as they would be in a real operational environment, with full pre-sortie briefings, crew planning, sortie execution and debriefing. The implementation of the trial infrastructure involved significant development and integration effort, covering aspects such as:

- Credible Computer Generated Forces
- Long-haul secure data and voice communications
- Terrain database generation
- Scenario development and management
- Exercise and technical management systems, including data recording and analysis tools
- Planning, briefing and debriefing systems
- Role-player systems

This paper covers the development of the trial infrastructure, and lessons learnt during development and use.

TRAINING IN A SYNTHETIC ENVIRONMENT FOR IMPROVED OPERATIONAL EFFECTIVENESS IN COLLECTIVE AIR OPERATIONS

Heather M. McIntyre & Ebb Smith, Defence Evaluation & Research Agency

A synthetic Composite Air Operations (COMAO) exercise was conducted by the Defence Evaluation & Research Agency (DERA), in the United Kingdom (UK) during February 2000. A complex mission scenario was created over a simulator network involving; a manned 4-ship of Ground Attack aircraft, a manned 4-ship of Air Defence aircraft, with other friendly forces such as Suppression of Enemy Air Defence (SEAD) assets and Airborne Warning and Control System (AWACS) assets represented by Computer generated Forces (CGF). In addition hostile forces, both Ground-Based Air Defence (GBAD) and air threats were represented by CGF, under the control of a Sector Operations Centre Director (a human role player). The scenario was based on a realistic operational setting. The manned participants were frontline aircrew who flew one mission per day, over a number of days, increasing in complexity. Each day involved a complete Plan, Brief, Execute, Debrief cycle. Operational military personnel also role played CGF assets by giving appropriate voice inputs; over a telephone during mission planning and briefing (as if located at another air base) and via radio transmissions during mission execution. An AWACS controller was also role played during mission execution, controlling both CGF and manned players. Both objective and subjective measures of aircrew performance indicate that training value was achieved and tactical lessons learned over the course of the exercise. A number of other research objectives were also achieved, simultaneously, including: a comparison of the training value of simulator environments, of differing levels of complexity, to the training value of the aircraft for role specific mission task elements; comparison of the effectiveness of live vs. synthetic COMAO training; evaluation of the utility of using role players and facilitators in the scenario; assessment of interactions between manned and CGF members of an aircraft package. The initial response from aircrew is very positive indicating training value and immersion, the capability to practise things that cannot be done in the real aircraft during peacetime training, and meaningful interaction with aircraft in other roles, within a complex mission environment.

Previous Years Papers Available on CD

THE SUBJECTIVE OBJECTIVE ASSESSMENT OF AIRMANSHIP

Sqn Ldr Sarah A Heycock, Royal Air Force Halton

Airmanship has been a notoriously subjective, poorly-assessed part of flying training across the UK Royal Air Force (RAF) for many years. Airmanship is a critical part of any flying instruction and yet is largely unassessed or perhaps worse, incorrectly assessed. This proposal is aimed at standardising a very subjective area that differs greatly between RAF Commands. However, to go to a purely objective assessment brings its own disadvantages in that it is too clinical, particularly as the assessment of individual capacity and airmanship is in an environment that is subject to many external influences. Consequently, this airmanship proposal has been put together for the use of all those undertaking flying training to aid diagnosis of student weaknesses with subsequent spin-offs to clarify assessment, dedicated instruction and role disposal. It consists of the following areas: Situational Awareness; Mental Capacity; Decisiveness; Communication; and Resource Management.

INTEGRATION OF FIELDED ARMY AVIATION SIMULATORS WITH MODSAF: THE EIGHTH ARMY TRAINING SOLUTION

Joseph M. Sardella and Darryl L. High
L-3 Communications Corporation, Link Simulation & Training Division

The Eighth United States Army (EUSA) in the Republic of Korea employs UH-60 and CH-47 flight simulators to support individual and crew training for Blackhawk and Chinook pilots, respectively. These simulators are high fidelity, man-in-the-loop, training devices that support initial entry, qualification, and sustainment training in system operations, crew coordination, emergency procedures, and combat skills. As part of the EUSA Korean Simulator Upgrade program, the two flight simulators are receiving an upgrade to the visual image generation system (including a geo-specific database of the Korean Peninsula) while maintaining, as a minimum, existing performance capabilities. One of the key training areas to maintain was the tactical environment. In the existing visual database, target sites and pathways were modeled into the database manually, based on training requirements and customer inputs, using custom database generation tools. The sites and paths, along with the behaviors of these targets, were under instructor controls; thus, providing numerous, realistic, dynamic, yet deterministic and repeatable tactical scenarios. In addition to these real-time scenarios, both training devices provide a reset and playback capability that allows the student and instructor to review the mission and allows fly-out to real-time at any time during the playback. Under the scope of the contract, these capabilities were to be maintained.The solution needed to be a constructive simulation that not only maintained previous tactical environment fidelity (critical to each helicopter's training environment) but one that added enough robustness to provide a set of routes that can be altered as training requirements change without requiring a large database modeling effort. With an off-line scenario generation capability and realistic target movement models, Modular Semi-Automated Forces (ModSAF) was selected as the constructive simulation. By adding a Distributed Interactive Simulation (DIS) network interface between the legacy device and ModSAF, the Instructor Operator Station (IOS) at the training device can control each ModSAF target as directed by the existing tactics within the legacy training device. The use of DIS as the interface also provides future growth potential for the devices to perform collective training in a DIS or High Level Architecture (HLA) networked environment.

LESSONS LEARNED FROM THE SPECIAL OPERATIONS FORCES STOW-A HLA EXERCISE

Gilbert González,Science Applications International Corporation
Ivan Carbia, Gene Lowe, Glenn Valentine, John Bray
Science Applications International Corporation
Víctor Colón, Naval Air Warfare Center Training Systems Division

The U. S. Special Operations Forces (SOF) conducted their second Synthetic Theater of War-Architecture (STOW-A) exercise during the week of October 25th, 1999. The first STOW-A exercise utilized the Distributed Interactive Simulation (DIS) protocol; the second exercise was designed and executed using the High Level Architecture (HLA). The exercise consisted of two missions, which were classic infiltrate and assault using air and ground assets, requiring joint coordination between the Air Force and Army pilots, Rangers and the other SOF units. This exercise had two primary objectives. The first objective was to conduct a realistic Computer Aided Exercise (CAX) using manned simulators from the 160th Special Operations Aviation Regiment (SOAR) at Ft. Campbell, KY and the 19th Special Operations Squadron (SOS) at Hurlburt Field, FL. The second was to establish a distributed training architecture using HLA that could be used to refine and validate tactics for multi-aircraft, all-weather operations. The exercise achieved the goals and objectives of all the participants. This paper captures the lessons learned during the integration, testing and execution of the SOF STOW-A training exercise using HLA. We address the technical challenges the federation developers overcame related to Run-Time Infrastructure (RTI) connectivity over a Wide Area Network (WAN), and the use of a DIS filter and gateway to integrate radios and non-HLA simulation applications into the federation execution. We discuss the elements used to coordinate and execute the federation between distributed sites.

I/ITSEC 99 JOINT TRAINING EVENT: HLA FEDERATION PERSPECTIVE

John Bray, Gene Lowe, Science Applications International Corporation
Bernard J. Gajkowski, U.S. Army Simulation Training and Instrumentation Command,Kevin Mullally, Motorola

The US Army, Air Force, Navy, and Marines, joined by a number of contractors and representatives from academia, conducted a Joint Training Event (JTE) on the floor of the Orange County Convention Center during I/ITSEC 99. The JTE involved approximately 30 High Level Architecture (HLA) federates including virtual simulators, semi-automated forces (SAF), and HLA tools. To our knowledge this was the largest number of diverse HLA federates ever called upon to operate together. There was a significant amount of technical planning and preparation conducted by knowledgeable engineers prior to the event, to try to ensure its success. The event, conducted as a series of four 30-minute vignettes over three days, involved warfighters supervising training, warfighters being trained, plus technical operation of the simulators and simulations by a variety of contractors and government personnel. The JTE was managed to balance the dual objectives of pioneering technical achievements and warfighter training effectiveness. The event is considered to have been a significant success. This paper conveys the experiences gained from the perspective of federation buildup and control. The story begins with a description of the complex federation we wanted to establish, the steps we took to try to accomplish it, and what we achieved. The federate test strategy we used is presented along with influencing factors, problems encountered and lessons learned. Establishment of the federation on the I/ITSEC floor and management of the federation execution are similarly presented.

Previous Years Papers Available on CD

LEGACY FLIGHT SIMULATION TRANSITIONS TO THE HIGH LEVEL ARCHITECTURE (HLA) AND THE NAVAL AVIATION TRAINING SYSTEMS INTEROPERABILITY MATURATION MODEL

CAPT Rory Fisher, Naval Air Systems Command (NAVAIR), PMA205
Daniel J Paterson, Naval Air Warfare Center Training Systems Division

The Naval Aviation Training Systems and Defense Advanced Research Projects Agency (DARPA) teamed to investigate the feasibility and costs associated with the modification of a legacy flight simulator (F14D) that was not previously Distributed Interactive Simulation (DIS) capable, to become a High Level Architecture (HLA) Federate. The F14D legacy flight simulator was modified using the Gateway approach at the Naval Air Station Oceana VA based "What If Simulation System for Advanced Research and Development (WIZZARD) Tactical Research Facility. This paper will examine the experiment performed, in context to the draft High Level Architecture (HLA) Interoperability Maturation Model. This paper will describe the Maturation Model and explain why this approach was developed. This paper then compares the F14D legacy flight simulators transition to HLA and the Maturation Model Transition level that was achieved. This paper also discusses associated costs, risks, benefits, and implications to the warfighter when upgrading these older legacy flight systems to the HLA environment

USING JTIMS FOR KNOWLEDGE ACQUISITION IN TRAINING AND SIMULATION REQUIREMENTS DEFINITION

Mr. Jack Glasgow, Marine Corps Association
Mr. Bruce Harris, Dynamics Research Corporation

As it moves into the new millennium, the Department of Defense (DoD) faces the challenge of creating Armed Forces that are "... dominant across the full spectrum of military operations - persuasive in peace, decisive in war, preeminent in any form of conflict." The training readiness of such a force is receiving renewed emphasis just as the challenges to conducting effective training are increasing. Competition for resources, loss of traditional training facilities in the United States and abroad, and the very complexity of modern warfare are training realities. Nowhere are these training challenges more evident than in training at the strategic and operational levels of war. One direct result of this situation is the ever-increasing reliance on modeling and simulation to traverse the gap between training requirements and resources.The DoD has sponsored a number of new organizations and new training initiatives. The Joint Warfighting Center and the Defense Modeling and Simulation Office are two examples of new organizations supporting the training community and the new Joint Training Management Information System (JTIMS) is an example of a state of the art, web-based system directly supporting the Combatant Commands. The JTIMS aids commanders in translating doctrine to specific tasks, in determining a set of conditions under which the tasks are conducted, and defining the measures of performance against which an organization may be evaluated on a particular task. This paper will provide the current status of programs that facilitate the Knowledge Acquisition (KA) function of translating doctrine to tasks. The paper will address the current status of the Joint Training System (JTS), the Universal Joint Task List (UJTL) 4.0, Service Tactical Task Lists (TTLs), and the JTIMS itself. The paper will further provide examples of automating the KA function using JTIMS, the UJTL 4.0, and a Joint Suppression of Enemy Air Defenses (JSEAD) mission, complete with the compilation of tasks, conditions, and measures of performance. The paper will conclude with a discussion of further processes connected to this initial KA effort.

DETERMINING THE RIGHT MIX OF LIVE, VIRTUAL, AND CONSTRUCTIVE TRAINING

Geoffrey A. Frank and Robert F. Helms II
Research Triangle Institute
David Voor,Naval Air Warfare Center Training Systems Division

The use of a mixture of live, virtual, and constructive training has become accepted practice for training within the Department of Defense. We call training environments that use a combination of these techniques an Advanced Learning Environment (ALE). A key issue is getting the right mix of live, virtual, and constructive training in order to achieve cost-effective training. We present a technology-based methodology for task analysis that assists in making the tradeoffs necessary for designing a cost-effective ALE. This technology-based methodology represents an update of traditional Instructional System Design methods that have been used for training analyses. The method divides the training of each task into four steps: Familiarization, Acquiring the skills, Practicing the skills, and Validating the skills. We use the acronym FAPV to refer to these four steps. We have implemented the FAPV analysis with a tool that starts with a database of tasks and training times. The tool allows dynamic tradeoffs across a variety of variables, including student loads, choice of training devices, available facilities, student/instructor ratios, and training device reliability. This paper describes the FAPV analysis and process, and illustrates the results with three examples developed for the US Army.

The effectiveness and cost associated with training in live, virtual, and constructive environments can vary significantly. FAPV analysis helps the training developer estimate the impact on training effectiveness and associated costs of the choice of live, virtual, and constructive training. The dynamic variables allows the training developer to make rapid tradeoffs between multiple training environment configurations to select training devices and determine the number of training devices that are required to meet student throughput goals.

AUTOMATED DECISION AID SYSTEM FOR HAZARDOUS INCIDENTS (ADASHI)

James Genovese,
Edgewood Chemical Biological Center,US ARMY SBCCOM Edgewood Area, Aberdeen Proving Ground

Arthur Stuempfle, Frank J. Wysocki, Karl Stuempfle,OptiMetrics

The Automated Decision Aid System for Hazardous Incidents (ADASHI) is a unique, portable, computer-based integrated decision-aid support system for improving the response to a hazardous incident by military and civil responders to chemical and biological incidents. The incident commander (IC) can use ADASHI at the incident site or it can be used at the higher echelon operation centers to actively support decision-makers. The tool has the capability to support individual and collective training at team locations and at the responder's home. ADASHI is designed to function on laptops and desktop computers providing user flexibility and portability to remote locations. The software architecture can be adapted to support advanced distributed learning strategies. ADASHI effectively integrates the specific technical functions required to manage a hazardous incident or WMD event. Those functions include, but are not limited to initial hazard assessment, hazard source analysis, mitigation alternatives, physical protection requirements, decontamination methods, hazard area prediction, detection planning and sampling, medical treatment, and triage criteria. Specific functional inputs are integrated with decision criteria enhancing response management in a crisis situation. ADASHI is automatically monitoring the essential aspects of an event, whether it be a "What if" simulated event for training purposes or a real event. ADASHI's automated multifunction tracking and monitoring can be used as a training tool where individual data inputs can influence a weapons of mass destruction (WMD) training scenario outcome. The trainee must then select a specific operational option in order to mitigate the effects of the incident. ADASHI's expert system can then help determine the scope of operational alternatives available and query the trainee using direct questions, memory prompts, etc. to help in making an informed decision. The expert database structure alleviates the training burden by offering in electronic format the volumes of disparate reference material. Team leaders and members can perform "trial and error" learning free from criticism while they build confidence and expertise without compromising the confidence that their team has in them. ADASHI can be utilized to augment the traditional 'table-top training' by providing automated tracking of decisions and making projections of the consequences of those decisions as they impact on the situation and the response resources available. ADASHI is to be utilized as an "over the shoulder" decision-support system to aid incident commanders in making better, more timely decisions by rapidly processing the multivariate input data and providing critical information to that incident commander or team leader in a high-stress environment. It also can be exploited as a powerful training tool to significantly improve the multidisciplined emergency response team's readiness for chemical/biological (CB) release incidents.

MILITARY BASED USER ASSESSMENTS FOR MEDICAL SIMULATION

M. Beth Pettitt, U.S. Army Simulation, Training, and Instrumentation Command, John J Anton, Medical Education Technologies Inc.

Modern warfare has demanded a different kind of approach to combat readiness. Modeling and simulation have successfully reduced instructional resources, increased training and retention quality, and have allowed non-lethal experience for combat conditions and mitigated the environmental impact of live training exercises. It makes absolute sense in a time of diminishing controlled clinical exposure to combat medicine conditions that this successful application of modeling and simulation be applied to the field of combat medicine. Simulation applied to medicine should yield the same results and advantages that come from warfighting, aviation, or other military simulations, and should follow the same requirements and principles. Under the U.S. Army's Combat Trauma Patient Simulation Program (CTPS), managed by Simulation Training and Instrumentation Command (STRICOM), and sponsored by Medical Research and Material Command (MRMC), a series of user based simulation assessments were conducted to facilitate the creation of a military medical simulation system. The user assessment methodology was not meant to produce an independent test to measure definitive first order principles. It was more correctly an attempt to survey a variety of military medical users as to their perceptions of the efficacy of using simulation within their educational domain for further development and research. The user assessments were conducted over a period of two and a half years, and are continuing as part of the CTPS program. They were conducted in the broadest range possible, in all areas of medical education and with as many domain experts as possible. Some of the assessments were directly related to CTPS and included use of existing CTPS hardware, particularly the Human Patient Simulator. While the CTPS chosen simulator was used, assessments were made of other types of training aids, devices, and patient simulators as well. This paper describes the results of those experiments.

SIMULATION OF VOICE COMMUNICATION BY SPEECH SYNTHESIS

Jacques Leong, BAE Systems
Flight Simulation and Training

This paper first describes two methods of speech generation to simulate voice communication: Speech Sampling and Speech Synthesis. The Digital Voice Response System (DVRS) simulates Automatic Terminal Information System (ATIS) and Radio Transmission (RT) chatter. ATIS broadcasts weather and airfield information. RT chatter designates radio conversations between aircraft pilots and Air Traffic Control (ATC) operators on air traffic services provided on different radio frequencies such as Ground Control, Arrival Control and Departure Control.

Earlier DVRS used sampling and playback of digitized voice to simulate ATIS. Words and phrases were pre-recorded using a particular individual's voice and were then digitized into audio files. This technique ensures maximum voice fidelity within the audio-sampling rate. However, it carries some maintenance drawback such as requiring more recording from the same individual, as new words need to be added to the vocabulary.

The new DVRS is taking advantage of Speech Synthesis or Text-To-Speech (TTS) technology for ATIS simulation. Relieved from the chore of sampling and editing speech, the simulation developer can concentrate on the simulation model. TTS provides complete vocabulary and even some words are not part of the standard vocabulary; speech can still be generated using phoneme symbols. The DVRS application interacts with a Microsoft Speech Application Program Interface (SAPI™) –compliant TTS engine. This architecture allows DVRS to continuously benefit from improved SAPI-compliant TTS engines. However, the biggest challenge currently facing TTS research is to resolve the lack of naturalness in synthesized speech.

The comparison of Sampling method and Synthesis method leads to a compromise in the areas of voice communication simulation. Real ATIS has become mainly synthesized, thanks to the convenience of TTS technology. This fully justifies the choice of simulation with synthesized ATIS. However, RT chatter simulation's value resides significantly in the human emotion embedded in the speech. So the Sampling method is more appropriate for RT chatter simulation, probably until TTS research makes a breakthrough in speech naturalness.

TRAINING IN DISTRIBUTED VIRTUAL ENVIRONMENTS

Dr. Michael J. Singer
U.S. Army Research Institute, Simulator Systems Research Unit

Dr. Stuart C. Grant
Defence and Civil Institute for Environmental Medicine, Canada

Merrill Zavod and Patrick Commarford
University of Central Florida

The U. S. Army is developing distributed interactive simulation (DIS) systems for combat training and military concept development, testing, and evaluation. The early emphasis and implementation has been on linking vehicle simulators, without providing for the training or participation of dismounted soldiers (Knerr, et al., 1994). The Army Research Institute for the Behavioral and Social Sciences (ARI) and Defence Research and Development Canada are investigating distributed training for dismounted soldiers. Unlike vehicle simulators, where the crew are able to interact within the simulator unimpeded by the simulation technology, simulators for dismounted combatants interpose the limitations of simulation technology between team members. Any effect this has on the acquisition of team skills is exacerbated in distributed simulations because interaction between team members will be further limited. To investigate the nature and severity of this situation, the reported experiment addresses the development of team coordination under conditions of either distributed or local mission rehearsal. In the virtual environment (VE) scenario two person teams search buildings for hazardous materials and neutralize them while being opposed by computer generated forces. Each participant is trained to standard criteria on all tasks and activities before the team is formed and mission rehearsals begin. Each team then performs eight missions with an after-action review (AAR) after each mission. Mission sessions are distributed over several days. The preliminary data show improvement in team overall performance in the number of rooms searched, time to perform collective tasks, and hazardous materials disarmed. We anticipate that teams trained using distributed simulation, having more limited opportunities to interact away from the mission and AAR, will not develop the same levels of performance achieved by those teams trained in the same location.

TRAINING-TRANSFER GUIDELINES FOR VIRTUAL ENVIRONMENTS (VE)

LT Joseph Cohn, Ph.D., Jessica Helmick, Christopher Myers
Naval Air Warfare Center Training Systems Division

John Burns, Ph.D.
Sonalysts, Inc.

In recent years, advances in both computer hardware and software have set the stage for designing Virtual Environments (VE) of ever-increasing fidelity. These improvements in VE technology have revived interest in using virtual worlds to provide training. There are many advantages to using VE-based training. For example, VE provides a cost-effective, flexible training environment that can be quickly and easily reconfigured to provide mission-specific training. Also, VE affords instructors the opportunity to expose students to situations that would otherwise be impossible (i.e. life threatening) to recreate in real-life training scenarios. As well, VE provides a unique opportunity for trainers to evaluate their students either in real time, by freezing training at critical points, or by replaying the entire training scenario upon completion.

One of the key assumptions in using VE-based training is that the training received in the VE world will transfer to the real world. However, it has often proven difficult to establish this transfer of training. One reason for this difficulty is that a consensus is lacking in how to establish that training-transfer has occurred. We present here a system of guidelines for establishing training transfer from a VE to a real-world task. In formulating our guidelines we draw upon a wide range of sources, including the flight simulator literature, academic and human factors research as well as findings from our own research.

Issues to be addressed include: defining a specific training task in terms of a series of readily observable variables that are critical to successfully learning the task; providing subjects with training in a VE that emphasizes this variable set; transitioning these trained subjects to the real-world task, while recording these same variables; observing a control group exposed only to the real-world task; finally, using a cross-validation process (Subject Matter Expert feedback), to supplement our evaluation of the degree to which training transfer has occurred. We choose as our model case a shiphandling task. Establishing a set of guidelines should provide future trainers/VE developers with a set of tools for determining how best to design their VE worlds and training protocols.

TRAINING TEAMS WITH SIMULATED TEAMMATES

Alma M. Schaafstal, Ph.D., Simone M. Stroomer
TNO Human Factors 3769 ZG SOESTERBERG

Denise M. Lyons, Ph.D.
Naval Air Warfare Center Training Systems Division

Training teams increasingly takes place in synthetic environments. However, team training is often still modeled after live team training, including the disadvantages of live training, such as instructor-intense performance monitoring, and the fact that all appropriate other teammates have to be available. This paper explores the latter issue: how to overcome the bottlenecks of the availability and drawbacks of human teammates in training teams in synthetic environments, while keeping the advantages: the opportunity to learn in a collaborative and cooperative fashion. Simulated teammates are a promising alternative to human teammates, because they are always available, may be modeled after experienced training personnel, and may be more cost effective in the long run. The research challenge lies in keeping the advantages associated with human teammates: simulated teammates should display the same collaborative and cooperative behavior typically associated with human teammates. This paper will review the relevant available research data, and will explore how intelligent teammates should be defined and modeled so as to take advantage of both worlds: optimizing the possibility of cooperative learning, as well as optimizing individual and team learning experiences.

THE ARMY AVIATION COLLECTIVE TRAINING SOLUTION: AVCATT-A

William C. Reese, United States Army Simulation, Training, and Instrumentation Command (STRICOM), AMSTI-EV
William H. Durham, Sam Knight, Gary R. George P. E.
L-3 Communications Link Training and Simulation

The existing suite of training devices for Army aviators is composed of single cockpit, stand-alone devices designed to support training appropriate for an individual aviator or a single crew. These training devices, while completely appropriate for individual aviator and crew training do not possess the networking and interoperability capability necessary to address collective, unit-level training of multiple crews. This inability to provide company/troop level collective training is to be corrected with the development and procurement of AVCATT-A.

This paper will provide an overview of the total AVCATT-A training solution to meet stringent Army aviation collective training requirements. The AVCATT-A represents a different approach to both the level of training addressed and the fidelity of the training devices. AVCATT-A is intended to provide company/troop level training for Army aviation reconnaissance, attack, assault and support units via six networked, reconfigurable cockpits interacting with a rich synthetic battlespace housed in a mobile facility. This approach differs radically from that of fixed site, aircraft specific, limited synthetic battlespace, individual aviator or crew level training devices that comprise the existing training suite.

CLOSE COMBAT TACTICAL TRAINER SAF ON A PC

Bob Burch, Peggy Hughley, Gene McCulley, Derrick Dietrich
Science Applications International Corporation

The current workstation designs used by SAFs, such as CCTT SAF and ModSAF, date back to a SIMNET legacy of the late 1980s. CCTT and other large simulation programs within Department of Defense are becoming the exception rather than the rule. The SAF Suite and Standalone configurations of CCTT SAF were created in part to provide a more cost-effective platform by combining application and workstation roles that normally would require no less than three host computers. The next logical step is to port SAF Suite and Standalone to the even more cost-effective Intel-based PC platform.

The porting of SAF Suite and Standalone to the PC requires a change in host computer platform, operating system (OS), compiler, and supporting software libraries. The current configuration is the IBM PowerPC/AIX OS UNIX workstation with the Powerada compiler from OC Systems, Inc. Powerada includes AdaMotif, a commercial Motif binding for Ada. The Intel-based PC configuration is a Pentium III/Linux OS PC workstation with the GNU Ada compiler, GNAT, and other public supporting software libraries.

INCORPORATING VIRTUAL SIMULATION WITH INTEROPERABILITY TRAINING

COLONEL James G. Diehl, United States Army
United States Joint Forces Command

Major Terence P. Brennan, United States Marines
United States Joint Forces Command

Interoperability training among the Services is increasingly important and valuable, given frequent deployments and smaller force structures. However, training Service tactical units on interoperability tasks is an expense in terms of both money and time. Nevertheless, it is the goal of US Joint Forces Command to prepare its components' routinely deploying units to perform interoperably during a contingency to ensure that no soldier, sailor, airman or Marine encounters an interoperability task for the first time in the deployed theater. Given the enormous challenge to train on Service specific tasks as well as joint interoperability tasks and the growing use of tactical simulators across the Services, the ability to link Service training events through the use of simulations and the ability of Service simulators to be linked with the intent to conduct joint interoperability training are important capabilities for the joint forces of the future. Joint logistics, joint fires and targeting, joint intelligence, and joint theater air and missile defense appear to offer significant promise as focus points for the creation of linked Service exercises as well as, potentially, a Virtual Interoperability Training Center. The intent of this paper is to define the requirement for "virtual" interoperability training and to offer a look at potential vehicles for the linkage of Service training events to address joint interoperability, as well as the possibility of establishing a Virtual Interoperability Training Center, which would allow Service tactical simulators to link to one another and address joint interoperability challenges.

INTEGRATING COMPLEMENTARY VIEWS ON AN EXERCISE INTO AN OBJECTIVES-BASED TRAINING SUPPORT TOOLSET

Jan van Geest, TNO-FEL
TNO Physics and Electronics Laboratory

Rudi Gouweleeuw, TNO-FEL
TNO Physics and Electronics Laboratory

A significant trend in the use of synthetic environments for military unit training is to move away from using generic scenarios that cover a multitude of training objectives. Instead, dedicated scenarios are designed that cover a smaller set of specific training objectives. A few tools exist that support the development of scenarios tailored to these objectives and the collection of data for an after-action review based on the objectives. For real-time monitoring of the exercise however, most environments use a standard set of tools, e.g. plan view display, 3D stealth and ORBAT (ORder of BATtle) Browser. These tools only provide a generic view on the exercise. Specific information necessary for evaluation of the training objectives is often not present or only available after time-consuming manual adjustment of the tools.This paper reports on the definition of a training support toolset that uses training objectives as a framework. The toolset enables the instructional staff to focus on training objectives during all stages of the lifecycle of an exercise: definition, preparation, execution and review. The current emphasis is on the execution and the review stages. The paradigm for the approach described in this paper is to regard the training support toolset as a set of complementary views on the synthetic environment. Each view is optimised to display certain types of entity information, e.g. position in the battlefield, force hierarchy or vehicle status. To support the evaluation of a particular training objective or group of objectives during an exercise, the toolset is configured for the instructional staff as a dedicated set of views, enabling them to retrieve the necessary information.
Two other guidelines used for the construction of the toolset are the presentation of additional information as overlays over the views, and the use of system-wide controls that influence all relevant views in the toolset. The paper gives examples that show how the toolset allows the members of the instructional staff to retrieve information on entities in an effective and efficient way. The instructional staff uses the information obtained to build a common mental picture of the performance of the trainees by evaluating the training objectives during the execution stage. They can provide on-line feedback, or store the information for use in an objectives-based after-action review. The approach is applied in co-operation with the Royal Netherlands Army to prototype training support tools for tactical training environments. One of their main interests in this approach is to conduct high-quality training exercises with a relatively small instructional staff.

CENTRALIZED TRAINING ANALYSIS FACILITY FOR LIVE TRAINING

Larry L. Meliza
U.S. Army Research Institute Simulator Systems Research Unit

Ira J. Begley II and Louis Anderson
Advancia Corporation

Analysts support observer/controllers (Ocs) at the Army's live instrumented Maneuver Combat Training Centers (MCTCs) by performing exercise control functions and preparing after action review (AAR) aids for feedback sessions. The Army plans to field an instrumentation system that will give units a MCTC-like training capability at their home stations, but the Army cannot afford to provide the same degree of dedicated analytical support that has been provided for MCTCs. The benefits of home station instrumentation are likely to be reduced when OCs at home station are supported by unit personal tasked temporarily to serve as analysts. The US Army Training Modernization Directorate (ATMD) envisioned the concept of a training analysis and feedback center of excellence (TAAF-X), supporting multiple MCTCs and home stations concurrently. A TAAF-X can provide home stations with access to experienced analysts, possibly reduce the ratio of analysts required per unit trained, and provide a continual human link between MCTCs and home stations. ATMD asked us to assess the feasibility of implementing the TAAF-X concept. We identified potential problems implementing the TAAF-X concept and proposed solutions where possible. Through an iterative process we refined the TAAF-X concept.

AUSTRALIAN COLLABORATION WITH USN BATTLE FORCE TACTICAL TRAINING PROGRAM

Dr Peter Clark, Dr Peter Ryan, and Dr Lucien Zalcman
Air Operations Division, Aeronautical & Maritime Research Laboratory, Defence Science & Technology Organisation,

Michael O'Neal, Program Manager
Performance Monitoring, Training and Assessment (PMTA) Program Office, Naval Sea Systems Command

Dave Kotick
BFTT HLA Lead Engineer
Naval Air Warfare Center Training System Division

Jim Brewer, Senior Engineer
NOVONICS Corporation

Australian Navy Project SEA 1412 is integrating a set of team trainers using Distributed Interactive Simulation (DIS) to develop the Maritime Warfare Training System (MWTS). The US Navy has a similar Program – Battle Force Tactical Training (BFTT) System, which will eventually include 158 major surface ships and five shore sites, providing training for individual and multiple ships, using distributed interactive simulation. This technology enables a number of ships and shore units to participate in the same virtual battlespace even though they may be geographically dispersed; e.g. one fleet unit could be at San Diego and one in Sydney, Australia, and they could participate in the same exercise through electronic linkages. DIS is the current mature standard for simulator interoperability and is used by BFTT. The US DoD has mandated that M&S projects be High Level Architecture (HLA) compliant. BFTT is currently migrating to HLA.
It is in both Australia's and the United States' interests to collaborate, since this will ultimately ensure that Australian Navy training systems both in the ships and ashore will be able to communicate with their US counterparts. The RAN could then participate in coalition training exercises with the USN in a series of exercises which might be termed Virtual RIMPAC. Through these two similar Programs, Australian and US researchers are sharing their experiences with DIS for naval training, including various difficult technical issues. This paper will discuss the issues from both the Australian and USN perspective, and outline a proposed collaborative R&D effort in the area of migrating to the newer HLA. Australian researchers have suggested a migration path for SEA 1412 which is similar to the BFTT migration path. At the higher level, both Australian and USN researchers are interested in investigating whether their systems will prove effective both from a cost and training perspective in delivering training to the RAN and USN, and how they endeavour to measure it.

AN ON-BOARD TRAINING SYSTEM FOR LPD-17

Grant John Gorton, CAE Electronics Inc

The LPD-17 is the Navy's next generation amphibious ship. Designed to carry Marines and all their support equipment anywhere in the world and land them with helicopters and air cushion landing craft. The ship has an integrated machinery control system (MCS) with consoles around the ship connected by a ships wide area network (SWAN). Any console can be shifted to "training mode", and the CORE database (CORE is not an acronym per se, it is the a term which refers to the basic software which resides in all consoles and includes data handlers, I/O handlers, initialization routines, etc.) of that console will be populated by the simulation in place of real data. The operator will then control the simulated equipment using the same HMI pages he has for real control. For team training, multiple consoles can be shifted to "training mode" with one console designated for use by an instructor, who will be able to initiate faults and equipment failures in the simulation, which the operator can then respond to. The instructor can also manipulate the simulation to modify the scenario presented to the trainee or to account for actions which would be do manually in real life. The system can be used for new operator training in the basics of machinery control, and refresher training in Engineering Operating Sequence System (EOSS) Operating and Casualty Procedures.

INTEROPERABILITY OF AIR COMBAT TRAINING SYSTEMS

Gayle Quebedeaux, Cubic Defense Systems

An innovative method has been developed to provide the necessary data to the F/A-18 wing tip weapon stations enabling interoperability with existing Rangeless Air Combat Training instrumented pods. Without any modifications to existing aircraft hardware or software, the Air Combat Training Interface Device (ACTID), embedded in the aircraft, gives the F/A-18 the capability of rangeless air combat training when fitted with the Rangeless Air Combat Training instrumented pod.

Rangeless instrumented pods, which use Global Positioning Satellite information, give air combat crews an instant training range – anywhere in the world – while eliminating the restriction to train over a designated geographical area. Digital aircraft data and weapon systems data is required by the rangeless pod in order to support air-to-air training and air-to-ground weapon scoring. The design of the F/A-18 aircraft does not provide a means of transferring digital data to an external pod, effectively prohibiting the use of rangeless air combat training systems.

ACTID was developed as an IR&D funded project to provide the digital data existing on the F/A-18 avionics multiplex data busses to the wing tip weapon stations. The uniqueness of the solution is that the data of interest for rangeless air combat training can be transferred to the wing tip weapon launcher using existing aircraft data bus wiring and a set of crossover cables installed for that purpose.

Previous Years Papers Available on CD

USING HLA FOR INTEGRATING WEAPONS ANALYSIS LETHALITY TOOL SET (WALTS) WITH LIVE FLIGHT RANGES AND VIRTUAL SIMULATORS

Jerry Szulinski
Defense Threat Reduction Agency / Cubic Defense Systems, Inc.

Accurate three-dimensional pre- and post-strike target visualization tools, such as the Defense Threat Reduction Agency's (DTRA) Weapons Analysis Lethality Tool Set (WALTS), provide a valuable addition to mission planning, the battle damage assessment (BDA) process, training, simulations and mission rehearsal. When struck, the 3D target models are dynamically repolygonized in near-real time using physics codes describing the weapon-target interactions. These models are then rendered for user inspection on the WALTS viewer or are passed to other rendering systems using the HLA methodology for further environment interaction.

Live Range data, when treated as a HLA federate, drives WALTS and, in return, WALTS provides for an enhanced after-action review and restrict/no-restrike training capability. Additionally, simulated weapons scoring can be used to quantify student performance during training and mission rehearsal. Finally, the HLA concepts allow for range objects and interactions, including the targets, to be visible to other federates. These federates can be other simulations or they can be display systems with varying levels of fidelity.

Another place for rendering these damaged targets is in the "out the window" scene of a virtual simulator. Virtual simulators are no longer limited to using pre-defined "damage states," i.e. 25%, 50% damaged, etc. Realistic damage visualization not only allows for an immediate and accurate feedback, but it also allows instructors to make restrike/no-restrike decisions on the fly while students are still immersed in their simulation. Mission rehearsal is one particular instance where this type of decision making becomes critical as the physics based weapon effects calculations guide us towards creating a more realistic and accurate synthetic environment.

HLA provides a good exchange mechanism for this type of integrated simulation. The WALTS federate can participate with a single virtual simulator federate, Live Range federate or as a part of a greater federation with several different types of federates: live, virtual and/or constructive.

IMPROVED BATTLE TRAINING THOUGH FBCB2 COMMUNICATIONS LINK WITH MILES 2000

Calvin Lombard, Physicist Michael Papay, Chief Engineer Dan Welsh, Project Engineer,TRW

Digitizing support and combat forces is the means by which the US Army will continue to maintain information dominance capability on the battlefield. However, only when it is used appropriately and efficiently will information dominance translate to force dominance. The digitized Army therefore requires digitized training. Together, the Force XXI Battle Command Brigade and Below (FBCB2) system and the Multiple Integrated Laser Engagement System (MILES) 2000 provide vital tools that permit combat training centers and home stations to train troops in the conduct of digitized warfare, as well as to impart an understanding about the employment of information dominance to affect force dominance.Currently, combat training facilities employ large numbers of human observers to collect and process truth data for entities involved in training exercises. The MILES 2000 family of training instrumentation gear provides direct fire engagement truth data. However, this data must be manually collected from each unit and centrally processed to support after action reviews. With the integration of a MILES 2000 communications interface into FBCB2, digitized training facilities can now make timely, far better use of truth data available during training exercises. Collection of unit and engagement truth data can now occur in real time, making it immediately available for processing and redistribution. This data is both generated and collected autonomously – simultaneously reducing the observer staffing and freeing up these observers to teach vital combat skills and to point out shortcomings as they occur. This paper addresses recent FBCB2 enhancements that provide MILES 2000 interface capability. Digitized training process improvements resulting from the MILES 2000 interface are highlighted.

Previous Years Papers Available on CD

TACTICAL DRIVER TRAINING USING SIMULATION "RECENT EXPERIENCES IN LAW ENFORCEMENT DRIVING SIMULATION

Reginald T. Welles and Michael Holdsworth, Ph.D., L.P.C.I-Sim Co.

Leading edge Commercial Driving Simulators are being employed by several police departments in the United States to help them cope with the expanding demand to improve their drivers' safety and proficiency. These simulators are being used in a variety of application areas: Basic Driver Decision Making, Tactical Driver Maneuvering, Hazard and Threat Awareness, Intersection Analysis, Improving Driver Multi-tasking Skills, Patrolling, Pursuit, Practice of Policies and Procedures, and Emergency Code 3 Response. The lessons learned by these police departments, i.e., Raleigh, NC, San Antonio, TX, West Covina, CA and several others, can provide an introductory look at the benefits, challenges, and techniques that work in a simulator-based, tactical training environment. This paper addresses those lessons learned from an operational and mission perspective. In addition, the technology is described. Simulator performance is defined in technical and human factors terms. Special emphasis is made to identify how the technology is used and its success in improving driver performance. Finally, a summary of successful simulator features and their corresponding value to desired performance is provided based upon police department results.

LOW COST TACTICAL TRAINER INSTRUCTION / TACTICAL TRAINING

Christian BIDAULT, Olivier GAUTHRON
THOMSON TRAINING & SIMULATION (France)

The capability of an Army to fight not only resides in the use of leading edge technology weapons, communications, command and control systems but also in the readiness of well trained troops and officers. This level of readiness requires appropriate staff training. However, the needs for such training at unit level are drastically different to that of individual / crew training.

This paper describes an innovative approach for the training of commanders of small armored or mechanized infantry units, company commanders or section/platoon leaders. It features a realistic virtual tactical environment, is capable to operate with a limited number of instructors and is easy to deploy for training at battalion facilities.

This tactical trainer (called SYSIMEV-IA) ordered by the French Army to THOMSON- CSF in Dec 98, will undergo experimental trials in the combat training center in MAILLY (France) at the end of 2000. The system design is resulting from a trade-off between cost, realism and fidelity to the real world. In this particular case, rather than seeking full fidelity in representing the trainee's environment, emphasis is put in reproducing the tactical environment of the commanders; in other words : simulation-relevant is what influences the trainees decisions. So, the main objective is to place the trainees in a situation as near as possible to a real battlefield, providing a tactical situation with immediate feedback capability (3D simulated sensors, tactical data links, 2D map presentation, simulated radio communications layer) and to train the trainees to react to unplanned events, take the initiative and make the right decisions.

The system architecture is based on PC-based 3D graphic desktop stations for trainees and role players, networked with a sophisticated constructive simulation PC server, and the exercise director /instructor / analyst PC stations. The constructive simulation is controlled in real-time by the instructors who activate the enemy, neutral, allied and flanking units. The role players carry out the orders from the trainees. The system can train company commanders or platoon commanders with their subordinate teams (trained role players).

This first application is planned to be followed by a tactical trainer for commanders of attack helicopters, and also to be experimented for combined arms tactical training using HLA/DIS networking interface capabilities within a simulation federation based on legacy simulations.

This paper will describe the operational objectives, system architecture, simulation technologies, and choices and trade-offs that led to this innovative concept.

Previous Years Papers Available on CD

AN EVOLUTIONARY APPROACH TO EMBEDDED TRAINING

Mike Riley
Raydon Corporation

Since the earliest days of armored vehicle simulation trainers, forward looking leaders and planners have envisioned the day when armored vehicle simulation training could occur on the combat vehicle rather than in a "simulator white box." The effectiveness of a training simulation system that could be embedded (fully enclosed) within a combat vehicle has been discussed and realized for years. Almost everyone has agreed that such an "onboard" system would be a tremendous leap ahead in simulation based training. However, the long awaited "breakthrough" of this leap ahead technology has not been forthcoming. The technology necessary for an embedded simulation system has, however, been steadily evolving forward, and very few within the simulation community have recognized this evolution. The evolutionary process has now created the technologies necessary to produce an embedded gunnery training system for an armored combat vehicle.

Until recently there have been two fundamental problems associated with embedding simulation systems into combat vehicles. The first problem has been the space constraints onboard combat vehicles versus the space required to accommodate the simulator's very large image generator and host computers. The second problem has been the direct view optical sighting systems on armored vehicles that make injection of virtual images very difficult, without modifying these sights. As simulation systems and combat vehicles have evolved (and will continue to evolve), they have grown more compatible. The disparity between space onboard a combat vehicle and the space required to house simulation hardware has diminished due to the miniaturization of image generator and host computer components. Also, as combat vehicle sighting systems have shifted away from optical sights to image projection sights like thermal, FLIR, and daylight TV, and as micro-display technology has improved there are now multiple means to project simulated images into or onto vehicle sights for realistic battlefield training.

There are numerous advantages to a simulator that is embedded within a combat vehicle. A simulation system onboard a combat vehicle will: (1) remove the crew from the artificial environment of current "simulator white boxes," (2) allow simulation training away from home station, (3) allow training aboard the vehicle while crews "sit and wait" during any number of circumstances, (4) allow rehearsals of missions in assembly areas prior to battles or onboard ships enroute to an area of conflict, and (5) tremendously reduce cost per system - almost no hardware is required.

BASELINING INTEROPERABILITY FOR MARINE CORPS AIR AND GROUND SIMULATORS: THE MARINE AIR GROUND TASK FORCE FEDERATION OBJECT MODEL (MAGTF FOM)

Mr. Steve Zeswitz
The Mitre Corporation

Ms. Christina L. Bouwens
Science Applications International Corporation

The United Stated Marine Corps Continues To Increase Its Reliance On Simulators To Prepare For And Augment Live-Fire Training. To Fully Capitalize On The Benefits Of These Simulators, They Must Be Applied To The Operating Forces Of The Marine Corps Identified Need For Collective, Combined Arms Tactical Training For Battalion, Company And Platoon Operations. To Date, This Training Has Been Marginally Enhanced Through The Use Of Simulators. However, Legacy Simulator Systems Were Designed To Support Specific Individual And Small Crew Training Objectives And These Systems Do Not Interact With Other Systems To Support Collective Training Or Mission Rehearsal. Advances In Simulation Technology, Specifically In The Area Of Distributed Simulation, Have Made It Technically Feasible For The Marine Corps Training Community To Explore Collective, Combined Arms Training Using Simulators. Recent Advancements In The High Level Architecture (Hla) Technical Specifications And Policy Implementation Show Hla To Be A Promising Approach For Achieving The Required Interoperable Environment.

This Paper Will Describe An Evolutionary Approach To The Development Of An Interoperable Environment That Is Being Considered By The Marine Corps For Future Generations Of Training Systems. The Described Activity Focuses On Developing An Interoperability Specification That Will Allow Soon-To-Be-Developed Training Systems To Be Designed For Interoperability To A Common Standard. A Demonstration Of The Collective Training Capability Is Planned That Will Assess Both The Technical Feasibility Of The Interoperability Approach As Well As The Military Utility Of The Resulting Training Capability. A Discussion Of Key Interoperability Issues Facing The Magtf Fom Development Effort Is Also Provided.

Previous Years Papers Available on CD

I/ITSEC 2000 Author Index

A

B

I/ITSEC 2000 Author Index

2000 Papers on CD-ROM

The I/ITSEC proceedings are produced on CD-ROM and contain all the papers for on-line reading, searching by keyword, and/or printing. Many papers contain drawings, color graphics, or color photographs, and some also have active WWW links. There is also a Quick Tip file which provides instructions for getting started and obtaining worldwide technical support.

1999, 1998, 1997, 1996 and 1995 Proceedings on CD-ROM

The previous years' proceeding CD-ROMs are available for $30 (USD) from National Training Systems Association (NTSA).

Contact:

NTSA
2111 Wilson Boulevard, Suite 400
Arlington, VA 22201 USA
1 800-677-6897
+1 703 247-2569
+1 703 243-1659 (fax)
www.iitsec.org

Engineering Provided by

ſſai

Simulation Systems and Applications, Inc.
info@simsysinc.com • www.simsysinc.com

CMPC

Computer Multimedia Productions Corporation
www.cmpc.com

2000 Papers on CD-ROM

The I/ITSEC proceedings are produced on CD-ROM and contain all the papers for on-line reading, searching by keyword, and/or printing. Many papers contain drawings, color graphics, or color photographs, and some also have active WWW links. There is also a Quick Tip file which provides instructions for getting started and obtaining worldwide technical support.

1999, 1998, 1997, 1996 and 1995 Proceedings on CD-ROM

The previous years' proceeding CD-ROMs are available for $30 (USD) from National Training Systems Association (NTSA).

Contact:

NTSA
2111 Wilson Boulevard, Suite 400
Arlington, VA 22201 USA
1 800-677-6897
+1 703 247-2569
+1 703 243-1659 (fax)
www.iitsec.org

Engineering Provided by

ſſai

Simulation Systems and Applications, Inc.
info@simsysinc.com • www.simsysinc.com

CMPC

Computer Multimedia Productions Corporation
www.cmpc.com