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2014 FELLOWS PAPER: METASIMULATION

2014 IITSEC Paper No. IF1401
Andy Ceranowicz
Alion Science and Technology
Harvard, MA

Simulation is used in an increasingly large segment of our scientific, economic, entertainment, and government activities. Its expanding influence makes it important to understand its strengths and limitations. However, each field specializes simulation for its problem domain making it difficult to agree on a common definition. In this paper, I survey the fundamental mechanisms underlying simulation and attempt to come closer to such a definition. In this quest, I have borrowed heavily from metaphysics, especially the concept of possible worlds from modal logic. I define a simulator as a device that uses deduction and sampling to incrementally create possible worlds. I define simulation analysis as the use of analogical reasoning to map actual or hypothetical target worlds to a simulator and the use of induction on the possible worlds produced by the simulator to make claims about the target world. The analogs that simulators are built on can be physical, human, symbolic, analog (computer), digital or hybrid. The construction of simulation analogs requires approximating the target world with a finite model bounded by means of inputs, state, and objects. Integration of small changes and sampling are the magic bullets that allow simulation to tackle problems that are impossible to solve by analytic means. Small changes decouple complex systems and sampling replaces the complexity of the general with the simplicity of the concrete. Parallel simulator design and its realization as a posteriori composition of simulators are reviewed. I find that advancing simulation time is not a necessary or sufficient criterion for identifying a simulator and that simulation is used widely by the human mind and probably by animals. It may even be the foundation of consciousness. Finally I examine a posteriori simulator composition and interoperability concluding that once it becomes technically viable, a priori composition will be a better approach.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320A
BP-1 - HSE, PSMA & Training

1030 Measuring Visual Displays’ Effect on Novice Performance in Door Gunnery (14012) (HSE)
1100 Proficiency Evaluation and Cost-avoidance Proof of Concept M1A1 Study (14055) (PSMA)
1130 Missing: A Serious Game for the Mitigation of Cognitive Biases (14295) (Training)

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MEASURING VISUAL DISPLAYS’ EFFECT ON NOVICE PERFORMANCE IN DOOR GUNNERY

2014 IITSEC Paper No. 14012

Dr. Jonathan Stevens
Army Research Laboratory (ARL)
Orlando, FL

Dr. Peter Kincaid
University of Central Florida (UCF)
Orlando, FL

The purpose of this paper is to present the results of our recent experimentation involving a novice population performing aerial door gunnery training in a mixed reality simulation. Specifically, we examined the effect that different visual displays had on novice soldier performance; qualified infantrymen with machine gun experience. The results of this study differed from the findings of our first study, which utilized an expert population of qualified helicopter crew members.

The U.S. Army continues to develop new and effective ways to use simulation for training. One example is the Non-Rated Crew Member Manned Module (NCM3), a simulator designed to train helicopter crewmembers in critical, high risk tasks. Novice participants were randomly assigned to one of two visual display treatments (flat screen or Head-Mounted Display) and executed three aerial door gunnery training scenarios in the NCM3. Independent variables were visual display, trial, immersive tendency and simulator sickness questionnaire scores. Dependent variables included performance, presence and simulator sickness change scores. The performance results of this study differed from our first study and indicated there was a main effect of visual display on performance. However, both visual treatment groups experienced the same degree of presence and simulator sickness. Results of this study indicate that higher immersive simulation may lead to better performance for a novice population.

PROFICIENCY EVALUATION AND COST-AVOIDANCE PROOF OF CONCEPT M1A1 STUDY RESULTS

2014 IITSEC Paper No. 14055

Robb Dunne
Innovative Reasoning LLC
Orlando, FL

Dr. Tim Cooley
DynamX Consulting
Larkspur, CO

Dr. Steven Gordon
Georgia Tech Research Institute
Orlando, FL

Evaluation of simulation-based training systems to determine their contributions to trainee proficiency and to determine the level of cost avoidance vice live training is essential to plan the future live-virtual-constructive training environment for the United States Marine Corps (USMC). This need is reinforced in a recent Government Accountability Office report (GAO 13-698, August 2013) on Army and Marine Corps Training titled Better Performance and Cost Data Needed to More Fully Assess Simulation-Based Efforts, which states that the Services “lack key performance and cost information that would enhance their ability to determine the optimal mix of training and prioritize related investments.” USMC Program Manager Training Systems (PM TRASYS) has conducted cost avoidance studies on USMC simulation-based training systems for the past 2 years, and these studies are being refined to capture improved cost information. A related study, begun in June 2013, evaluates the effects of USMC simulation-based training programs on proficiency. This paper presents the process, results, and recommendations of the recent PM TRASYS Proof of Concept (POC) study of measuring proficiency changes and cost avoidance due to use of the M1A1 Advanced Gunnery Training System (AGTS) simulator. For the POC, a group of consistent crews in initial AGTS training are monitored (without interference) through a sequence of 10 gunnery table tasks, with a total of 500+ task instances in the AGTS simulator, to the culminating live-fire tasks. Early session scores are compared to “Gate-To-Live-Fire” scores in the simulator, and these results are compared to the live-fire M1A1 qualification scores for these crews. Results of the POC are promising. The study finds that with performance-oriented metrics and measures, tied to doctrine and captured automatically, it is possible to determine both proficiency trending and cost avoidance. This paper also discusses lessons learned and provides recommendations and implications of findings for training system design.
The current study was designed to address the following research question: Can a computer game provide an effective mechanism for training adults to identify and mitigate their cognitive biases? Human decision making relies on a variety of simple heuristic decision rules that can be quick and effective mental shortcuts when making judgments. However, these heuristics can also lead to irrational thinking and problem-solving in ways that produce errors or illogicality, known as cognitive biases. Though knowledge of cognitive biases and bias mitigation strategies can help to reduce the potential impact of cognitive biases on human reasoning, such deeply ingrained cognitive strategies are difficult to alter. The current study was designed to leverage the virtual learning environment of a serious game to take on this training challenge. To that end, a training game – Missing: The Pursuit of Terry Hughes (Missing) – was developed. Missing was created for an audience of educated adults, and the described instructional design is based on current research on effective andragogical learning theory. The Missing game design immerses the user into bias-invoking situations which provide direct experience with cognitive bias identification and mitigation strategies. In this paper, details of the game instructional design are presented, including a cognitive framework based on dual-process systems of reasoning which relates multiple biases, their causes, and mitigation techniques. An external test campaign was conducted to determine whether the game had a positive transfer of in-game experiential learning about biases to real world skills and behavior change. Results are presented that suggest this novel serious game both engages and trains players, resulting in measurable reductions in cognitive biases.
INSTITUTIONALIZING BLENDED LEARNING INTO JOINT TRAINING: A CASE STUDY AND TEN RECOMMENDATIONS

2014 I/ITSEC Paper No. 14208

David Fautua, Ph.D.
Joint Staff J7, Joint Training
Suffolk, VA

Sae Schatz, Ph.D. & Patricia Bockelman
MESH Solutions, LLC™ (a DSCI® Company)
Orlando, FL

Emilie Reitz
Alion Science and Technology
Suffolk, VA

In 2011, the Joint Staff J7 (Joint Training) directorate initiated the Continuum of eLearning project in order to integrate blended learning into joint exercises. This three-year research and development effort included construction of both the blended learning instructional materials (e.g., best practices for online instructional delivery [andragogy] within Joint Knowledge Online) and the processes required to implement blended learning within the existing joint training enterprise. Although the capacity for blended learning has existed for decades, such large-scale institutionalization of it presented unique challenges, which have previously limited its use within the joint training community.

Joint Training personnel built the blended learning system iteratively, concurrently, and incrementally over the three-year project. We also systematically measured the effectiveness of implemented components. This paper presents an overview of this process as a case study for others, and it summarizes the results of the empirical testing. The paper builds upon two previous I/ITSEC presentations, each of which detailed separate portions of the ongoing project (i.e., effectiveness of blended online courses in 2012 and integration of a part-task team-training simulation in 2013). This paper adds to those earlier articles by presenting holistic project outcomes, along with previously unpublished data from the empirical trials. For instance, some notable results indicated that participants felt more confident performing their assigned tasks as a result. Finally, this paper includes ten recommendations for other organizations seeking to formally implement a blended learning system, including don’t assume that trainers know how to “blend” from an instructional perspective and to truly implement a robust blended learning system the organizational culture and its shared narrative about training must evolve.

FROM DESIGN TO CONCEPTION: AN ASSESSMENT DEVICE FOR ROBOTIC SURGEONS

2014 I/ITSEC Paper No. 14170

Alyssa Tanaka, M.S.
Florida Hospital Nicholson Center
Celebration, FL

Manuela Perez, M.D.
University Hospital of Nancy
Nancy, FR

Mireille Truong M.D. & Khara Simpson M.D.
Columbia University Medical School
New York, NY

Gareth Hearn & Roger Smith, Ph.D.
Florida Hospital ISA, Florida Hospital NC
Orlando, FL, Celebration, FL

The daVinci Surgical System offers surgeons improved capabilities for performing complex minimally invasive procedures; however, there is no standardized assessment of robotic surgeons and a need exists to ensure that a minimal standard of care is provided to all patients. The Department of Defense and governing surgical societies convened consensus conferences to develop a national initiative, resulting in a curriculum called the Fundamentals of Robotic Surgery (FRS). FRS is comprised of an online curriculum and a psychomotor skills dome.

This paper describes the production process used to create a psychomotor skills assessment device - the FRS Dome. The device was designed to measure the essential skills that are required of any robotic surgeon and to provide a basis upon which to grant or deny privileging with the robot. It was constructed to test seven tasks of manual dexterity: Docking, Ring Tower Transfer, Knot Tying, Suturing, 4th Arm Cutting, Puzzle Piece Dissection, and Energy Dissection.

The initial design of the device was created by a committee of experienced minimally invasive surgeons, with a background in testing protocols and materials. The design was rendered in computer animation, which kickstarted a prototyping effort with physical materials. These included platinum cure silicone approximating human tissue and a 3D polyjet printer for the structural framework. Usability testing was conducted and iterative modifications were made to improve ergonomics, standardization, and cost requirements. Final CAD diagrams and specifications were created and distributed to medical and simulation companies for both physical and digital manufacturing. This development process demonstrates the evolution of a simulation and a physical testing device based on international expert consensus. The specifications are open source, allowing competitive production and future iterations. The goal of this paper is to discuss how this device evolved from an idea to a manufactured product and a digital simulation.
EXPLORATION OF SOLDIER MORALE USING MULTI-METHOD SIMULATION APPROACH

2014 IITSEC Paper No. 14215

Mariusz Balaban, Dr. Thomas Mastaglio
MYMIC LLC
Portsmouth, VA
Dr. John Sokolowski, Dr. Barry Ezell
Old Dominion University
Norfolk, VA

Soldier morale is a complex social construct influenced by factors at multiple levels and integrates many research domains. Performance of soldiers can be influenced by morale, but the degree of this effect is difficult to assess and map back to strategic, operational, and/or tactical decisions based on current research approaches. Physiological and psychological factors related to low morale can lead to undesirable behaviors like suicides, substance abuse, and accidents. The current approach to measuring soldier morale is often based on a single point estimation limiting dynamic perspectives on this phenomenon. This may also impact similar exploratory studies - due to insufficient data for validation of model causalities. The simulation-based work found in the literature focuses on a single level of analysis and uses the System Dynamics method, which overly reduces scope and detail necessary for capturing related dependencies even if more data were available. This research seeks to explore, model, and simulate soldier morale at multiple levels of analysis. The developed sample case scenario pertains to US security efforts against insurgency in Afghanistan in 2007. The scenario includes representation of the patrol base operations serving as a platform for calibration and exploration of factors affecting soldier morale and its relationship with sample performance measures. The developed proof-of-concept simulation model was used for testing the effect of both size of patrol base and violence level on soldier morale. The model can serve as a platform for evaluation of decisions during surges and deployments that pertain to system structure, scheduling, and policies.

TUESDAY, 2 DECEMBER, 2014 ROOM S320E
ED-1 Designing Educational Games

1400 Transmedial and Paramedial Serious Game Deployment (14375)
1430 Effectiveness of Embedded Game-Based Instruction: A Guided Experiential Approach to Technology Based Training (14198)
1500 An Experiment to Evaluate the Effect of Narrative Delivery in Military Training (14081)

NOTES
Despite extensive research, training to overcome cognitive biases has proven largely ineffective. Critical decision-making in the face of uncertainty is difficult because participants employ heuristics that are unconscious and subtle, but which can produce very serious impacts. It has often been demonstrated that even cognitive bias experts make judgment errors by falling prey to the very biases they study (Heuer, 1999). Our team designed and developed a video game to teach cognitive bias recognition and mitigation as an alternative to current classroom methods. Then we performed an empirical study of that game’s learning and training efficacy. The results indicated that the game was effective for learning, but impacts on biased behavior were inconsistent for the different cognitive biases addressed by the game. Additional training aids to reinforce the game learning may be critical in order for it to reliably supplant higher education courses in cognitive thinking. This paper provides a high-level overview of the project and the particular cognitive biases taught in the game. We discuss the blend of instructional theories, techniques, and media used in the game and the results of our effectiveness study. The paper describes the transmedia training package we created to provide a variety of out-of-game experiences which show promise for increasing the learner’s ability to mitigate these cognitive biases. This training package provides: a) an ongoing reminder to apply their new knowledge and skills; b) additional practice honing their skills; and c) refresher training to reduce knowledge and skill decay. The use and ratios of the in-game transmedia types and the use of out-of-game transmedia has not been studied yet. The paper concludes with suggested research of the effectiveness of post-learning transmedia.

Game-based technologies are being increasingly leveraged by the military for training purposes. However, despite their perceived contribution, games are rarely empirically evaluated for their training effectiveness nor used to their full potential. Instead games are often implemented as practice environments alone, lacking instructional capabilities that are known to lead to more effective training (Clark, Yates, Early, & Moulton, 2007). In an effort to integrate evidence-based instructional design into serious games, effectively “bringing the classroom into training games,” the U.S. Army Research Institute collaborated with Soar Technology to develop a training game for course-of-action analysis (COAA) based on the Guided Experiential Learning (GEL) Model (Clark et al., 2010). Course of Action Analysis (“Wargaming”) involves step-by-step human simulation and evaluation of a course of action. The game-based instruction (GBI) COAA prototype includes part/whole task practice, field-based problems, demonstrations, and guided practice. These methods are prescribed by GEL, which is based on Merrill’s principles of instruction (Merrill, 2006). To explore the effectiveness of this approach, Soldiers were run through a study to compare the use of the GBI COAA prototype to a control that approximates how games are typically used in simulation centers (i.e., upfront instruction, practice without guided feedback, AAR/post-training feedback). Assessments included usability, attitudes toward technology, and training effectiveness/efficiency (e.g., number of errors). The goal of this evaluation was to determine whether the method used in the COAA tool is more effective and efficient when compared to current training practices. Findings support the use of embedded instruction in games; a significant decrease in the number of errors was found for Soldiers exposed to game play that featured the GEL model of instruction compared to Soldiers who had traditional training. These results will help guide future development of game-based instruction environments and provides support for the continuing use of games in training.
AN EXPERIMENT TO EVALUATE THE EFFECT OF NARRATIVE DELIVERY IN MILITARY TRAINING

Mark Lewis
Centre for Simulation and Analytics, Cranfield University, Defence Academy of the UK
United Kingdom

Prof Robert J. Stone
University of Birmingham
United Kingdom

The use of serious games in military training has now become commonplace. However, unlike most commercial entertainment games, explicit “storylines” (as portrayed in, for example, cut scene inserts) are rarely used to introduce games-based training simulations. A storyline constitutes an information-rich framework for the structuring of learning content delivery, networked episodes, tasks and activities. It follows a narrative and pedagogical outline with reference to key questions, learning tasks, activities, resources, media and cooperative interactions. A game-based simulation study was undertaken using undergraduate Defence Technical Officer and Engineer Entry Scheme students from the UK universities of Birmingham and Aston. Based around cultural awareness training, a core scenario and narrative were developed to teach participants how to interact with a fictional civilian population.

The experimental aim was to investigate if the method of narrative delivery had a direct impact on the student’s learning performance. Using one of three delivery styles (“passive”, “semi-active” and “active”), the narrative took the form of (a) a paper brief, (b) a (military) instructor-led presentation, (c) a short paper brief followed by an interactive but predominantly scripted first-person (FP) simulation scenario, and (d) a fully interactive FP scenario. Participants were then exposed to a similar FP scenario in which they had 20 minutes to achieve the objective of intercepting an insurgent. In addition, subjective measures of participant learning style were obtained to investigate whether or not different styles might have some bearing on the impact of specific narrative delivery method.

This paper presents the early findings of this study, which is sponsored by the UK’s Defence Science and Technology Laboratory (dstl).
MODELING AND SIMULATION CHALLENGE PROBLEMS IN HIGH SCHOOL CLASSROOMS AND INTERNSHIPS: LESSONS LEARNED

2014 I/ITSEC Paper No. 14103

Jennifer Winner
Lumir Research Institute, Inc.
Dayton, OH

Kimberly Puckett & Leesa Folketh
Tri-Village Local School District
New Madison, OH

Amelia Malone
University of Maryland College Park, MD

Jerred Holt
Lumir Research Institute, Inc.
Dayton, OH

The use of modeling and simulation is widespread across scientific and engineering disciplines and all branches of the United States military utilize modeling and simulation for training, testing, and developing next generation capabilities. Despite this reality, modeling and simulation is largely absent from high school classrooms. Through the use of game-based technology challenges, our team has implemented three years of internship experiences and developed high school M&S content as a way to get learner buy-in and engage students. The Air Force Research Laboratory’s Gaming Research Integration for Learning Laboratory has hosted educators, student interns, and mentors since 2011. In this paper we describe the history and evolution of this program which introduces high school students to modeling and simulation, problem-based learning, and provides models of the types of problem-solving capabilities required for working in the defense industry. We review and discuss observations from summer internships and high school classrooms and present anecdotal evidence on student outcomes. Further, we discuss lessons learned with regard to student motivation and teacher education and training as well as future measurement of the program’s effectiveness. Observations made to-date suggest that for students who have already achieved academic excellence in high school, substantial gains may be made through short-term internships such as a summer appointment. For students at risk of excluding themselves from science and technology-related career paths, modeling and simulation content has potential to motivate students to address any gaps in their completion of prerequisite courses they will need to move forward. Successful integration of modeling and simulation content within a classroom requires a substantial time investment in the teaching staff but through consistent support, teachers are able to develop the baseline level of comfort and proficiency with the content to support the students in their exploration of the technologies.

USING UNITY TO IMPLEMENT A VIRTUAL CRASH SITE INVESTIGATION LABORATORY IN SUPPORT OF DISTANCE LEARNING OBJECTIVES

2014 I/ITSEC Paper No. 14050

Christina Tucker & Jimmy Moore
Pinnacle Solutions, Inc.
Huntsville, AL

The purpose of this paper is to describe the use of Unity to develop an interactive virtual environment to support distance learning in a higher education curriculum. Online and distance learning has become a viable delivery method for course content in higher education and is continuing to gain acceptance and popularity as students and faculty become more comfortable with this medium. The demand for online learning and the emerging requirement to have students bring their own devices to the classroom is also driving a need for innovative methods of instruction. This paper discusses the need to utilize a virtual crash site for the Embry Riddle Aeronautical University (ERAU) - Worldwide Master's-level Crash Site Investigation course and the decision to utilize the Unity gaming engine for its implementation. Many obstacles had to be overcome during the development and implementation of the virtual laboratory environment to ensure that it provided an effective learning environment for students, and that it is engaging, useful, and intuitive enough for students who are not “gamers.” A set of course objectives was provided by staff members of the College of Aeronautics from the school’s eLearning sector. These objectives were then transformed into a concrete set of requirements to be used as the basis of development. Derived requirements were developed to define how to meet these objectives in the virtual world. This paper will address why Unity was chosen for the development environment; it will discuss the different capabilities of the lab desired to meet the course objectives (including tasks like taking photographs and measurements, diagramming the crash site, and interviewing witnesses); and how the course is being made available to students. The Virtual Crash Site Investigation Laboratory is currently in its pilot course; therefore, data showing the effectiveness of the course is not available. However, feedback from staff and technology personnel has been positive. Once the course is complete, student surveys and instructor feedback will be collected to determine the aspects of the class that were well received, as well as any issues that need to be addressed.
DEVELOPING THE SIMULATOR INSTRUCTOR’S PEDAGOGICAL COMPETENCE
2014 I/ITSEC Paper No. 14043

Peter Sjoestedt
Royal Danish Defence College
Copenhagen, Denmark

The full benefits of investment in simulator-based training are achieved only when development of the simulator instructor’s pedagogical competence accompanies the acquisition of advanced technology. In spite of this, the instructor’s pedagogical competence often is not well developed. Courses for simulator instructors that address their experiential instructional skills and their understanding of adult participants' learning processes are rare. Lessons learned about the instructor’s role that focus on the relationship between instruction and learning are seldom reported. Simulator instructors’ pedagogical competence appears to be an area afforded insufficient attention from the simulation community.

Based on lessons learned from our four-day pedagogical course for naval simulator instructors in the Danish armed forces, this paper presents a framework for instructors’ pedagogical competence development. It explains why the subjects of the course are 1) the instructor’s various feedback tasks, 2) knowledge about how to ask questions, 3) the likelihood of conflicts and how they can be managed and 4) cooperation between the learners and the instructor as a leader and facilitator of learning. The paper addresses how this course – based on the particularly experiential nature of simulator-based training – differs from general courses on teaching and instruction. The participants’ reactions are reported and discussed and finally, possible adjustments and perspectives for the future of the course are outlined.

The purpose of this paper is to make those teachers and leaders responsible for simulator-based training aware of the value of pedagogical competence development and to provide inspiration for how a course can be planned in their academies and organizations.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320E
ED-3 Building It Right

1400 An Instructional Media Selection Process for Virtual World Training Delivery (14369)
1430 Developing the Human Dimension: Current Practices and Future Methods (14161)
1500 Hey, Your E-learning Courses are Giving Me a Cognitive Overload (14008)

Notes
AN INSTRUCTIONAL MEDIA SELECTION PROCESS FOR VIRTUAL WORLD DELIVERY

2014 I/ITSEC Paper No. 14369

Leslie A. L. Mazzone  Anh Bao Nguyen
Submarine Learning Center  Navy Undersea Warfare Center
Groton, Connecticut  Newport, Rhode Island

The U.S. Navy has recently focused on improvements to training techniques with reduced resources. Strategies to meet this goal include evaluating the necessity of each course, determining if each learning objective is required, and examining if efficiencies can be met through a reduction in training time or through the use of advanced training technologies. Within the last few years, Submarine Learning Center (SLC) and the Naval Undersea Warfare Center (NUWC) have been exploring the use of virtual world technology to cope with declining resources. The primary focus has been on the technological capabilities within a restrictive environment in which the protection of data networks drives training technology acquisition. Having addressed the technological issues, SLC is prepared to consider virtual world technology a viable alternative to delivering some of the 300 submarine courses. These courses are unique in that most are classified and rely on use of actual training hardware at full fidelity. A downside to current training hardware is that the submariners must go to the physical location to obtain training. The virtual world technology that SLC plans to implement allows the submariners to use these trainers without having to travel to their physical location. This paper presents a process that facilitates the selection of the best course candidates for conversion to virtual world technology. General factors considered include course length, site distribution, and the characteristics of the course. For courses that include the use of training hardware, factors considered include the degree of virtual world equipment fidelity, environment fidelity, and sensory fidelity required. Purposeful media selection is an important part to reducing training resources while improving training. The instructional media selection process presented in this paper can be implemented by a larger community faced with deciding which courses are the best candidates for virtual world conversion.

DEVELOPING THE HUMAN DIMENSION: CURRENT PRACTICES AND FUTURE METHODS

2014 I/ITSEC Paper No. 14161

Michael Prevou, Ph.D. & Laurie B. Waisel, Ph.D.
Strategic Knowledge Solutions, Inc.
Leavenworth, KS

The strategic white paper “Winning the Clash of Wills” declared that better integration of the human domain into military plans and operations is essential to achieving overarching national security objectives. The human dimension reaches beyond simply equipping soldiers with language, culture, moral, and physical skills and must focus more on the subtle cognitive components. While training develops skills and techniques through practice and observation, educating leaders must emphasize the development of new competencies that apply critical thinking and reasoning skills, strategies for problem solving under pressure, and cooperative leadership styles. But Army doctrine does not tell us how to achieve this; it tells us only that we must develop the triad of moral, physical, and cognitive components of the human dimension. Meanwhile, the emerging Army and Air Force learning models call for continuous, adaptive learning using operationally relevant training scenarios to provide outcome-oriented instruction and leveraging informal and formal training opportunities. Exactly how this can be done is the subject of this paper.

This paper describes one of two case studies that provide insights into how to achieve improved learning outcomes using an adult learning model that emphasizes Critical Moment Strategy and experiential learning as espoused by Army Learning Model (ALM) 2015 and emerging Human Dimension doctrine. The paper then describes a future state methodology for course design structured to develop self-aware and adaptive leaders. The case studies use simulations, games, and vignette-based exercises that put the learner “in the moment,” continuously changing variables to teach soldiers to think critically and out-of-the-box. This methodology is easy to replicate and uses a set of thinking exercises (cognitive battle drills) to reinforce effective thinking habits in tactical situations by applying deliberate practice to leaders’ thinking skills. The paper also outlines an Experiential Learning Model that addresses different learning styles and turns traditional classroom methodologies upside down.
HEY, YOUR E-LEARNING COURSES ARE GIVING ME A COGNITIVE OVERLOAD

2014 IITSEC Paper No. 14008

Commander Geir Isaksen,
Norwegian Defense University College
Oslo, Akershus

Like many large organizations, the Norwegian Armed Forces rely more and more on e-learning to deliver cost-effective and high-quality learning to their employees. The main distribution method is through learning management systems and varies from low-cost courses, based on text and graphics, to more expensive productions containing video and advanced interactivity. A continuous drawback however is the fact that many of the students do not complete all of the courses they have registered for, which is often called “dropout.” The dropout rate varies from below 10% to over 50% in some courses. In a typical e-learning environment, the learner will go through the course alone, on a personal computer, with no contact with a teacher or a tutor.

This paper presents the findings from a first years’ thesis conducted as a part of master’s program in information computer technology & learning. It examines how the use of multimedia in e-learning courses might influence learner dropout. Research suggests that used incorrectly, multimedia can contribute to a so-called cognitive overload for the learner. This again can influence learner retention and decrease motivation, ultimately leading to dropout.

Recommendations from leading theories and research are used to analyze four different e-learning courses from the Norwegian Armed Forces and discuss any relevance between the theories and the dropout rate of each course. This paper summarizes the findings and delivers concrete recommendations on how to build e-learning course in the future, to minimize student dropout.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320E
ED-4 Practice What You Preach

1600 Rediscovering the Eightfold Path: Some Observations on using Simulation for Training and Evaluation from Afghanistan (14196)

1630 Mobile Instructional Strategy Templates for Guided Mobile Content Development (14194)

1700 Are They Mission Ready? Using the Modified Angoff Method to Set Cut Scores (14060)

Notes
**REDISCOVERING THE EIGHTFOLD PATH: LESSONS LEARNED IN EMPLOYING SIMULATION FOR TRAINING AND ASSESSMENT IN AFGHANISTAN**

*2014 I/ITSEC Paper No. 14196*

Christopher Huffam PhD  
Canadian Defence Academy  
Kingston, Ontario

In developed countries, selection of simulation technologies is based on intended use, planned content and resources available. In these settings, choices of simulation for training or competency assessment are only limited by time, expertise and resource availability. In failed state settings such as Afghanistan, the use of specific technologies, the availability of support infrastructure, and cultural considerations (including baseline educational skills) are factors in selection and use, as the available approaches to the delivery of content and use of simulation to support learning and assessment may be limited by the circumstances of place. This situation results in unique challenges to the provision of education and the rebuilding of training and educational institutions, with occasional novel solutions to defined obstacles to effective training and competency assessment. Examples discussed range from purely cultural (such as Dari having one word and related concept for the English equivalents of Task, Job and Occupation), a consideration which has significant impact on initial training and subsequent assessment of individual capability, to more technically complex issues. This paper will discuss a sample of the lessons learned in training delivery and assessment of student capabilities for the Afghan National Police (ANP). The information included is drawn from a combination of onsite personal observation in Afghanistan by the author between July 2013 and March 2014, Training Assessment Team reports for training conducted before and after handover to local authorities by the NATO Training Mission – Afghanistan (NTM-A) for the 13 enduring Provincial Training Centers. It includes information drawn from interviews with staff from NTM-A, the Europe-an Union Police Mission in Afghanistan (EUPOL), German Police Project Team (GPPT), the International Police Coordination Board (IPCB), and relevant findings from the NATO lessons learned repository for that same period. This information was collected during the final nine months of the Canadian contribution to the International Security Assistance Force (ISAF).

**MOBILE INSTRUCTIONAL STRATEGY TEMPLATES FOR GUIDED MOBILE CONTENT DEVELOPMENT**

*2014 I/ITSEC Paper No. 14194*

Peggy Kenyon & Helen Remily  
U. S. Training and Doctrine Command  
Ft. Eustis, VA

Dennis Wikoff  
Adayana Vice President of DoD Programs  
Falls Church, VA

Mobile learning (mLearning) is an evolving field that introduces exciting capabilities and challenging complexities into the learning-design process with limited guidelines to steer mLearning designers. The promise of true anytime, anyplace learning compels decision makers to make learning content available on mobile platforms immediately. However, without the appropriate research to rethink and redesign learning methodologies targeted for mobile platforms, many training practitioners are simply shrinking the screen size of learning content for mobile devices. Such conversions do not actualize the full potential of the mobile platform and may result in learners’ rejecting the content.

The Advanced Distributed Learning (ADL) MoTIF project focuses on a practical understanding and applicability to real-world design projects for mLearning. At present, the early stage of the ADL research is examining the issue at the macro level of general learning theory and a mLearning framework. The available research provides “how-to” guidance that instructional systems designers (ISD) can use to develop their own instructional strategy approaches to mLearning, but the budgets and schedules of most mLearning development projects usually constrain ISDs from completely following the how-to guides through analysis, design, and development of instructional strategies that consider how users interact with mobile devices and take advantage of technology available in those devices. Improving fielded mLearning requires the application of the existing research on effective mLearning models to create a library of reusable mobile instructional strategy templates. This paper proposes how the ADL macro research findings can be coalesced into a library of useable instructional strategies or instructional interactivities that can be used by mLearning developers to create effective learning modules. Strategies will be coded as reusable templates and incorporated into the Army Enterprise Content Development Capability authoring framework for rapid prototyping and distribution to the Army user community.
ARE THEY MISSION READY? USING THE MODIFIED ANGOFF METHOD TO SET CUT SCORES
2014 IITSEC Paper No. 14060

Ingrid Mellone, Carol Faben
Camber Corporation
Orlando, Florida

Formal assessment is well established in the military and government for applications such as initial selection, promotion, and end-of-course training. For end-of-course assessments of lengthy and/or critical training, it is particularly important for leadership to be confident in the passing score required. Qualified people must not be excluded from passing, and unqualified people should not pass. Yet currently, required passing scores for criterion referenced tests are often set using arbitrary methods. Although such methods may take into account the criticality of the content overall, they do not use a detailed enough description of job performance requirements to establish “minimally acceptable levels.”

This paper describes the importance of establishing a rational passing score, or cut score, and several ways of establishing cut scores, focusing on the Modified Angoff (MA) method. This widely used conjectural method has been adjudicated in the courts and is therefore considered defensible. The MA method features a group of informed judges independently estimating what proportion of minimally qualified test takers will correctly answer each test question. Advantages and disadvantages of the method are discussed, as well as factors in its successful application. The authors have employed the MA method for several years on behalf of the Veterans Benefits Administration (VBA) Skills Certification program, a system of Congressionally mandated, high-stakes certification tests. Although the MA method may be applied to a variety of assessment tests and formats, the VBA tests are comprised of multiple choice and similar test item formats, and are delivered online. The process used to collect judges’ estimates is discussed, including the frame-of-reference training provided, the technology supporting the intake of ratings, and the computation of cut scores for these tests. Compared with arbitrary methods, the MA method provides greater assurance that those who pass are, indeed, qualified to pass.

THURSDAY, 4 DECEMBER, 2014 ROOM S320E
ED-5 Is Skill Development Your Specialty?

0830 Retention and Retraining of Integrated Cognitive and Psychomotor Skills (14220)
0900 Retention and Retraining of Integrated Cognitive and Psychomotor Skills (14220)
0930 Assertiveness and Responsiveness in Teams: Essential for Mission Command (14197)

Notes
RETENTION AND RETRAINING OF INTEGRATED COGNITIVE AND PSYCHOMOTOR SKILLS

2014 I/ITSEC Paper No. 14220

Anna Skinner
AnthroTronix, Inc,
Silver Spring, MD

Maintenance of specialized skills during periods of nonuse presents a significant challenge across multiple domains, and is most relevant within applications in which skill degradation is common and has significant negative consequences, as is the case within high-risk task environments typical of the military and medical domains. Few studies have examined retention of complex skills that integrate multiple skill components involving cognitive, psychomotor, and perceptual subskills. As a result, little is known about the nature of skill decay for performance of many military and medical tasks, and the military medical/surgical domain presents an especially problematic construct with respect to skill decay due to the nature of deployment cycles. For example, specialized medical skills such as laparoscopic surgery (LS) skills, which involve integration of underlying psychomotor and cognitive/perceptual skill components, often are subject to decay during deployments in which military surgeons primarily practice open procedures. A need has been identified for research and development to support prevention of LS skill attrition, as well as subsequent retraining. This experiment empirically assessed the relative retention of psychomotor and cognitive skill components within an integrated task relevant to LS, as well as in isolation, following a 3-week retention period. Results demonstrated significantly greater skill decay for the integrated task than the cognitive task, and no significant decay for the psychomotor task, suggesting greater decay overall for the constituent skills within an integrated context. This study also assessed the comparative effectiveness of video-based retraining to hands on retraining of the integrated skill. Results indicated significant skill recovery for both the video-based and hands-on retraining groups based on mean trial time and cognitive subtask component accuracy, with no between groups differences detected. Results are discussed within the context of training strategies to detect and reduce skill decay within LS as well as other complex task domains.

AN INDIVIDUALIZED APPROACH TO REMEDIATING SKILL DECAY: FRAMEWORK AND APPLICATIONS

2014 I/ITSEC Paper No. 14229

Roberto K. Champney, Erin G. Baker, Tarah N. Schmidt-Daly, Kay M. Stunney, Kelly Hale, Richard Long, George Chadderdon
Design Interactive
Oviedo, FL

Julie Jacko, François Sainfort, Jit Chan, Andrew Nelson
BioMedical Metrics, LLC
Golden Valley, MN

Physicians predominantly use self-monitoring to assess and maintain skill proficiency, and to determine when refresher training is required. However, strikingly low correlations exist between physician self-assessments and observer-expert ratings. In addition, in many military and civilian positions, training and education schedules are often standardized and rigid, potentially leading to wasted resources on training that is not needed for those that remain proficient at needed skills. In order to optimize training, there is a critical need for adaptive learning systems that can objectively measure, and preemptively or timely refresh knowledge and support skill maintenance. This paper outlines challenges associated with objectively quantifying skill decay within the medical domain. Requirements for a skill decay framework are summarized based on identified challenges, and a preliminary Skill-DETECT (Degradation Evaluation Toolkit for Eliminating Competency-loss Trends) framework is presented. This Skill-DETECT framework uses objective data to tailor an education and training program to a user’s specific needs. The current application of the Skill-DETECT framework is developed within a medical environment, and utilizes electronic medical records generated by a physician, as well as real-time cognitive assessment data to suggest recommendations on individualized, optimized retraining regimens to reduce the likelihood of skill decay.
ASSERTIVENESS AND RESPONSIVENESS IN TEAMS; ESSENTIAL FOR MISSION COMMAND

Hilde T.A. van Ginkel, Rendel D. de Jong, Mandy G. van de Velde
Utrecht University
Utrecht, The Netherlands

John W. van Buren, Richard G. Oppelaar
Royal Netherlands Navy
Den Helder, The Netherlands

Though differences in rank within military teams help to define responsibility, they may hamper necessary bottom up communication, jeopardizing performance and safety. In aviation, lack of bottom up communication was attributed to lack of assertiveness in junior team members, providing them with assertiveness training as a consequence. However, failing upward communication may not only be related to junior member’s characteristics but also to lack of responsiveness of the senior member. It was the purpose of this study to examine the connection between rank, assertiveness, responsiveness and team potency as indicator of effectiveness in teams.

Data were provided by 67 military crews, consisting of pilot and observer, during training-missions in a Naval Helicopter high fidelity simulator. In a post-flight questionnaire, both crewmembers provided ratings of the other member’s assertiveness and responsiveness, and gave their own rating of team potency.

Results show a negative impact of pilot’s rank on observer’s assertiveness, while observer’s rank was not related to pilot’s assertiveness.

The higher the pilot’s rank, the higher the observer’s responsiveness, and the lower his own responsiveness, both irrespective of observer’s rank. The higher the observer’s rank, the more responsive the pilot was, again, irrespective of the pilot’s rank. Both crewmembers’ rank was related positively to their own rating of team potency, but not to the rating by the other member.

A consistent positive connection was found between responsiveness and team potency; pilot’s responsiveness was related positively to team potency as indicated by the pilot as well as the observer. The same pattern was found for the observer’s attributed responsiveness.

These results confirm that responsiveness is essential in multi-rank military teams, with important consequences for Mission Command. Therefore, it is incorporated into existing initial and advanced RNL Navy Crew Resource Management training, to enhance mission readiness in our Navy and Marines.

THURSDAY, 4 DECEMBER, 2014 ROOM S320E

ED-6 Automatic for the People: Content Alignment for Instructional Performance

1330 Tailoring Multimedia Instruction to Soldier Needs (14049)
1400 Automated Content Alignment for Adaptive Personalized Learning (14068)
1430 An Army Learning Model Implementation: Challenges, Successes, Future Directions (14153)

Notes
TAILORING MULTIMEDIA INSTRUCTION TO SOLDIER NEEDS

2014 I/ITSEC Paper No. 14049

Thomas Rhett Graves, Ph.D.  
U.S. Army Research Institute  
Fort Benning, GA

Paul N. Blankenbeckler, Richard L. Wampler  
Northrop Grumman Technical Services  
Columbus, GA

To address particular learning needs, instruction should be designed to provide the right information to the right learner at the right time. While interactive multimedia instruction can reach a large audience, different learners have different learning needs. In this research, three questions were addressed: (a) how could existing Army interactive multimedia instruction (IMI) be modified to a needs-based format, (b) what types of instructional design techniques could be applied to design IMI for learners’ specific needs, and (c) what outcomes are associated with different types of needs-focused IMI? Following a survey of existing Combat Arms IMI, it appeared that most would require modification for reuse in a needs-based context. Six IMI exemplars were developed for two topics (i.e., Adjust Indirect Fire and Conduct a Defense by a Squad) targeting the learning needs of new squad or team leaders. The IMI were developed for three needs-focused conditions to test whether learners with differing levels of prior knowledge and experience performed better with different types of IMI. One condition was tailored training, and the other two were not tailored, and were designated as familiarization and core/refresher training. The exemplars were tested with Soldiers attending the Warrior Leader Course at Fort Benning. In all conditions, Soldiers showed higher test scores after training. However, for the less familiar topic, the greatest impact was found for the tailored training condition over non-tailed familiarization and core/refresher training. The familiar topic showed no differences among needs-based conditions. These results indicated that structure is necessary for novel material to mimic what learners naturally do with familiar material. To effectively modify IMI to a needs-based format, one needs to define the learning needs of the specific audience up front and to structure the IMI to support individual choice and flexibility.

AUTOMATED CONTENT ALIGNMENT FOR ADAPTIVE PERSONALIZED LEARNING

2014 I/ITSEC Paper No. 14068

Elliot Robson  
Eduworks  
New York, NY

Robby Robson  
Eduworks  
Corvallis, OR

Effective learning interventions (online courses, SIMS, live instruction, and self-directed activities) must be strongly aligned with instructional goals. Programs such as the Personal Assistant for Learning (PAL) being developed by the US Advanced Distributed Learning initiative and the Generalized Intelligent Framework for Tutoring (GIFT) developed by the Army Research Lab (ARL) emphasize the Government’s investment in learning interventions that adapt to learner goals and preferences. To be practical, such systems must automatically detect and align digital content and other learning intervention with learning goals.

The research reported here addresses one step in this process. It is part of the larger integration effort between GIFT and Tools for the Rapid Development of Expert Models (TRADEM), supporting the efforts and goals of the Army Research Lab (ARL). This paper presents techniques that automatically use a set of text-based features to detect pedagogically appropriate topics. These techniques are part of an attempt to automate portions of the front-end analysis and design steps in the tradition “ADDIE” (analysis, design, development, implementation, and evaluation) [Branson et. al., 1975] approach to content creation. This paper sets the context for this work, describes the tech-niques and algorithms used, and provides data that shows that auto-detection performs well when reviewed by and compared to hand-generated mappings by instructional design experts.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
AN ARMY LEARNING MODEL IMPLEMENTATION: CHALLENGES, SUCCESSES, FUTURE DIRECTIONS

2014 I/ITSEC Paper No. 14153

Camilla Chavez, Scott Flanagan, William R. Bickley, Krista Ratwani, Courtney Dean, Fred Diedrich

The Army Learning Model (ALM) focuses on developing Soldiers over time using a variety of “Soldier-centered” methods in a range of settings that foster 21st Century Soldier Competencies (e.g., initiative, critical thinking). Such competencies are critical for enabling a high degree of operational effectiveness in the context of Unified Action/Full Spectrum Operations. Achieving the ALM’s vision requires changes to Army training including instructional approaches and technology applications. Accordingly, one instructional approach suggested in response to this challenge is “Adaptive Soldier and Leader Training and Education” (ASLTE). The ASLTE approach, rooted in Outcomes Based Training and Education, promotes instructional principles focused on developing desired leader competencies through instructor-student interactions over time. It requires that instructors (1) possess a reasonable level of expertise and leverage their capability to adapt to new challenges, (2) are capable of maintaining a positive attitude conducive to building trust and confidence in their students, and (3) purposefully and systematically move student learning activity towards a threshold of failure to challenge them while ensuring success to build confidence and initiative. This paper discusses the theoretical basis of the ASLTE approach and findings concerning successes, challenges, and opportunities based on observations during various applications (i.e., marksmanship training in Initial Entry Training, the Army Reconnaissance Course, and the Infantry Advanced Leader Course). Additionally, we summarize workshop findings from a cross section of courses and organizations at Ft. Benning regarding challenges and best practices. Collectively, these analyses indicated that much progress has been made in implementation and ASLTE holds great promise, but key challenges remain. We propose recommendations for further ASLTE implementation focused on issues including but not limited to instructor development (e.g., building expertise), instructional methods (e.g., scaffolding techniques), and reliable assessment of competencies across and within courses (e.g., methods to consistently assess leader attributes such as initiative).

TUESDAY, 2 DECEMBER, 2014 ROOM S320C
EC-1 Game On

1400 Considerations on Utilizing a Game Engine as an Image Generator (14274)
1430 Towards Minimalist Serious Game Design (14348)
1500 Human Motion Capture in Natural Environments (14116)

Notes
CONSIDERATIONS ON UTILIZING A GAME ENGINE AS AN IMAGE GENERATOR

Kevin Bland
AVT Simulation
Orlando, FL

Stephen Lopez-Couto
US Army PEO STRI
Orlando, FL

Jelani Vassall
TAPE, LLC
Orlando, FL

Modern commercial game engines enable the rendering of visual scenes that are a stark improvement over what was feasible just a few years ago. Powering these engines are graphics processing units (GPUs) that continue to rapidly advance in capability. Game developers keep pace with the hardware vendors by regularly incorporating software modifications that take advantage of the new hardware. The Department of Defense (DOD) has already taken steps to incorporate these commercial capabilities into its training portfolio, primarily in ways that are complementary to the typical gaming use case. The utilization of gaming technology in DOD Virtual (man in the loop) Training Systems is still far behind specialized, requirement-intensive Image Generator (IG) technology. The US Army’s Close Combat Tactical Trainer (CCTT) program is in the process of integrating gaming technology used for the Army’s Games for Training (GFT) program to perform as a multi-channel IG with legacy virtual environments. This paper discusses the technical and programmatic considerations that are recommended when evaluating the inclusion of a gaming application into traditional virtual simulator architecture. The focus will be on considerations related to incorporating a game engine as an IG in a heterogeneous environment, integrating gaming into a legacy training system with an established architecture, and planning for the long term sustainability of the full system.

TOWARDS MINIMALIST SERIOUS GAME DESIGN

Dr. Peter A Smith
University of Central Florida
Orlando, FL

Stuart Armstrong
QinetiQ
Orlando, FL

The last ten years the military has seen large success in the use of games and game technologies within the tactical training community. First person shooters dominate this area with significant investment around the world, primarily increasing the realism and fidelity to meet perceived training requirements. Unfortunately, not all training objectives can be easily met through the current military approach to gaming. In an effort to meet these needs some organizations are investing in completely new high end game based training systems or worse, attempting to shoehorn in functionality that is not a good fit for current systems. Both strategies are leading to greater cost, system complexity, and user confusion. One methodology that has been applied to entertainment games is minimalist game design. Minimalist games designs generally define small games with compact but rich rule sets that provide narrow decision spaces and often abstract world representations without diminishing the perceived depth of play. These minimalist designs create micro worlds in which a player can experience and experiment with a distinct subset of rules to train on requirements that would not necessitate a large simulation game. Further, they meet the promise of replay ability, self-regulation, and motivation that other gaming solutions often lack. This paper looks at how minimalist game design can be leveraged in serious games in order to focus on delivering a particular learning or training outcome. Using case studies from around the world, and supported by data collected from the Serious Games Showcase & Challenge this paper aims to set out the fundamental game design principles that support minimalist serious games design, and provide examples of how they can be leveraged to synergistically support existing enterprise solutions to gaming in the field.

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HUMAN MOTION CAPTURE IN NATURAL ENVIRONMENTS
2014 IITSEC Paper No. 14116

Zhiqing Cheng and Anthony Ligouri
Infoscitex Corporation
Dayton, Ohio, USA

Timothy Webb and Huaining Cheng
Air Force Research Laboratory
Dayton, Ohio, USA

In this paper, the problem of capturing human motion in a natural environment is discussed from the perspective of needs, significance, scenarios, and technical challenges. The technologies that can be potentially used to capture human motion and activity in a natural environment are discussed, which include electromagnetic sensors, LED lights, inertial measurement units, range sensors, and computer vision-based markerless motion capture technology.

Two markerless motion capture methods for capturing human motion from video imagery are investigated and implemented in this paper. The first method uses a silhouette shape descriptor to describe silhouette shape and maps the silhouette shape descriptor (input vector) to joint angles (output vector) through a mapping matrix which is determined using relevance vector machine. The second method performs pose estimation by fitting a 3D human model to the silhouette through an iterative optimization. By minimizing the distance between the silhouette and the template skeleton-surface model that is embedded inside the silhouette, joint angles are estimated and thus pose is identified. The silhouettes extracted from human animation data are used for training the methods. The initial results of the two methods are presented and analyzed.
THE LARGEST FIELD OF VIEW COLLIMATED DISPLAY EVER BUILT

2014 I/ITSEC Paper No. 14322

Justin Knaplund
FlightSafety International Visual Systems
Austin, TX

Dave Fonkalsrud
FlightSafety International – Simulation
Broken Arrow, OK

Terry Linn
FlightSafety International Visual Systems
St. Louis, MO

As flight simulators increase in fidelity and performance, more training tasks can be transferred to the simulator, freeing up aircraft time for other tasks. For some training missions, there are tasks that can currently only be performed in the aircraft due to limitations in the simulator Field of View (FOV). In addition, a large horizontal FOV aids in the pilot’s peripheral cues for aircraft attitude, speed and height above terrain, and the addition of lower chin and side displays are required for helicopter pilots to perform hover and landing tasks, especially in “brown out” conditions. Since Mylar displays are not typically able to extend beyond 65° vertically x 225° horizontal, the customer would have to add supplemental real image or collimated displays located outboard of the Mylar mirror plenum, resulting in a large discontinuity in the image. A better option is to use glass mirrors for the Out the Window collimated display, extending the FOV by adding glass mirror segments to achieve a 300° horizontal FOV. Supplemental chin and side displays can be tucked under the edge of the mirror to eliminate gaps between the displays and extend the vertical FOV down to -65°. However, designing and building such a large FOV display has its own challenges, including engineering a single piece Back Projection Screen (BPS) to cover the full FOV, manufacturing a matched array of glass mirrors, designing a projector turret that locates the array of projectors across the top of the BPS, and fitting the cockpit and Instructor Operating Station within the wedge-shaped gap left between the ends of the mirrors and/or BPS. This paper will focus on the unique challenges our team overcame to build the largest collimated system ever designed, the 300° x 85° FOV display for the US Marine Corps UH-1Y Flight Training Device, and how these lessons can apply to enhancing the FOV of other flight simulators.

HIGH QUALITY VISUAL DISPLAY SYSTEMS IN PHYSICALLY CONSTRAINED ENVIRONMENTS

2014 I/ITSEC Paper No. 14248

Reed Moody
Rockwell Collins Inc.
Salt Lake City, UT

Realistic training for pilots seated side by side is, and always has been, a top priority for all simulation customers. Traditional collimated displays meet this need with relatively large and delicate systems. These displays are housed in specially-designed facilities that can accommodate the complete visual system and its associated structures.

In recent years, the need for high quality collimated display training has grown and the desire to bring this capability nearer to the battlefield has intensified. To ensure pilots are trained and mission ready, high quality simulation must become available in the theatre of operation. An innovative solution to this problem, currently being deployed on the US Army’s Transportable Blackhawk Operations Simulator (TBOS) program, applies the basic concepts of large collimated displays reconfigured into smaller transportable configurations.

The approach described by this paper meets the following objectives: 1) reduce overall size and weight of the display. 2) Separate the mirror into manageable and easily-transportable units that can be safely stored and also accurately installed and aligned in the field. 3) Ruggedize each component of this typically delicate and fragile visual system, thereby enabling its reliable use in a variety of harsh environments. This paper describes how technical challenges were overcome to meet these three objectives. Using examples from the TBOS program this paper will also help explain how timely and mission-critical training can occur in the theater of operation anywhere in the world.
DYNAMIC FLIGHT SIMULATION: 45 YEARS OF RESEARCH & DEVELOPMENT

2014 I/ITSEC Paper No. 14019

Kenneth L. Ginader, Michael C. Newman, Richard A. Leland
Environmental Tectonics Company (ETC)
Southampton, PA

This paper will present the development of technologies available for the next generation of flight simulation that would provide realistic training, combined with physical and physiological stressors, and recent results on research conducted on their effectiveness. Included will be information highlighting the development of motion for flight simulators, the distinct differences between transient motion cueing and G on Demand motion, the misnomer that motion cueing provides G forces, and that transient motion cueing in hexapod motion-based simulator cannot provide realistic motion sufficient for tactical flight training.

In the early 1980s both the U.S. Navy and Air Force concluded (hexapod) motion-based simulators did not justify their cost and complexity in transfer of training. However, by 2004 both manufacturing and software technology advanced to the point where it was possible to combine high fidelity flight simulator training with acceleration stressors for realistic tactical flight training.

Conventional wisdom has held that Coriolis Cross-Coupling (CCC) artifacts in centrifuge-based systems prevent any useful motion-based tactical training. This paper will present research establishing sufficient management of motion artifacts that allows not only for adaptation but also increased mitigation of CCC induced by cockpit and head movements in a high performance motion system. This research further establishes that real motion for tactical flight simulation is achievable and replicates an experience just like flying an aircraft. Information will additionally be presented on the technology of high performance motion, software technology that can provide realistic G on Demand and sustained G motion, and technology that provides the “real feel” of an aircraft in flight simulation.

Finally, high performance motion in flight simulation has the added benefit for advanced research on the effects of air combat accelerations on pilot training, G tolerance refreshment, and protective modalities that will provide significant cost savings when applied to realistic air combat training.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320C
EC-3 Emotional Engagement

0830 Design and Evaluation of Surprise Effects in Simulation – A Framework (14193)
0900 Validated Development of Stress Inoculation through Cognitive and Biofeedback Training (14051)
0930 Using Virtual Reality as Part of an Intensive Treatment Program for PTSD (14079)

Notes

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DESIGN AND EVALUATION OF SURPRISE EFFECTS IN SIMULATION - A FRAMEWORK
2014 IITSEC Paper No. 14193

Jelke van der Pal, Konstantinos Georgiadis
National Aerospace Laboratory NLR
Amsterdam, The Netherlands

While a certain level of surprise is required for nearly any type of learning, it is a challenge to provide for surprises in an effective way. Simulation enables the training designer with powerful options to provide for surprising experiences, either to engage students, to stimulate thinking, or to learn to deal with them. Dealing with emergencies or replanning for example are explicit training objectives in many simulator sessions – although the students often already expect the surprising events. Alternatively, surprises in simulation sessions can be instrumental to achieve a context in which other training objectives can be achieved, such as leadership, decision making, and coordination. This study explores the nature of surprises and provides suggestions for designing surprises in training and subsequently for assessing its effectiveness. The framework for designing and evaluating surprises relates to the capabilities that cause the surprise (this may be cue based, narrative based or personal-based) as well as a human (surprise) information processing model. Assessing the effects of surprises is relevant during the design of the training scenario to tailor the effects to the target audience, and may also have the potential to guide the instructor during the training to inject weaker or stronger events. The use of electro encephalogram (EEG) is a promising technique for assessing mental state levels of relaxation, attention, or agitation/confusion. In this study EEG is applied to analyze brainwave patterns and investigate the potential for assessing the effects of a variety of surprise types in a VBS training scenario. Preliminary results indicate that EEG is sufficiently sensitive to measure mental state effects of surprising events. More study is required to determine the validity of the measurements and whether it can be used as the single technique or that a toolkit using a variety of techniques are needed.

VALIDATED DEVELOPMENT OF STRESS INOCULATION THROUGH COGNITIVE AND BIOFEEDBACK TRAINING
2014 IITSEC Paper No. 14051

Dr. Peter Squire
Elizabeth O’Neill
ONR
Washington DC

CDR Joseph Cohn
US Navy MSC
Washington DC

Dr. Gershon Weltman, Elan Freedy
Perceptronics Solutions, Inc.
Washington, DC

Dr. Rollin McCraty
Institute of Heartmath
San Diego, CA

Donald Chartrand
Ease Interactive, Inc.
Boulder Creek, CA

A key military priority is building resilience to stress, because of the near- and long-term effects of stress on mission performance, personal well-being, and relationships. Most stress treatment and prevention research focuses on the adverse effects of stress, neglecting to build on its potential positive effects on performance. The efforts discussed in this paper demonstrate that a software training app can provide an effective individualized method for mitigating the negative effects of stress while emphasizing its positive effects on performance. The Stress Resilience Training System (SRTS) iPad app blends cognitive training with advanced biofeedback to teach individuals to understand, regulate and exploit their stress responses, using a game-based learning framework. SRTS provides information on stress and its effects, techniques for self-regulation based on heart rate variability (HRV) biofeedback, HRV controlled simulations, narrative self-tests, and adaptive coaching. The paper describes the SRTS methodology and positive results from multiple evaluations, including usability and efficacy studies on military, para-military and non-military samples. The usability study showed the app is intuitive and easy to use. The efficacy studies showed that participants improved in a number of key resilience-related measures including perceived PTSD symptoms, stress and depression, and also reported improvements in on-the-job performance, personal, and familial relations. The empirical results strongly support the ability of game/simulation-based biofeedback training to build stress resilience in a variety of different populations. Evaluation results suggest additional enhancements to the methodology including: a web-based version for multi-platform delivery; increased use of biometric data for better feedback of progress; incorporation of social networking for supportive interaction; and virtual mentoring to replicate the benefits of personal mentoring. The enhancements will make the capability a more valuable addition to initial and sustainment resilience training over a range of military and non-military applications.
USING VIRTUAL REALITY AS PART OF AN INTENSIVE TREATMENT PROGRAM FOR PTSD
2014 I/ITSEC Paper No. 14079

Deborah C. Beidel, Ph.D., ABPP
Sandra M. Neer, Ph.D.  Clint Bowers, Ph.D.
University of Central Florida
Orlando, FL
B. Christopher Frueh, Ph.D.
University of Hawai‘i Hilo
Hilo, Hawai‘i
Albert Rizzo, Ph.D.
Institute for Creative Technologies
University of Southern California

Up to 18.5% of veterans returning from OIF/OEF are diagnosed with posttraumatic stress disorder (PTSD). In addition to symptoms of anxiety (intrusive thoughts, re-experiencing, hyperarousal, and avoidance), PTSD can result in social maladjustment, poor quality of life, and medical problems. Other emotional problems include guilt, anger, and unemployment, impulsive or violent behavior, and family discord. Many veterans seeking treatment for PTSD also seek disability compensation for debilitating occupational impairment. There are few administrative or research data to indicate veterans are recovering from PTSD. Exposure therapy, a form of behavior therapy, alleviates anxiety symptoms, but may not address the anger, depression and social impairment that accompanies this disorder. In this presentation, we will discuss an intensive treatment program, known as Trauma Management Therapy (TMT), which combines individual virtual reality (VR) assisted exposure therapy with group social and emotional rehabilitation skills training, delivered in a 3 week format. The presentation will demonstrate the VR environment (Virtual Iraq), will discuss how often/successfully various VR elements are integrated into a comprehensive treatment program, and the adaptability of the program for active duty military personnel, as well as veterans. We will discuss the format of the intensive program as well as factors such as compliance and drop-out rates, comparing these important clinical variables to more traditional outpatient treatment programs. Additionally, we will address common clinical concerns regarding the use of VR exposure therapy for individuals suffering from PTSD.

WEDESDAY, 3 DECEMBER, 2014 ROOM S320C
EC-4 Training Hard to Train Skills: Perception, Sensemaking and Adaptability

1030 Microgames for Training Perceptual Skills (14282)
1100 Beyond Socio-Cultural Sensemaking: Observing and Interpreting Patterns of Life (14101)
1130 Developing Effective Adaptive Training Systems to Enhance Military Instruction (14140)

Notes
MICROGAMES FOR TRAINING PERCEPTUAL SKILLS
2014 IITSEC Paper No. 14282
Sean Guarino, Ryan Jarvis, Samuel Mahoney
Charles River Analytics Inc.
Cambridge, MA
Michael Connell
Institute for Knowledge Design, LLC
Arlington, MA

A common challenge in military training lies in motivating personnel to practice and retain lessons in the limited time they have available. A training methodology that can exploit the moments of “micro-boredom” that lie between missions and other duties can help to address this challenge. However, exploiting those moments requires training methods that are self-motivating, can be completed in isolation (e.g., without trainer interaction or forcing factors), and of a duration that can easily fit in these available time slices. To address this need, we are exploring the application of microgame-based training tools—casual games that provide critical lessons in periods lasting no more than a few minutes—across a number of domains. Here, we describe our ongoing effort with the Office of Naval Research (ONR) to adapt microgames to augment perceptual training. Specifically, in this work we adapted microgames to support training objectives for the Marines’ Combat Hunter program, a program that focuses on training perceptual skills needed to recognize threats in urban environments. Designed to augment existing training, our engaging microgames assist Marines to prepare for in-classroom training, provide practice lessons during class, and rehearse lessons learnt after training is complete. In this paper, we describe our work designing these games, and some of the lessons we learned in adapting microgames to perceptual training objectives. In future work, we plan to further evaluate and test these games, and to extend our game library to address other Combat Hunter training objectives.

BEYOND SOCIO-CULTURAL SENSEMAKING: OBSERVING AND INTERPRETING PATTERNS OF LIFE
2014 IITSEC Paper No. 14101
Tracy St. Benoit
University of Central Florida
Orlando, FL
Clarissa Graffeo
MESH Solutions, LLC
Orlando, FL

Military leaders have identified a need for socio-cultural sensemaking capabilities to support operations in irregular conflicts. However, training programs lack practical applied techniques for such sensemaking. For example, observational training programs such as Combat Hunter instruct warfighters to set socio-cultural baselines, but provide little specific instruction on relevant sensemaking processes; furthermore, little of the existing or proposed socio-cultural training robustly integrates field-tested methodologies and concepts from anthropology or other social sciences. A related issue involves the overemphasis that training and policy recommendations place on “culture” as a rigid concept. Warfighters may overcompensate by focusing too much on culture over other relevant factors, and often treat culture as a fixed entity that can be read at a superficial level. Culture, however, is a fluid construct without fixed boundaries that constantly interacts with other factors and situational exigencies; the complexity of social systems alongside cultural mixing and shifting within operational environments demands a more holistic model.

In a 2012 I/ITSEC paper, our team outlined a concept of archetypal, cross-cultural Patterns of Life for training in virtual environments. In this paper we propose a revised concept of Patterns of Life as a critical thinking framework that extends beyond culture to incorporate human and non-human actors, practices, functions, environmental interactions, and temporal, cultural, and situational contexts that better reflect social science theories. We also draw on prior perceptual training and ethnographic methodologies to define an Ethnographically-informed Sensemaking Protocol consisting of a nested, iterative process of framing and baseline construction that supports both individual encounters and the entirety of a warfighter’s deployment; this will improve sensemaking and framing baselines in complex, uncertain environments, and allow applicability across operational environments. We discuss the theoretical foundations of this revised approach, and then provide a brief summary of the current state of the framework and protocol.

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DEVELOPING EFFECTIVE ADAPTIVE TRAINING SYSTEMS TO ENHANCE MILITARY INSTRUCTION
2014 IITSEC Paper No. 14140

Fleet Davis, Sandro Scielzo, Jennifer M. Riley
SA Technologies, Inc.
Marietta, Georgia

Heather A. Priest
Navy Air Warfare Center Training Systems Division
Orlando, Florida

Today’s military training environment poses many challenges to instructors, developers, and support personnel. One obstacle is the limited amount of time instructors have to interact with trainees during live training, leading to an increase in simulation in the school house with often high instructor-to-student ratios, dividing an instructor’s efforts across many students. To address this issue, the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and SA Technologies, Inc. developed an adaptive training system prototype that provides automated support for instructor-led training through trainee self-guided learning. Using predefined instructor input, the system actively monitors trainees’ activities within a simulation and automatically provides targeted feedback and coaching through metacognitive prompts. These prompts mimic the essential input a live instructor would normally provide, allowing instructors to provide consistent, valuable input to all students while lowering their workload. However, despite a wealth of evidence promoting the efficacy of feedback during practice, such system-based interventions are often regarded as intrusive. The purpose of this paper is to provide an overall review of the constraints and considerations associated with developing and implementing such training systems. This includes a summary of our system evaluation, conducted at the United States Military Academy (USMA) at West Point during incoming cadets’ normal land navigation training, which included classroom, simulation, and live training exercises. Results demonstrated the efficacy of the system for enhancing training with improved task performance both in the simulation and the subsequent live exercise. Additionally, subjective measures yielded positive evaluations for perceived effectiveness of the training intervention, usability of the system, and subjective workload associated with trainees’ interaction with the tool. Together, these findings suggest that the training system and intervention it provides may be a viable approach to enhancing instructor-led, classroom training and provide guidance for the development of future adaptive training tools.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320C
EC-5 Perspective on Data and Services

1400 Future of LVC Simulation: Evolving Towards The MSaaS Concept (14072)
1430 Rapid Data Generation: A Flexible Data Discovery and Access Architecture (14096)
1500 Optimizing Supervised Learning for Pixel Labeling and Material Classification (14016)

Notes
FUTURE OF LVC SIMULATION: EVOLVING TOWARDS THE MSAAS CONCEPT
2014 I/ITSEC Paper No. 14072

Jose-Ramon Martinez-Salio & Jose-Maria Lopez-Rodriguez
NADS
Madrid, Spain

Live, Virtual, and Constructive (LVC) simulation has been one of the main topics of discussion in Modeling and Simulation (M&S) community in last decade. Reports like “Live Virtual Constructive Architecture Roadmap” (LVCAR) established a baseline to start planning next steps to improve LVC simulations. Based on LVCAR insights, new SISO workgroups, like LSA (Layered Simulation Architecture) or WebLVC have been born. While improvements in performance, usability and scalability of the LVC federations are still a hot topic for discussion a new demand is standing-out; the use of simulations assets as Services. Initiatives in US DoD (JLVC2020) and NATO -Modeling and Simulation as a Service (MSaaS) and Distributed Networked Battle Labs (DNBL)- are trying to change the paradigm of how simulations are developed, deployed and used, looking for a Cloud-based publisher-consumer service paradigm for the assets. This paper analyzes where we are in this quest, pinpointing gaps and main challenges we need to address to be able to do a fluent transition from LVC simulations to MSaaS clouds.

RAPID DATA GENERATION: A FLEXIBLE DATA DISCOVERY AND ACCESS ARCHITECTURE
2014 I/ITSEC Paper No. 14096

Kevin T. Gupton, Bruce Carlton, Roy Scrudder
Applied Research Laboratories
The University of Texas at Austin
Austin, Texas

Dr. Rob Cox
PEO Simulation, Training, and Instrumentation
Orlando, Florida

Ralph O’Connell
Joint Staff J6
Suffolk, Virginia

Obtaining and preparing the right data for M&S-based activities is a huge consumer of resources, regardless of the activity supported by M&S (training, testing, etc.). The Rapid Data Generation (RDG) project, sponsored by the US Department of Defense (DoD) M&S Coordination Office, on behalf of the Under Secretary of Defense for Acquisition, Technology and Logistics, was therefore established to improve the visibility and accessibility of data, as well as to reduce the time and effort necessary to integrate the necessary data for an M&S event.

This paper presents the RDG Common Data Production Environment (CDPE) system architecture. This architecture defines a service-oriented design that specifies how data provider and data consumer systems integrate to enable net-centric discovery, assessment, and retrieval of M&S-relevant data. The architecture has been implemented in “order of battle” data capabilities in addition to the “environmental representation” data capabilities. These two capability releases focus on the sharing of military force structure datasets, such as orders of battle, scenarios, and entity-type enumeration data, as well as geospatial imagery, elevation, feature, and weather effects datasets and 3D models. The CDPE system architecture design makes use of DoD enterprise standards with industry best practices and design patterns to achieve a solution that is agnostic to the types of data exchanged. Through the use of reference architectures with implementation-independent and -specific designs, the design is resilient and adaptive to evolving technologies. The architecture also incorporates design alternatives that mitigate the variety in data producer and consumer system architectures. As a result, the architecture can be applied by others to develop capabilities for data discovery and sharing across diverse, loosely connected communities. The CDPE system architecture enables the rapid use and improved reuse of the data necessary for simulation-enabled training and mission readiness exercises for multiple tiers of training, all while incorporating and enabling data sharing with peer communities.
OPTIMIZING SUPERVISED LEARNING FOR PIXEL LABELING AND MATERIAL CLASSIFICATION
2014 I/ITSEC Paper No. 14016

Mark Rahmes, Morris Akbari, Mike McGonagle
Harris Corporation, Government Communications Systems
Melbourne, Florida

The visualization and simulation industry has a demonstrated interest in classification products for sensor simulation. The challenge lies in providing highly accurate material classification of remotely sensed imagery while significantly reducing the time and cost to create products. Visualization and simulation products for material classification are created by merging and mosaicking multi-source satellite and aerial imagery of different resolutions on an elevation surface to provide realistic, geo-specific terrain features. This requires that all image data is orthorectified, seamlessly co-registered, tonally balanced and feather blended into mosaics from source data of different resolution. To achieve highest accuracy at faster speed and lower cost, we apply an innovative, optimal pixel-labeling process to the mosaic imagery. This process is based on artificial intelligence (AI) algorithms using Nash Equilibrium and game theoretic analyses to help solve the problem of feature extraction through supervised classification. This can be viewed as a constant sum game, whereby the players are pixel data points that take part in the game to decide their class memberships. A player's land cover classification strategies are based on four different supervised learning algorithms: k-Nearest Neighbors (KNN), Decision trees using a classification and regression tree (CART), Normal/Naive Bayes probabilistic graphical model, and support vector machine (SVM). Within this formulation, we used a weighted reward matrix for consistent labeling of feature pixels and classification factors, resulting in higher accuracy and precision when compared to the individual machine learning algorithms alone.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320A
EC-6 Simulation: Supporting Experiment, Acquisition and Military Planning

1600 Early Synthetic Prototyping: Exploring New Designs and Concepts Within Games (14133)
1630 When Tradespace Analysis Meets Combat Modeling and Simulation (14264)
1700 Simulation in Support of Course of Action Development in Operations (14119)

Notes
EARLY SYNTHETIC PROTOTYPING: EXPLORING NEW DESIGNS AND CONCEPTS WITHIN GAMES
2014 IITSEC Paper No. 14133

Kate Murray, Rudolph Darken
Naval Postgraduate School
Monterey, CA

Brian Vogt
Army Capabilities Integration
Fort Eustis, VA

Simon R. Goerger
Army Corp of Engineers ERDC
Vicksburg, MS

Early Synthetic Prototyping (ESP) is a new concept the Army is exploring that will use game environments to assess novel system designs and concepts early in the acquisition cycle. ESP is a process and tools that enable Soldiers to assess emerging technologies within scenarios to provide feedback that will inform decisions. Acquisition, science and technology, and industry partners develop scenarios and models of interest to serve on the ESP network for Soldiers to play. ESP allows an unbounded increase in potentially disruptive ideas to be explored at minimal cost. The goal is to engage the whole Army in defining the future of the Army and to ensure that the Soldier remains the centerpiece of future development. To this end, we completed a study to explore an unmanned vehicle concept called Wingman. Groups of military officers of all services played red versus blue in three scenarios: chase/recon, attack, and defend. The study asked (1) What feedback could we gather from game players that is useful to the Research Development and Engineering Centers (RDECs) and the Army Capabilities Integration Center (ARCIC), (2) Would the organization value that feedback? Using a game environment to explore design concepts early in the acquisition process is valid and can be applied to early requirement refinement and rudimentary tradeoff analysis. Through the game sessions, players expressed ideas, both creative and surprising, towards a preferred interface and how to best employ Wingman. The encouraging results of this preliminary work clearly demonstrated a strong potential to leverage game environments to explore revolutionary concepts to efficiently and effectively shape the future of the Army.

WHEN TRADESPACE ANALYSIS MET COMBAT MODELING AND SIMULATION
2014 IITSEC Paper No. 14264

Chris Gaughan, Christopher J. Metevier
Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center
Orlando, FL

Simon Goerger
U.S. Army Corps of Engineers – Engineer Research and Development Center
Vicksburg, MS

Tommer R. Ender, L. Drew Pihera
Georgia Tech Research Institute
Atlanta, GA

Scott Gallant
Effective Applications Corporation
Orlando, FL

The Department of Defense (DoD)’s Science & Technology (S&T) priority for Engineered Resilient Systems (ERS) calls for adaptable designs with diverse system models that can easily be modified and reused, the ability to iterate designs quickly and a clear linkage to mission needs. Towards this end, tradespace analysis is of great importance. The Georgia Tech Research Institute (GTRI) has been developing web-based, collaborative modeling and simulation tools that use a Model-Based Systems Engineering approach to address the analysis of alternatives for acquisition programs to assess cost, schedule and performance risk; of particular note is the United States Marines Corps (USMC) funded Framework for Assessing Cost and Technology (FACT). In parallel, the United States (U.S.) Army Research Laboratory (ARL) has been pursuing the Executable Architecture Systems Engineering (EASE) research project, which links analytical, experimental and training objectives with the technical complexity of modeling and simulation in an easy to use, scalable tool. This paper details an effort to develop a formal Application Programming Interface (API) between FACT and EASE, which creates the ability to develop system concepts and assess Measures of Performance (in FACT), and then send those system concepts to a combat simulation to assess Measures of Effectiveness (through EASE), and finally back to FACT for a high-level trade study. It further describes a proof-of-concept demonstration using a Force Protection use case that allows a user to tune parameters of detection on an unmanned platform that is then simulated in an operational scenario to collect performance data. This effort effectively lays the framework for future simulation-enabled tradespace analysis that will be a pillar of ERS and can be adapted by other simulation efforts.
SIMULATION IN SUPPORT OF COURSE OF ACTION DEVELOPMENT IN OPERATIONS
2014 IITSEC Paper No. 14119

Lt Col Jens Inge Hyndoy
Norwegian Army, Land Warfare Centre
Rena, Norway

Ole Martin Mevassvik, Karsten Brathen
FFI (Norwegian Defence Research Establishment)
Kjeller, Norway

This paper outlines investigations and suggests use cases to where simulation could be utilized to assist planners in developing better plans. In order to introduce simulations to headquarters and command posts one first has to convince operational personnel that the additional equipment and training are acceptable considering the contribution these systems offer. On-going work in Norway focuses on developing a demonstrator for allowing simulations to interoperate with command and control (C2) systems using Coalition Battle Management Language (C-BML) and Military Scenario Definition Language (MSDL). The purpose is to demonstrate that even a small planning group without simulation specialist training can draw benefit from autonomous or semi-autonomous simulations. We believe that important factors to success are a simple user interface and commonality in “look and feel” between the C2 system and simulations.

The main hypothesis is that simulation can assist wargaming for better understanding of the planned sequence of events. This will allow planners to draft a more precise synchronization matrix and more efficiently determine the use of combat support and combat service support assets. One can envision analysis functionality where different Courses of Action (COAs) are compared based on quantitative measures rather than personal preferences safeguarding that the potential for operational success is maximized. Experimentation conducted in an international context, the NATO Modelling and Simulation Group 085 C2-SIM Interoperability, indicate that such a capability allows for parallel planning and better synchronization between coalition forces.

The pedagogical aspect of this combination of systems should not be forgotten. Review of simulations could greatly enhance the common understanding during orders meetings and briefings. A further distribution and viewing of simulations would also allow subordinate commanders and staff insight to a commanders’ intent. This research is conducted in close co-operation between the Norwegian Army and FFI and is characterized by development and testing executed in an iterative pattern. This ensures that operational personnel are comfortable using the system, and cumbersome and marginal functionality is discarded.

This paper reviews on-going research on a digital COA capability for the Norwegian Army C2 system and experiences from an autonomous land warfare simulation demonstrator developed by FFI.
FUNDAMENTAL COMPETENCY SETS (FCS) DEFINITION TO SUPPORT TECHNOLOGY DEVELOPMENT FOR PILOT TRAINING
2014 I/ITSEC Paper No. 14126

Amanda Avenoso
Air Force Research Laboratory
Wright Patterson AFB, OH

Jamie Donsbach
The Group for Organizational Effectiveness
Albany, NY

As the Air Force looks toward the future of preparing highly competent warfighters, there is a need to articulate the capability required to develop next generation pilots. The challenges associated with this are non-trivial. Not only must training approaches address emerging knowledge/skill sets, they must do so in a way that efficiently leverages training technologies and resources. This paper describes the Training Enhancement Study (TES), a collaborative effort between 711 HPW/RHA and AETC that can provide a foundation for optimizing the Advanced Pilot Training (APT) syllabus and evaluating the utility of various training technology/media within the pilot training program. The TES centers on the Fundamental Competency Set (FCS) approach that defines knowledge/skills required for APT students to successfully transition to their Formal Training Unit (FTU). This approach is based on a proven methodology for identifying Mission Essential Competencies (MECs), which focuses on mission execution in a non-permissive or combat environment, and is also used to identify Initial Competency Sets (ICS) – the building blocks in the transition from FTU to combat readiness. The FCS, ICS, and MEC continuum represents a unique opportunity for analytic alignment across all parts of the training and readiness pipeline. This paper discusses the application of the FCS process for Fighter, Bomber, and Mobility APT, based on SME input and quantitative data from 1051 Instructor Pilots (IPs) to identify training requirements, gaps, and priorities for the APT syllabus. It shares potential innovative applications of the FCS data, such as using the APT testbed to review training technologies and determine the best environment for addressing training gaps. Finally, we provide implications of our capability to integrate the FCS, ICS, and MEC work and use a consistent analytic approach to support the operator throughout the full training life cycle.

JOINT TERMINAL ATTACK CONTROLLER-TRAINING REHEARSAL SYSTEM:
COMPETENCY-BASED RESEARCH
2014 I/ITSEC Paper No. 14097

1Lt. Sean A. Morris, Dr. Christine M. Covas-Smith, Christine L. Kunkle, Keith W. Westheimer
Leah J. Rowe
Leidos, Inc.
Dayton, OH

Air Force Research Laboratory
Wright Patterson Air Force Base, OH

The Joint Terminal Attack Controller (JTAC) warfighter is responsible for supporting the Army Maneuver commanders by controlling aircraft and weapons employment in Close Air Support (CAS) environments. JTACs are typically co-located with Army units, however, they are required to communicate and collaborate with a number of personnel operating external to their locations. JTACs are required to maintain a significant level of proficiency by regularly training in both live and simulation environments. Due to increasing reductions of aircraft to aide in live training events and limitations in simulator technology, trainings gaps have arisen that hinder the opportunities for JTACs to achieve required levels of proficiency. This paper will introduce an ongoing effort to create a robust JTAC training environment – the Joint Terminal Attack Controller-Training Rehearsal System (JTAC-TRS). The JTAC training gaps are being assessed and explored within the JTAC-TRS using problem-based learning approaches by analyzing the Mission Essential Competencies (MEC). Using MECs, we have identified the primary and supporting competencies, knowledge, skills, and developmental experiences that a JTAC must have to effectively execute the mission. Preliminary evaluations of this system demonstrate that the JTAC-TRS has reduced 50% of these training gaps. We will present data regarding the identified training gaps and how they are addressed in this unique training environment.
OPERATOR QUALIFICATION DIFFERENCES BETWEEN MANNED AND UNMANNED AERIAL SYSTEM (UAS)
2014 IITSEC Paper No. 14287

Jennifer Pagan, Randy Astwood & Henry Phillips
Naval Air Warfare Center Training Systems Division (NAWCTSD)
Orlando, FL

Currently, no empirically validated qualification standard exists for selecting Naval Unmanned Aerial System (UAS) operators (Howse, 2011). Some UAS platforms (e.g., Triton, Fire Scout, and Predator) require their operators be winged aviators. This involves a $1 million investment per pilot and years of pilot training, in addition to mandatory, UAS platform-specific training (Cohn, 2012). The Shadow UAS program, on the other hand, uses junior to mid-grade enlisted personnel with no aviation experience. The training program for Shadow pilots is 10 weeks long and approximately a third of the investment (about $347,000) of manned aviators (Cohn, 2012). While adapting a Shadow-like selection/training model could yield significant cost avoidance, thorough research is necessary to develop qualification and training standards that support identification of the most qualified people to operate UAS and who will be most likely to succeed in training and operations (i.e., select the right individuals capable of acquiring these UAS specific skill sets). These differences in standards may be driven more by the relative size and cost of different UAS platforms rather than by empirical comparison of the Knowledge, Skills, Abilities, and Other personal characteristics (KSAOs) underlying performance in each (Howse, 2011). This paper describes differences between KSAOs required to operate manned and unmanned platforms, possible reasons underlying those observed differences, and implications of the observed trends for selection criteria, training requirements, and system design.

THURSDAY, 4 DECEMBER, 2014 ROOM S320C
EC-8 More Braaaiinss

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Notes
VIDEOGAME DESIGN FOR COGNITIVE ENHANCEMENT THROUGH MICRO-PUZZLE COGNITIVE PROFILING

2014 I/ITSEC Paper No. 14039

Patrick S. Gallagher, PhD
Serco in support of Advanced Distributed Learning
Alexandria, VA

Shenan Prestwich
Katmai in support of Advanced Distributed Learning
Alexandria, VA

The Advanced Distributed Learning (ADL) Initiative’s Next Generation Learner researchers previously investigated whether five video game design features hypothesized to be contained within Portal 2 might increase cognitive adaptability (CA). Their results highlighted a lack of understanding of the cognitive elements of video games within the literature. Subsequently, a protocol for applying cognitive task analysis (CTA) to video games was developed and a CTA was performed on Portal 2 to understand the cognitive components, decisions, and knowledge needed for successful gameplay, as well as to gain a detailed understanding of its design. As a result of the CTA, a compendium of within-level tasks and puzzles the player must complete, referred to as “micro-puzzles,” was compiled, and mapped to the five design features for CA. Results from the initial study showed that certain measures of CA were increased in those playing Portal 2; however, the design of Portal 2 was treated as a “black box.” Through performing a CTA, the presence of the five design characteristics for adaptability was validated by location and by micro-puzzle. Although precisely identified and mapped by game location, there were no specific alignments identified between cognitive measures and micro-puzzle attributes, or between micro-puzzle typology and design feature support. For this reason, the researchers are cognitively codifying micro-puzzles in Portal 2 by type according to their measurable cognitive attributes. This involves defining the micro-puzzles and mapping them to cognitive skills, measurable by the CANTAB battery of tests for CA, followed by empirical testing in the game environment. This paper details this codification and mapping, as well as efforts to build levels in Portal 2 based upon this information in order to cultivate specific cognitive skills, empirically validate the correlation of puzzle type in-game to cognitive gains, and further validate hypothesized game design features to improve cognitive functioning.

GAME-BASED TRAINING TO MITIGATE THREE FORMS OF COGNITIVE BIAS

2014 I/ITSEC Paper No. 14180

Benjamin A. Clegg, Rosa Mikeal Martey, James E. Folkestad
Colorado State University Fort Collins, CO

Jennifer Stromer-Galley
Syracuse University Syracuse, NY

Kate Kenski
University of Arizona Tucson, AZ

Tobi Saulnier
1st Playable Productions Troy, NY

Joanna E. Lewis
University of Central Florida Orlando, FL

John D. Patterson
Binghamton University Binghamton, NY

Tomek Strzalkowski
University at Albany Albany, NY

Cognitive biases are systematic errors that result from reliance on heuristics in decision-making. Such biases are typically automatic and unconscious influences on behavior, and can occur in a wide range of situations and contexts. Cognitive biases are generally resistant to mitigation training. This project adopted a novel approach to develop computer game-based training to attempt to mitigate three forms of cognitive bias: fundamental attribution error, the tendency to assume dispositional rather than situational influences account for behavior of others; confirmation bias, the tendency to seek and remember information that matches or supports one’s view; and bias blind spot, the tendency to regard one’s own decisions as being free from cognitive bias, even where one can recognize that bias in others. Participants were randomly assigned to play the training game once, or repeated twice with a 7-10 day delay between sessions (mean duration first play=43 minutes; second play=34 minutes), or to a control condition that employed a 30-minute professionally developed training video. Effects of training were measured on external questionnaire-based items, both immediately post-exposure, and at an 8-week retention interval. The game was intended to develop conceptual understanding of these biases, and recognition of circumstances within which they might occur. Using notional “tools” presented within the game, participants learned and practiced strategies to avoid decision-making influenced by the cognitive biases. Results showed that the training game successfully reduced bias on the assessment instrument, and outperformed the video both immediately post-training and at the retention test. Repetition of the training game did not further advantage immediate post-test performance but significantly improved retention. Validation of the key findings was confirmed by an independent group who used the training game with their own novel bias assessment instruments (to which the researchers and game-developers had no access or content information).
TOWARDS ENHANCING INTUITIVE DECISION MAKING THROUGH IMPLICIT TRAINING
2014 IITSEC Paper No. 14253

Peter Squire, Joseph Cohn
Office of Naval Research
Arlington, VA

Denise Nicholson, Margaret Nolan
MESH Solutions, LLC
Orlando, FL

Paul J. Reber, Delphine Oudiette
Northwestern University
Evanston, IL

James Niehaus, Charles River Analytics
Boston, MA

Alexandra Geyer
Aptima, Inc.
Boston, MA

Liz O’Neill
Strategic Analysis, Inc.
Arlington, VA

A recent study published by the National Academies focuses on improving decision making (DM) abilities of small unit leaders, underscoring the significant weight that senior military leadership assigns to the art of training effective DM. DM training is often based on an analytical model which requires a methodical, step-by-step, time consuming approach to sequentially process data. While this model is appropriate for many military decisions, an interesting outcome from military operations in Iraq and Afghanistan has been the degree to which intuitive decision making (IDM), which uses a more holistic approach to processing information at a subconscious level, has been cited as playing a critical role in saving lives and enabling mission success.

IDM offers distinct advantages during ambiguous military missions. For example: a leader may be forced to make a time-critical decision for which he can neither afford to wait for detailed, quantitative data, nor analyze new information without risking the tactical initiative. Nevertheless, the processes underlying analytical DM have traditionally been viewed as more amenable to training than those which underlie IDM. Yet, a growing body of results, ranging from biological to cognitive, suggests that IDM uses some of the same underlying neurocognitive structures that are affected by implicit learning, a type of non-conscious learning that occurs through repeated interactions with an environment.

In this paper we propose that IDM may be enhanced through a novel regimen that enables acquiring domain knowledge implicitly. We motivate the theory that targeted, implicit training automatically strengthens, at the neural, cognitive, and behavioral levels, the same capabilities that are needed for effective IDM. We also provide a framework for testing and implementing this theory. The results from this work will advance the body of research in understanding IDM processes and inform and direct successful training strategies to develop IDM training for military leaders.

THURSDAY, 4 DECEMBER, 2014 ROOM S320A
EC-9 Medical Matters

1030 Challenges to Upgrading a Mobile Web Application (14057)

1100 Development and Evaluation of a Humeral Head Intraosseous Training System (14058)

1130 Comparative Analysis of Holographic Display and Three-Dimensional Television (14230)

Notes
CHALLENGES TO UPGRADING A MOBILE WEB APPLICATION

Howard Mall
ECS, Inc
Orlando, FL

Teresita Sotomayor, PhD
Army Research Lab
Orlando, FL

The Army Research Laboratory (ARL), Human Research and Engineering Directorate, (HRED), Simulation and Training Technology Center (STTC) developed a mobile web application for conducting research in applying emerging mobile capabilities to the U.S. Army’s Combat Medic curriculum. The mobile application used early Apple iOS devices and their native web browsers to deliver highly interactive training content. It consisted of a web server that delivered the application to mobile devices via Wi-Fi wireless internet connections. Students would play group trivia games or answer questions about emerging medical scenarios that included a visual synthetic casualty. A training effectiveness evaluation was conducted to assess how introducing this system into a program of instruction would improve individual learning outcomes. Lessons learned identified the need to update the application. This paper outlines the challenges and solutions that were addressed in updating the mobile application to take advantage of the strides made in mobile web capabilities. Application server technologies and web client development libraries have matured and become highly capable in terms of visual fidelity and usability. The mobile devices themselves now support multi-core Central Processing Units, Graphic Processing Units for rendering, highly optimized web browsers, and greater resolution screens that sometimes eclipse their desktop counterparts. We will describe our strategy for upgrading the mobile application to take advantage of the new technologies especially with regard to the simulation and visualization of the synthetic casualties in the scenario exercise portion of the mobile application. We will walk through our decision process and describe the lessons learned during the upgrade. We conclude with a set of guidelines for other groups taking on the task of upgrading an older mobile web application to take advantage of the myriad and ever-expanding possibilities that mobile devices afford in delivering important simulation-based curriculum to our warfighter and to education in general.

DEVELOPMENT AND EVALUATION OF A HUMERAL HEAD INTRAOSSEOUS TRAINING SYSTEM

Angela M. Alban, Cheryl Coiro
SIMETRI, Inc.
Winter Park, Florida

Teresita M. Sotomayor, Ph.D.
U.S. Army Research Laboratory HRED-STTC
Orlando, Florida

Over the past few years, the British Medical Emergency Response Team (MERT) and U.S. Air Force Search and Rescue Unit (also known as PEDRO) have been administering fluids to patients at point of injury and en route through the use of intraosseous (IO) devices in the humeral head. The MERT includes an Emergency Medicine residency trained physician. The PEDRO includes pararescue trained medical providers who are afforded the opportunity to train on cadavers prior to deployment. The U.S. Army Center for Predeployment Medicine (CPDM) at Fort Sam Houston, Texas provides medical training to providers of all levels. CPDM currently does not have an adequate training model for the humeral head intraosseous device. The U.S. Army Research Laboratory (ARL) executed a Small Business Innovative Research (SBIR) initiative to analyze the scientific, technical, and commercial merit, and feasibility of using a low-cost medical simulator for training medical personnel in Army Combat Training Schools. As part the initial phase, ARL conducted research and developed a capability to fill the gap in training this procedure. The research focused on identifying innovative technologies, technical risks of the approach, costs, and benefits associated with development and demonstration of the prototype. Additionally, a usability study was conducted with emergency medicine residents to gather feedback and assess whether the initial prototype met training requirements. This paper will discuss in detail how training requirements impacted the design of the humeral head intraosseous training system. It will also explore the criteria used to develop the overall design, as well as the identification of specific capabilities. In addition, it will explain how subject matter expertise was utilized to develop requirements and performance metrics used to evaluate the feasibility of the concept. Finally, it will review results from usability evaluations and lessons learned from the development and implementation of this project.
COMPARATIVE ANALYSIS OF HOLOGRAPHIC DISPLAY AND THREE-DIMENSIONAL TELEVISION
2014 IITSEC Paper No. 14230
Matthew Hackett; Kevin Fefferman
ARL-HRED STTC
Orlando, FL

Data visualization is a key component in a variety of high-impact fields: medicine, engineering, architectural design, intelligence, and many others. Current sensors used in these fields record multi-dimensional data sets, such as light detection and ranging (LiDAR) sensors, magnetic resonance imaging systems (MRI), and three-dimensional (3D) cameras. While these communities have a plethora of sensors to create data sets, the visualization of these data sets is lacking. The most common display modality is two-dimensional (2D), despite having data sets representing 3D geometries. Furthermore, additional dimensions such as time or a force measurement must be displayed in many situations. When using a 2D display, these additional dimensions must be compressed, or they are simply not displayed. The use of a 3D display alleviates many of these issues, by presenting the additional dimension naturally. A number of 3D display modalities are present in the market, with various strengths and weaknesses inherent in their designs. In this study, we compare a commercial 3D television which is a time-multiplexed stereoscopic display and an autostereoscopic holographic display. Participants in the study completed two tasks: a medical task and a tactical task. The tasks required them to identify certain landmarks in each data set, such as the tallest building or a particular anatomical structure. After the tasks, researchers gathered data on usability, visual perception, and cognitive load using the displays. Performance metrics for the medical and tactical task were also collected. The paper reports the study results and discusses the merits of the 3D display modalities, including recommendations of suitable use cases for both.

THURSDAY, 4 DECEMBER, 2014 ROOM S320C
EC-10 Get a Grip on Reality

1030 Live Augmented Reality Based Weapon Training for Dismounts (14093)
1100 Augmented Reality Virtual Personal Assistant for Training, Maintenance, and Repair (14031)
1130 PERLS: An Approach to Pervasive Assistance in Adult Learning (14335)

Notes
LIVE AUGMENTED REALITY BASED WEAPON TRAINING FOR DISMOUNTS
2014 I/ITSEC Paper No. 14093
Supun Samarasekera, Rakesh Kumar, Zhiwei Zhu, Vlad Branzoi, Nicholas Vitovitch, Ryan Villamil
SRI International, Princeton, NJ
Frank Dean, Pat Garrity
U.S. Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center
Orlando, FL

Current small arms training is limited to either live ammunition training, which is both expensive and limited to specific ranges and times, or laser based Tactical Engagement Simulation System (TESS) training which has some potentially negative training implications, since it has no visual blast effects, does not simulate time of flight and leading of moving targets and does not work for Non-Line Of Sight (NLOS) scenarios. Additionally, live ammunition training is limited to Force on Target training with extremely limited scenarios (no movers, same old targets); while laser based TESS training does allow Force on Force training it is limited by the scheduling of exercises, range time availability and limitation of scenarios possible with live forces. In this paper, we present technical algorithms, system description and experiment results for a prototype Augmented Reality (AR) based system that addresses the limitations of both live ammo and laser TESS training. The AR based dismount weapon training system provides fully geo-located 6-degrees of freedom orientation and location of the weapon and of the trainee operating it, thus allowing the weapon to fire simulated projectiles for both direct fire and NLOS during live training. Using this tracking and a terrain model of the environment, the fully virtual projectiles and synthetic enemies are displayed on the trainee’s head mounted display overlaid on top of the real world and full blast effects and simulated damage are displayed allowing the soldier to adjust fire accordingly. Since the projectiles, weapon characteristics and enemy combatants are all simulated they can easily be changed to vary scenarios, new projectile types and future weapons. Additionally, turn-around time on scenarios is very quick allowing more training in shorter amount of time in any available live environment, without the need to schedule range time, Opposition Forces, training ammo or any other logistical requirements.

AUGMENTED REALITY VIRTUAL PERSONAL ASSISTANT FOR TRAINING, MAINTENANCE, AND REPAIR
2014 I/ITSEC Paper No. 14031
Rakesh (Teddy) Kumar, Supun Samarasekera, Girish Acharya, Louise Yarnall, Zhiwei Zhu, Michael Wolverton, Vlad Branzoi, Glenn Murray, Nicholas Vitovitch, Ryan Villamil, Jim Carpenter
SRI International, Princeton, NJ

The military trains a large pool of personnel skilled in maintaining and repairing a variety of complex equipment. The U.S. Army itself requires personnel for more than 130 different Military Operational Skills. Often these trained personnel are not available for repair and maintenance of critical low density equipment in deployed locations. Augmented Reality and Virtual Personal Assistance are technologies that can supplement live training to address the challenge of affordably training personnel.

In this paper, we present the system design, hardware, algorithms and initial field results for a prototype training system AR-Mentor. The system is designed to act as a personal mentor to a user, providing human-like understanding and guidance. It provides a Heads-up and Hands-free experience. The user can train anywhere and also use the system for providing guidance during actual maintenance of the equipment.

The experimental system consists of a compact computer, head worn cameras, microphone, ear-buds and eyewear. Virtual Personal Assistant technology is used to provide a real-time dialog and reasoning system that supports human-like interaction using spoken natural language. The reasoning system aims to recognize the user’s intent and provides feedback to the user. The feedback and interaction occurs both verbally and by engaging the Augmented Reality system to display icons and instructions visually on the user’s eye-glasses. The inserted visual objects appear as part of the live scene and are precisely aligned to the equipment.

A formative evaluation indicated that the AR-Mentor system permitted individual learners to focus on their learning needs and reduced the perceived mental demand of learning the procedure. Checks into understanding showed no difference between learning with the AR-Mentor system, as compared to learning from an instructor, or a technical manual. The evaluation also indicated the need for alternative ways to design the AR-Mentor representations around complex procedural steps.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
PERLS: AN APPROACH TO PERVASIVE PERSONAL ASSISTANCE IN ADULT LEARNING

2014 I/ITSEC Paper No. 14335

Michael Freed, Louise Yarnall, Jason Dinger, Melinda Gervasio, Adam Overholtzer, Mar Pérez-Sanagustin, Jeremy Roschelle, Aaron Spaulding
SRI International
Menlo Park, CA

Adult learners in both military and civilian settings increasingly use mobile devices for “Pervasive Learning” (Banavar et al., 2000; Thomas, 2007), which occurs without classrooms, instructors, and training facilities. By expanding options for what, when, and how we learn, Pervasive Learning has the potential to remedy stubborn deficiencies of traditional instruction. The central feature of PERLS is a virtual personal assistant that supports self-learning by recommending specific content, general topics, and various learning actions based on learners’ interests, available time, and location. PERLS is intended to guide learners to resources located in both formal (closed corpus) and informal (open corpus) repositories.

In this paper, we present the pedagogical design, user interface, system architecture, initial concept validation results, and field test goals for PERLS, a prototype PERvasive Learning System. The concept validation and field-testing take place in one civilian corporate context. The concept validation indicated that adult learners in the corporate setting favored limited use of “push” reminders to engage in learning and broader use of adaptive lists of content that have been intelligently informed by contextual data about their interests and available time for learning. Planned field tests will examine system functionality, usability, and impacts on self-learning habits around corporate onboarding content for new hires.

THURSDAY, 4 DECEMBER, 2014 ROOM S320C
EC-11 Networking Cross Domain Solutions: Cross Domain Solutions, Cloud

1330 Implementing Stateless Cross Domain Solutions to Continuously Maintain Security Assurances (14301)
1400 Cybersecurity Impacts of a Cloud Computing Architecture in Live Training (14120)
1430 Using Social Network Analysis to Model the Spread of Misinformation in Simulated Environments (14205)

Notes
IMPLEMENTING STATELESS CROSS DOMAIN SOLUTIONS TO CONTINUOUSLY MAINTAIN

2014 I/ITSEC Paper No. 14301

Christopher Huey, CISSP, OSCP
Parsons Corporation
Orlando, Florida

Kelly Djahandari, CISSP, Charles Kristofek
Northrop Grumman Information Systems
Orlando, Florida

The Combat Air Force (CAF) Distributed Mission Operations (DMO) Network uses cross domain solutions to interconnect networks operating at different security domains during scheduled training events. Implementation of cross domain solutions on the DMO Network helps achieve the CAF DMO vision of “train like we fight” to keep our air crews mission-ready. There is an increased risk that networked systems function with degraded security assurances caused by the system’s continuous exposure to harmful actions such as inadvertent installation of malware (viruses, rootkits, spyware, worms), unauthorized changes made to the system security configurations, and unintended introduction of exploitable vulnerabilities caused by system users. Although cross domain solutions are designed to be resistant to attacks, it is prudent to ensure the system is operating in a known secure state to reduce the risk of exploitation of unidentified vulnerabilities. Maintaining a high level of security assurance is critical since cross domain solutions must be trusted to correctly and consistently adjudicate the release of data between two different security domains according to established security policies. A cross domain solution that consists of a read-only disk, no hard drive, and lacks writable non-volatile storage (stateless system) will provide an innovative and cost-effective approach to greatly reduce the risk of degraded security assurances. This paper discusses the need for evolution to a stateless cross domain solution and explains how a stateless cross domain solution can be implemented to maintain the required security assurances throughout system operations. This paper provides the technical and accreditation challenges associated with implementing a stateless cross domain solution. Finally, this paper describes potential solutions for mitigating security risks associated with stateless system implementations.

CYBERSECURITY IMPACTS OF A CLOUD COMPUTING ARCHITECTURE IN LIVE TRAINING

2014 I/ITSEC Paper No. 14120

Graham Fleener
U.S. Army PEO STRI
Orlando, FL

Dr. Cliff Zou
University of Central Florida
Orlando, FL

Jason Eddy
AIT Engineering
Orlando, FL

Today’s live training environment is comprised of many systems in various states of configurations with a limited ability to leverage shared services. The future of live training systems will evolve to a Training as a Service (TaaS) state to reduce overall operating costs, implement new technologies to improve the training experience, and centrally manage the training exercise of distributed training systems. With a TaaS approach to system architecture, a number of new cybersecurity and DoD Information Assurance requirements will need to be implemented in order to ensure the Confidentiality, Integrity, and Availability of DoD information Systems. Previous papers (Lanman and Linos, 2012) have outlined in greater detail the motivation and migration strategy for a pilot study on implementing TaaS within the Common Training Instrumentation Architecture (CTIA) used by the Army’s Live Training Transformation (LT2) Product Line. This paper will present a number of cybersecurity threats, challenges, requirements, and commercial best practices for secure operations as well as Certification and Accreditation (C&A) requirements of a TaaS approach. Threats not previously present in isolated system architectures will now need to be countered with appropriate defense mechanisms across physical and logical boundaries. This paper will describe and discuss cloud computing guidance for cybersecurity from the U.S. Army Chief Information Officer/G-6 guidance, National Institute of Standards and Technology (NIST), and the Defense Information Systems Agency (DISA). This paper will present a strategy for implementing commercial best practices to facilitate secure operations of a cloud computing approach to live training. Finally, the purpose of this paper is to provide an overview of the security requirements associated with cloud computing, document the certification process necessary to achieve an Authorization To Operate (ATO) for a cloud implementation, and discuss unique best practices associated with a PM TRADE implementation of a TaaS architecture.
A central question for social interaction is to recognize the circumstances under which exchange of information will lead to the spread of misinformation (incorrect information) and how misinformation spread can be stopped. What is unclear is the importance of variables within networks in curtailing the spread of misinformation. Specifically, if we were trying to stop the spread of misinformation within certain network types (i.e. clustered, small world, scale-free) what network elements should we consider most important, given that we may not know where the misinformation is arising from? We pose this research question: what are the relationships between network types and misinformation spread inventions types? Using simulated models we find that only in the small world network setting do we see a statistical difference in the misinformation spread rate among the four intervention types (random placement, and targeting based on degree centrality, betweenness centrality and closeness centrality). We also find that the misinformation spread rate for the three network settings is different only in the case of the closeness centrality targeted intervention type and not in the others types. Next, we apply this model to a virtual world training scenario under which basic social network principles are taught to help soldiers recognize how to infiltrate networks that may cause misinformation spread.
CLASSIFYING STRESS IN A MOBILE ENVIRONMENT
2014 IITSEC Paper No. 14195

Sara Dechmerowski, Brent Winslow, George Chadderdon, Tarah N. Schmidt-Daly, David Jones
Design Interactive Inc.
Oviedo, FL

Over half of all Veterans suffer from stress-related illnesses; of particular concern is PTSD. In addition to supporting post-deployment stress treatment, it is critical to integrate stress inoculation training pre-deployment to teach proper coping mechanisms and prevent the PTSD cycle from starting. A challenge with developing such training is the objective, real-time monitoring of stress across trainees. Current methods for stress monitoring are laboratory-based (not mobile), and episodic in nature (e.g. self report). Wearable physiological sensors provide a quantitative assessment of stress (such as heart rate variability and electrodermal activity); however, the main challenge with these technologies is the lack of robust algorithms to classify stress in a mobile environment in real time. Physiological sensors are often activated by other inputs such as temperature and physical activity, and individual differences (e.g. age, gender, health status) and daily activities (e.g., physical movements, environmental changes, caffeine intake) pose a complex problem in achieving an accurate classifier. A review of several stress monitoring algorithms published in literature has been conducted and applied to a study designed to collect the high quality data necessary for modeling and development of a classifier that accurately detects stress in a mobile environment in real-time. The study procedures, results, and development of this algorithm are outlined, including use of unobtrusive hardware and robust logic to disseminate between psychological stress and physical activity. Although the main objective of developing a mobile classifier using non-invasive sensors to classify stress with over 85% accuracy was achieved, further refinement is needed to maintain the high level of accuracy across a variety of users and environmental conditions. Future research will include further accuracy refining through reduction in environmental noise and a smart algorithm to learn individual user stress thresholds. Applications for this research within the military and others are discussed.

INVESTIGATION OF THE SENSITIVITY OF PHYSIOLOGICAL, PERFORMANCE, AND SUBJECTIVE MEASURES FOR IDENTIFYING CHANGES IN NOVICE INTELLIGENCE ANALYST WORKLOAD
2014 IITSEC Paper No. 14035

Lisa Tripp, Robert Nelson, Elliot Humphrey, Chad Tossell
Air Force Research Laboratory
WPAFB, OH

Jennifer Winner, Jerred Holt
Lumir Research Institute
WPAFB, OH

The United States Air Force has a vested interest in advancing intelligence, surveillance, and reconnaissance technologies. Although software and hardware testing is performed for these technologies to demonstrate functionality, only limited research has investigated the effect of these tools on human performance. This research describes a process for the identification of suitable metrics to assess the effectiveness of new ISR technologies. We used several factors to determine the potential suitability of candidate measures including their relative sensitivity, reliability, content validity, and task intrusiveness. Additionally, the sensitivity of several measures, including performance-based, physiological and subjective measures, for the discrimination between levels of difficulty of imagery analyst tasking were compared. Twenty participants from a school for training intelligence analysts volunteered. Real recorded footage from two imagery types, wide area motion imagery and full motion video, was presented to analysts in short video clips. Tasking for each clip was provided prior to viewing. Tasking was developed by a subject matter expert and validated by five career analysts who independently rated the tasking in terms of difficulty. Performance data showed a significant difference based on difficulty of tasking as predicted ($F(1,19) = 220.32, p < .001$), as did subjective difficulty ratings assessed by the NASA-Task Load Index ($F(1,19) = 12.84, p < .01$). The sensitivity of physiological data to difficulty was mixed. Significant differences based on difficulty rating were identified for fixation duration ($F(1,14) = 5.30, p = .037$) and saccade duration ($F(1,14) = 15.13, p < .01$). However, no significant differences were identified in heart rate or heart rate variability ($p > .05$).
TRAINING WITH ADAPTIVE SYSTEMS: UTILITY OF BAROREFLEX SENSITIVITY

2014 IITSEC Paper No. 14297

Warren D. Franke, Amanda A. Anderson, Nir Keren, Andrew F. Lilja, Kevin M. Godby
Iowa State University
Ames, IA

Significant resources have been invested toward the development of systems that adapt to user functional state in real-time and based on users’ physiological responses, where the user may be in a wide array of stressful situations. These adaptive systems are promising as platforms to enhance training effectiveness, yet progress to date has been somewhat limited.

The physiological responses to a stressful situation have been characterized as “fight-or-flight” or “challenge vs. threat” responses. The cardiovascular changes associated with these responses are mediated by the autonomic nervous system and include both central (e.g., heart rate, stroke volume) and peripheral (e.g., blood pressure, total peripheral resistance) changes. Blood pressure (BP) is modulated acutely by the baroreflexes. Baroreceptors are stretch-sensitive mechanoreceptors located in the vasculature which provide negative feedback to the brain; changes in BP change this stretch and ultimately lead to changes in BP and heart rate (HR). Both physical exercise and mental stress can increase HR and BP. However, baroreflex sensitivity is unchanged with physical exercise and limited evidence suggests it is altered with mental stress. Changes in baroreflex sensitivity may therefore provide an objective marker for mental stress that HR- and BP-based markers cannot. Thus, real-time monitoring of baroreflex sensitivity may be the missing component for bridging the gap in developing an effective adaptive system.

Consequently, the purpose of this study was to assess the extent to which baroreceptor sensitivity changes during acute physical stress (cold pressor test), laboratory-based mental stress (Stroop test, mental arithmetic, anagrams) and using a virtual reality environment, stressful occupationally-relevant “real-life” simulations.

We will then propose a framework for the utilization of baroreflex sensitivity measures as a tool for assessing laboratory and occupational stressors in real-time.
A NOVEL APPROACH TO DETERMINE INTEGRATED TRAINING ENVIRONMENT EFFECTIVENESS
2014 IITSEC Paper No. 14011

LTC Glenn A. Hodges
Naval Postgraduate School
Monterey, California

This paper discusses the development and use of an analytical assessment methodology anchored in systems engineering principles, affordance theory, and human abilities, to measure the potential of integrated training environments (ITE) to effectively support training. An integrated training environment is defined here as any human in-the-loop training system that includes live, virtual, constructive or game-based training aids, devices, simulators, or simulations (TADSS) alone or in combination, used to support the deliberate practice of skills for defined mission tasks. Empirical investigation of ITE is costly, lacks formal guidance, and is therefore often unreliable. Ad hoc studies, commissioned by individual organizations, constitute the current state of Army ITE evaluation. These assessments are often entirely based on subjective opinions gained through surveys, which produce results that are linked indirectly and loosely to the ITE. What is required is a repeatable, inexpensive, analytical approach to ITE assessment that bounds the potential of a given system to the support it provides to the deliberate practice of specific tasks. The results of this research include the development and use of the integrated training environment assessment methodology (ITEAM). ITEAM was used to evaluate the ability of several ITE to support the deliberate practice of specific tasks during training. During application, ITEAM consistently predicted where training was supported by an ITE and generally how well. ITEAM is offered as a tool to be used early in the material acquisition process to affordably define and verify the requirements of candidate ITE solutions for Department of Defense needs.

PISTOL SKILL ACQUISITION AND RETENTION: A 3-YEAR LONGITUDINAL STUDY
2014 IITSEC Paper No. 14042
Gregory P. Krätzig
Royal Canadian Mounted Police
Regina, Saskatchewan Canada

This paper will build on previous research designed to investigate the effects that pistol training, in a no-recoil synthetic environment, has on skill acquisition, the transferability of this skill in situ (Krätzig, Parker & Hyde, 2011), and the long term implications on skill retention. Krätzig et al (2011) found that live-fire training was not necessary for pistol skills acquisition nor was it needed when testing occurred in a live-fire setting. However, two areas of investigation were missing. The first was to measure performance after introducing live-fire before each Benchmark test. The second was to investigate the long term effects that this type of training has on pistol shooting skill retention (e.g., annual firearms recertification). This paper will present three follow-up lines of research. Two hundred and fifty-six Cadets [i.e., 128 Cadets (control group) vs. 128 Cadets (experimental group)] were used for this study, with ninety-six Cadets being trained in the synthetic environment. The three lines of research are: 1) The effects of this training on skill retention in the field for three consecutive years. 2) Will adding live-fire training before each test improve performance and what effect does this have on skill retention in the field? 3) Results of a replication study. Although evidence was found that skills transfer from a synthetic training environment to a live-fire setting (Krätzig, et al., 2011), unknown were the long term effects on skill retention, and as such results of a 3-year longitudinal study will be reported. Additionally a potential confound was identified following the Final Benchmark Test from the Krätzig et al (2011) study. Krätzig argued that because the first time these Cadets fired a live-fire weapon was during their Benchmark tests, that the unfamiliarity of the recoil, concussive blast, noise, etc resulted in lower scores and an increase in the failure rate during the Benchmark tests. In an effort to determine if overall performance could be improved, it was decided that live-fire training would occur preceding each Benchmark test. These results will be discussed in full. There is increasing evidence that supports integrating technology into the basic 24-week training program; however, it was important to replicate the Krätzig et al., (2011) study. The third area of discussion will present the results of the replication study.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
EFFECTIVE LVC TRAINING: PERSONNEL RECOVERY’S EXPERIENCE WITH INTEGRATED SENSOR TECHNOLOGY

Curtis Wray, Mark Speed and Timothy Rodabaugh
Ball Aerospace & Technologies Corp
Fairborn, Ohio

Ms. Kristen Barrera
Warfighter Readiness Research Division 711 Human Performance Wing Wright-Patterson AFB, Ohio

Special operations training presents a unique challenge for exploring the application of live, virtual, and constructive (LVC) training opportunities. Personnel Recovery (PR) operators (Pararescue, Combat Rescue Officers, and Survival, Evasion, Resistance and Escape) have specialized and widely varying training needs placing unique requirements on the training system. The objective is to carry out meaningful training and therefore the training system itself must be flexible and minimally invasive to the trainee. Present training of PR operators typically does not exploit modern training systems. By augmenting the PR operators training with LVC technology and rich time-synchronized after action review capabilities, training can be far more effective. The Air Force Research Laboratory has extensive experience in research and development (R&D) for fast jet LVC. This paper discusses AFRL’s efforts to extend LVC development to the PR domain. The LVC Sensor Integration for Data Fusion in Operations and Training (SIDFOT) effort presents unique challenges for instrumenting live participants, collecting physiological metrics, observing and collecting data for the training exercise and robustly supporting after action review. This paper summarizes the recent efforts in integrating PR training into an LVC research infrastructure. The paper is divided into sections that cover newly integrated LVC technology, after action review, the PR training scenario and method, and concludes with results from the final PR demonstration. Each training scenario was performed in two parts, one with and one without the technology augmentation. By comparing the results, the authors were able to assess the overall value of LVC technology augmentation to training. Effectiveness results, with an emphasis on after action review, are further broken down into categories exposing which LVC capabilities and technologies yield the greatest gains in training effectiveness.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320F
H-3 A Cornucopia of Human Behaviors

0830 In Search of Interoperability Standards for Human Behavior Representations (14027)

0900 Factors Impacting Performance in Competitive Cyber Exercises (14108)

0930 Cognitive Processing Considerations of the Small Unmanned Ground Vehicle (14134)

Notes
IN SEARCH OF INTEROPERABILITY STANDARDS FOR HUMAN BEHAVIOUR REPRESENTATIONS
2014 I/ITSEC Paper No. 14027

Glenn Gunzelmann, Chris Gaughan
U.S. Air Force/Army Research Laboratory, USA

Wim Huiskamp, Karel van den Bosch
TNO, The Netherlands

Thomas Alexander
FKIE Human Factors, Germany

Agostino G. Bruzzone, Alberto Tremori
DIME University of Genoa, Italy

There is a long history of research to create capabilities that address the need for human behaviour representations in training simulations and other M&S application domains. In training, human behaviour models have applications as synthetic teammates and adversaries, but can also be used as a representation of the state of the trainee and as synthetic instructors to increase the effectiveness of the training enterprise as a whole. They are essential components for achieving the goals for training simulations and for Live, Virtual, Constructive (LVC) training, including affordability, availability, and credibility. Over the last two decades, numerous formalisms and architectures for modelling cognition, performance, and other relevant characteristics of the human being have emerged, and the capabilities and applications have expanded dramatically. However, models vary along many dimensions, including fidelity, application domain, underlying modelling formalisms, and behavioural repertoire. This diversity leads to critical challenges with respect to interoperability and reuse, in particular the integration of component models into a comprehensive behaviour model, and the integration of behaviour models into simulation environments. The challenges are further complicated by a lack of standards for human behaviour modelling, leading to brittle models, lack of reusability, and increased costs driven by the requirements of model integration and reengineering. In this paper, we discuss the need for human behaviour modelling, its role in supporting affordable, available, and credible training experiences in simulation and LVC environments, and propose a reference architecture to enable interoperability standards that support a variety of models serving a diverse set of purposes, both within and beyond the training domain. The authors represent a North Atlantic Treaty Organization (NATO) Modelling and Simulation Group (NMSG) activity focused on developing a baseline reference architecture and interoperability standards for human behaviour modelling to facilitate the creation and integration of human behaviour representations into simulation.

FACTORS IMPACTING PERFORMANCE IN COMPETITIVE CYBER EXERCISES
2014 I/ITSEC Paper No. 14108

Austin Silva, Jonathan McClain, Theodore Reed, Benjamin Anderson, Kevin Nauer, Robert Abbott & Chris Forsythe
Sandia National Laboratories
Albuquerque, NM

Many opportunities are available for training that involves participation as either individuals or teams in competitive events. Cyber security has proven conducive to this form of training. In competitive cyber security exercises, participants are usually provided with standardized hardware and software, including various software tools for cyber forensic analysis. Generally, performance is assessed on the basis of points awarded for completing challenges presented to the participants. Ideally, through thorough instrumentation of the software environment, instructors and test coordinators would be provided with detailed data concerning the performance of individual students, as well as their unique training needs. The research described here provides an illustration of such instrumentation implemented within the context of a competition-based cyber security exercise (Tracer FIRE). The study considered factors that contributed to successful performance within the competition. Emphasis was placed on the use of software tools by participants, including tools provided by the exercise coordinators and tools acquired online by participants during the event. Resulting findings provide the basis for recommendations to competition coordinators regarding key facets of the software environment and cues that individual participants are struggling and there is need for training intervention.
COGNITIVE PROCESSING CONSIDERATIONS OF THE SMALL UNMANNED GROUND VEHICLE

Victor J. Ingurgio
ARI-Fort Benning
Fort Benning, GA

Richard Catrambone
Georgia Institute of Technology
Atlanta, GA

Richard L. Wampler
Northrop-Grumman Corporation
Columbus, GA

Handheld applications (apps), such as those run on Android and iPhone devices, hold the possibility of revolutionizing military training by increasing the availability and engagement of training material. This paper describes progress on software design and development towards a general framework for deploying Android training apps. A primary objective is to allow nonprogrammers to reuse existing content to create training apps that make full use of the capabilities offered by mobile devices. The described prototype implementation includes a web page where the end user fills out a form, uploads content, and receives an email with a link that they can follow (and share with others) to download their app directly to their device.

The main contributions of this paper are: The requirements that led to the framework design, the description of the implemented framework, and a summary of qualitative feedback received from targeted demonstrations. While this framework has been developed with a focus on military training, it is broadly applicable in a civilian educational setting as well.
LEVERAGING SIMULATION TO AUGMENT RISKY DRIVING ATTITUDES AND BEHAVIORS

2014 I/ITSEC Paper No. 14004

Karen L. Morris
Center for Children and Families
Buffalo, NY

Gregory A. Fabiano
Counseling, School, and Educational Psychology
Buffalo, NY

Kevin F. Hulme
NYSC EDII
Buffalo, NY

Young, novice drivers continue to be responsible for a disproportionate amount of negative driving outcomes. A novice driver’s lack of: i) exposure, ii) semantic knowledge of driving situations, and iii) understanding of risky situations make them particularly vulnerable to costly mistakes while driving. Texting while driving (TWD) is a behavior commonly engaged in by novice drivers that greatly increases the risk for accidents, injuries and mortality. Cell phone use while driving causes deficits in performance (e.g., impaired attention to signs; braking and lane positioning deficits due to visual, motor, and cognitive distraction). While many drivers recognize that TWD is a serious problem, many admit to engaging in the behavior frequently. Studies have demonstrated that drivers perceive their own distracted driving performance to be better than their actual performance. This suggests that drivers may be engaging in dangerous behavior because they believe it affects the driving performance of others, but not their own. This is a major ongoing public health concern. Past studies have suggested that receiving concrete performance feedback can correct perceptions of risk of driving while engaging in a distracting task, and improve subsequent driving performance. In this regard, Simulation can serve an effective tool for Education and Training. Accordingly, the current study leverages a high fidelity driving simulator to provide performance feedback for a pilot cohort of novice adult drivers while driving distracted. The primary goal is to change attitudes towards and subsequently reduce TWD behavior with the use of the performance feedback during the simulated TWD exercise. Along with the simulator-acquired data and graphs (e.g., speed, lane position), TWD behaviors are measured objectively with a performance monitoring “Car Chip” device installed within each participant’s vehicle during the study observation period. Car Chip records including the dates and times of each participant’s drives are compared against each participant’s text messaging records (containing dates and times of texts sent or received) for any overlap, objectively measuring in-vehicle TWD behavior. The current study presents a novel approach for evaluation and intervention to reduce distracted driving behaviors specifically for the most at-risk driving population.

A VALIDATED AND INTEGRATED SIMULATION FRAMEWORK FOR HUMAN FACTORS ANALYSES

2014 I/ITSEC Paper No. 14006

Yunfei Hou, Jingyan Wan, Yunjie Zhao
University at Buffalo, Buffalo, NY

Kevin F. Hulme
NYSC EDII
Buffalo, NY

Changxu Wu, Adel Sadek, Chunming Qiao
University at Buffalo, Buffalo, NY

Transportation simulation researchers commonly institute two distinct simulation platforms that are often implemented independent of one another. Traffic Simulation models emulate the macroscopic or mesoscopic behavior of ground vehicles, while Driving Simulators are used to examine microscopic driver behavior within a virtual environment. This research sees the integration of these heterogeneous simulation platforms, which broadens the range of applications for which both simulator types are applicable. The integrated simulation framework has been validated by having several human subjects drive a segment of a signalized arterial in both the artificial environment and on the corresponding real-world roads, during (simulated and actual) rush hour traffic. Various data is collected within the integrated simulation framework, including timestamp, position, velocity, and accelerations, and comparable data is collected (and compared) when the human subjects drive the actual roads. The described framework is then deployed to focus on Human Factors (e.g., driver acceptance and preference) associated with autonomous control features anticipated in next-generation vehicles. In our experiments, participants were asked to assign the headway to a minimum value that they could “tolerate” (i.e., based on workload, confidence, comfort, safety and acceptance). The results demonstrate that most drivers prefer spacing between vehicles by relying on their judgment on distance, rather than headway (time). Future technology will be able to support autonomous vehicle operations, most likely with an evolving trajectory of acceptance, and the human factors element of accepting the technology may lag the deployment of the technology itself. Accordingly, simulator-based efforts to identify human tolerances on the roads have the potential to help to accelerate the adoption of these advanced autonomous technologies. This is the primary motivation for this study, which will help to inform the design of future autonomous vehicle applications, and will serve as a reference point for optimizing the route capacity of next-generation transportation systems.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
THE VIRTUOUS CIRCLE AND CONTEXTUALIZED KNOWLEDGE ELICITATION: APPLICATION OF A NEW PARADIGM FOR JOB ANALYSIS

Sterling Wiggins, Michael J. Keeney, Webb Stacy, Jeffrey M. Beaubien Aptima, Inc.
Woburn, MA

Jennifer Pagan Naval Air Warfare Center, Training System Division Orlando, FL

Amy Bolton Office of Naval Research Arlington, VA

Landing on the deck of an aircraft carrier is one of the most difficult and dangerous tasks that a Naval aviator must perform. Maritime Augmented Guidance with Integrated Controls for Carrier Approach and Recovery Precision Enabling Technologies (MAGIC CARPET) is a technology intended to make carrier landing performance better and safer, and to reduce pilot workload. The workshop described in this report included a set of contextualized knowledge elicitation sessions that provided preliminary multi-faceted evidence that MAGIC CARPET leads to improved performance during landings and to lower participant workload. Contextualized knowledge elicitation collects a combination of system-generated data and self-reports together in real-time. The combination of system-generated data and self-reports can provide cues to guide investigations about perceptual-cognitive skills required for successful task performance in high-consequence environments. Self-reports can highlight where to look within voluminous system data to gain insights about operator or system performance. Similarly, system data can indicate where verbal follow-ups can provide additional context about the objective data that were collected. The workshop was held at the Manned Flight Simulation operation at Naval Air Station Patuxent River. Six Naval Aviator participants, representing various F/A-18 experience levels, plus two non-pilot engineers used the simulator to conduct carrier landings using both conventional and MAGIC CARPET technology. Participant and Landing Signal Officer (LSO) reports as well as physiological and simulator-based measures showed a strong, noticeable, positive effect of MAGIC CARPET on landing performance. Participants reported dramatically reduced workload and LSOs reported that MAGIC CARPET made less-experienced participants perform as well as experienced pilots. These subjective participant observations were borne out by objective measures. Finally, the workshop provided rich information about a future more formal experiment to assess the impact of MAGIC CARPET on pilots and on the pilot training pipeline.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320F

1400 Serious Game User Data Analysis and Visualization: Savoring the Breadcrumbs (14377)

1430 Sonification: The Sound of Big Training Data (14261)

1500 Creating a Learning Infrastructure Where Every Soldier Can Be an Instructor (14124)

Notes
SERIOUS GAME USER DATA ANALYSIS AND VISUALIZATION: SAVORING THE BREADCRUMBS

Brandt Dargue
Boeing Research & Technologies
St. Louis, MO

Dov Jacobson
GamesThatWork
Atlanta, GA

John Sanders
Historical Online Learning Foundation
Louisville, KY

Following the evidence of research in critical thinking and cognitive bias training, we developed training designed to demonstrate people’s decisions and actions affected by cognitive bias or elicit a bias in the player. Ideas were collected from and refined by experts with diverse backgrounds distributed geographically using an innovative solution. We then developed a video game that used multiple scenarios to teach cognitive bias recognition and mitigation. A learning and training effectiveness study indicated that the game was effective for learning although results were inconsistent for the different cognitive biases addressed by the game. The game recorded detailed data about scenes, scenarios and decisions each player made in the game. Called “breadcrumbs”, this data detailed the path every player took. Traditional statistical analytic techniques tend to be clumsy instruments for breadcrumb analysis. Additionally, early aggregation and dimension reduction make the data more tractable but less meaningful. This paper details specific examples of how the breadcrumbs – paired with the study data – provided valuable answers in pinpointing areas to improve the game’s learning effectiveness. The paper provides enough background information on the subject to enable the audience to appreciate the difficulty in cognitive bias training effectiveness and understand the examples shown. The majority of the paper discusses the data, the analysis, and the innovative data visualization techniques used. We discuss approaches that may prove more appropriate to extracting useful information from breadcrumb trails than traditional statistical analytic techniques. The audience will gain an understanding of the value of testing, data collection, and data visualization in training, education, simulations, and serious games. The paper will conclude with a discussion on using the techniques to improve the small batch testing in serious game development.

SONIFICATION: THE SOUND OF BIG TRAINING DATA

Nat Napoletano
Lockheed Martin, MST
Akron, OH

Instructor assisted warfighter training requires a system that allows the instructor to monitor individual and team progress while guiding the students to preparedness. Traditional instructor stations rely heavily on visualizations of the team’s geographical position and status, while confining the use of sound to voice communications and warning messages. Our experience of sound is unlike any of our other senses in its immediate temporal nature and speedy presentation of massive information. Since sound can be used to create a unique cognitive view of a team’s situation, by underusing sound, we may be discarding an opportunity to inform the instructor about student performance in numerous domains. The emerging technology of “Big Data Analytics” offers the promise of hastening and deepening the warfighter’s training progress while reducing training costs. Static data is most familiar to analysts who are developing sophisticated tools to extract, analyze and visualize important features. Streaming data is different in that it emerges in real time, eventually expires and demands immediate attention to be of optimal use. It’s temporal in a way that resembles sound and the human auditory system is uniquely positioned to analyze streaming data. Sonification is the technique of turning data into sound. This paper presents the results of a study examining three computer based sonification tools developed by the author and designed to render mission activity into sound. The sonifications represent diverse techniques designed to sonify individual and team metrics for mortalities, damage, weapons skills and accuracy, fuel status, emergencies and communications usage. This paper demonstrates that the concept is practical, potentially effective and notes what techniques were superior. This paper reviews the knowledge gained from this evaluation and presents a framework for future experimentation designed to collect statistical data from a larger community of users.
CREATING A LEARNING INFRASTRUCTURE WHERE EVERY SOLDIER CAN BE AN INSTRUCTOR

2014 IITSEC Paper No. 14124

Ed Sims, PhD, Irene T. Boland, PhD
Dan Silvergate, Jeff Cashion
Vcom3D, Inc.
Orlando, FL

Rodney Long, Charles Amburn
US Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center
Orlando, FL

In recent years, web sites featuring user-created content have become some of the most popular sources of information for the general population. Users consult Angie's List and Yelp! to locate vendors and services, DIY Network to learn how to fix or create something, Wikipedia for information on more than four million topics and numerous LinkedIn communities of practice to enhance their professional skills and networks. Fourteen of the twenty top web sites are populated in part or entirely by content created by users. By contrast, the collaborative support networks for warfighters are often fragmented, difficult to access and navigate and limited in useful content. And when experienced warfighters report lessons learned in the field, it can take two years or more for these lessons to be reflected in formal training. This often results in gaps between official training and best practice.

Under the Army Research Laboratory's Soldier-Centered Army Learning Environment (SCALE) program, a social media test bed was developed to identify crowd-sourcing strategies that can be adopted to ignite a similar revolution in military knowledge management. Our research has identified technologies, affordances, incentives and user attitudes that have helped to create the wealth of accessible user-generated knowledge available on the World Wide Web. In this paper, we will discuss our research and propose changes to Army technology and organizational culture that could improve the speed and effectiveness of managing and disseminating crowd-vetted knowledge for performance support.

THURSDAY, 4 DECEMBER, 2014 ROOM S320F
H-6 Shocking Medical Assessments

1330
Quantitative Assessment of Combat Casualty Skills (14191)

1400
Assessment Instrument Validation for Critical Clinical Competencies: Pediatric-neonatal Intubation and Cholinergic Crisis Management (14232)

1430
A Decision Support System Predicting Imminent Cardiovascular Shock (14343)

Notes
QUANTITATIVE ASSESSMENT OF COMBAT CASUALTY SKILLS

2014 I/ITSEC Paper No. 14191

Christine Allen, Ph.D. & Mark Mazzeo
Army Research Laboratory (ARL) Human Research and Engineering Directorate (HRED)
SFC Paul Ray Smith Simulation and Training Technology Center (STTC)

Brian Goldiez, Ph.D. & Amanda Romeu
University of Central Florida (UCF) Institute for Simulation and Training (IST)

Thomas Pingel
Joint Base Lewis McCord (JBLM) Medical Simulation Training Center (MSTC)

Evaluating proficiency in combat casualty training includes the assessment of hands-on training with mannequins through instructor observation. The evaluation process can suffer due to the subjective nature of the assessment: differences between instructor rating schemas, student to instructor ratios, and time to observe individual student performance. Because combat casualty care requires timely and accurate assessment for medical interventions, evaluators can look at the trainees’ physical actions (e.g., hand motion) to assess proficiency, as seen in suturing literature. The Lempel Ziv (LZ) complexity index is then used to assess proficiency. The LZ algorithm reduces complex strings of data (i.e., hand motion) to a string of 1’s and 0’s. The string is then broken into small “unique” strings that are grouped together. The pattern formed is a measure of performance with more complex patterns per unit of time indicating expertise. Expanding the current state of the art, experimentation occurs using several different precision tracking devices that are unobtrusive and require limited setup. During this effort, student hand motion is tracked and digitally stored as participants complete multiple tasks part of a cricothyroidotomy (emergency airway procedure in the neck). Motion data is subsequently processed using an algorithm adapted for text compression (LZ algorithm). Data has been gathered from nearly 100 military combat medic trainees at Joint Base Lewis McChord (JBLM) Medical Simulation Training Center (MSTC). Participant hand acceleration data from an emergency surgical cricothyroidotomy reveals a statistically significant difference in ability among different expertise levels. The higher the LZ score and self reported expertise level, the better the participant performed. The results show that when presented with demographic and video performance-based data, it is possible to gauge experience using LZ scores.

ASSESSMENT INSTRUMENT VALIDATION FOR CRITICAL CLINICAL COMPETENCIES: PEDIATRIC/NEONATAL INTUBATION AND CHOLINERGIC CRISIS MANAGEMENT

2014 I/ITSEC Paper No. 14232

Andreatta P, Klotz J
University of Minnesota Medical School
Minneapolis, MN

Madsen JM, Hurst CG
U.S. Army Medical Research Institute for Chemical Defense (USAMRICD)
Aberdeen, MD

Talbot TB
Telemedicine & Advanced Technology Research Center (TATRC)
Fort Detrick, MD

Background: Military and civilian first-responders must be able to recognize and effectively manage casualties that necessitate immediate application of critical clinical competencies. Two examples of these critical competencies are the clinical management of injuries resulting from nerve agents and difficult intubation, especially for pediatric or neonatal patients. The opportunity to learn and practice the necessary skills for these rare, but urgent, situations is complicated by the limited ability to replicate essential situational factors that influence performance in the applied clinical environment. Simulation-based training may resolve some of these challenges, however it is imperative that evidence be captured to document the achievement of performance competencies in the training environment that transfer to applied clinical care. The purpose of this study was to establish psychometric characteristics for competency assessment instruments associated with two such critical competencies: management of cholinergic crisis and pediatric-neonatal intubation. Methods: To inform the development of assessment instruments, we conducted comprehensive task analyses across each performance domain (knowledge, performance). Expert review confirmed content validity. Construct validity was established using the instruments to differentiate between the performance abilities of practitioners with variable experience (novice through expert). Purposively selected first responder subjects for pediatric-neonatal intubation (N=214) and cholinergic crisis management (N=123) were stratified by level of experience performing the requisite clinical competencies. All subjects completed knowledge and performance assessments. Reliability was established using test-retest (Pearson correlation) and internal consistency (Cronbach’s alpha) for knowledge and performance assessments. Results: Significantly higher scores for subjects with greater levels of experience, compared to those with less experience established construct validity for each assessment instrument (p < .01). Significant correlations between test-retest outcomes indicated measurement reliability p < .01. Cronbach’s alpha for knowledge and performance scores demonstrated excellent internal consistency. Conclusions: Psychometric evidence establishes the value of assessment for identifying and remedying critical competency performance gaps.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
A DECISION SUPPORT SYSTEM PREDICTING IMMINENT CARDIOVASCULAR SHOCK

2014 I/ITSEC Paper No. 14343
W. Andrew Pruett, Leland D Husband & Robert Hester
University of Mississippi Medical Center
Jackson, MS

The human dynamical response to hemorrhage is complex and difficult to predict. For medical personnel involved in a triage situation, correct prioritization of patient is of paramount importance. In this paper, we present a decision support system (DSS) whose purpose is to provide warning of imminent shock/decompensation. As inputs, the system utilizes only rudimentary clinical measurements: heart rate, blood pressure, respiratory rate, skin temperature.

A human experiences three phases of hemorrhagic shock: an initial tachycardic, a compensatory phase, which is followed by a bradycardic decompensating phase and finally a tachycardic irreversible decompensation that leads shortly to death. Recognizing that most triage situations will involve individuals in the second phase, we used the progression into the final tachycardia as the observational endpoint.

The DSS is a function constructed through machine learning techniques (support vector machines). The function takes serial readings of standard clinical measurements as inputs that are transformed into a simple signal that indicates whether decompensation is imminent. The measurements in this case are drawn from an in silico population. The population is generated using HumMod, an integrative model of human physiology. HumMod, as originally created, is a deterministic model. We have converted HumMod to a population model by allowing model parameters to vary uniformly. This proof of concept is described in a recent paper (PLoS One, PMID:24058546).

The constructed model classifies a data set as decompensating within two minutes or not with an accuracy of 93%, and a 70% accuracy on these patients that will decompensate. These facts indicate that, despite requiring minimal inputs, the model is a potent tool for predicting imminent irreversible cardiovascular shock in a manner that allows medical professionals to offer appropriate intervention. In a triage situation, such a model would allow for improved prioritization of patient needs.

TUESDAY, 2 DECEMBER, 2014 ROOM S320A
P-1 Managing Resources at Home and Abroad

1400 Resource Implications of the Difference between Models and Simulations (14020)
1430 COTS to Capability: Lessons Learnt from UK MOD Research Programme (14115)
1500 Perspectives on Exportability and Program Protection in Virtual Training Systems (14265)

Notes
RESOURCE IMPLICATIONS OF THE DIFFERENCE BETWEEN MODELS AND SIMULATIONS
2014 I/ITSEC Paper No. 14020

Thomas J. Yanoschik
SAIC / Maneuver Battle Lab
Fort Benning, Georgia

The purpose of this paper is to argue that given the constrained fiscal environment that the Department of Defense (DoD) is facing, mid-level policymakers must consider whether training or experimentation objectives can be met with low fidelity models rather than high fidelity simulations. In order to do this, they must understand perhaps the most basic lesson of modeling and simulation (M&S)—the difference between a model and a simulation. The paper will begin with a discussion of the difference between the terms and show they are often (incorrectly) used interchangeably. It will then transition to a case study where the Maneuver Battle Lab (MBL) and the Combat Developments Division (CDD) of the U.S. Army’s Maneuver Center of Excellence (MCoE) conducted a short suspense wargame for which a specific simulation was requested (out of a lack of knowledge of other available tools) but the desired endstate was achieved through the use of a low fidelity model. The conclusion is, for some training and experimentation cases, the DoD save significant resources through the use of low fidelity models while still achieving their objectives to standard. On the surface, a simple discussion (tutorial) of the differences between models and simulations would not be worthy of discussion, but under fiscal constraints it is imperative that M&S professionals ensure that policymakers understand the differences and how differentiating between the two may result in a significant savings of resources. The paper will also emphasize the point that selection of the proper tool, be it a model or a simulation, should be based on the experiment or training objectives rather than selecting the tool and then determining which objectives can be achieved. The paper will end with areas for continued research.

COTS TO CAPABILITY: LESSONS LEARNT FROM UK MOD RESEARCH PROGRAMME
2014 I/ITSEC Paper No. 14115

Kent, J.R., Stafford, A., Nicholls, A.P.
QinetiQ
Farnborough, Hampshire, UK

Shawl, C
Dstl
Portsdown West, Hampshire, UK

The future of training involves simulation, which is often delivered by Commercial Off-The-Shelf (COTS) products. This principle was embraced by the United Kingdom (UK) Ministry of Defence (MOD) in 2010, under its Strategic Defence and Security Review (SDSR), and heralded the beginning of a paradigm shift in the way the MOD customer viewed simulation and COTS solutions. Given budgetary constraints and the need for a flexible, adaptive training capability in support of future military operations, the commitment to embrace COTS is a bold and sound step. However, whilst COTS offers obvious advantages, there is a perception that COTS provides the entire answer, and that procuring a training capability is as simple as walking into a store, picking a training solution from the shelf, taking it home and plugging it in. Unfortunately, although this approach can work for commodity items, it’s not always suitable as the basis for developing mission-critical training capability. In particular, the technical specification or level of innovation in an COTS product are not the only things that customers should consider when contemplating their options. They need to ask if they have considered the implications for meeting the training objectives, technical integration, safety, business or procurement or commercial processes, and legislative compliance. Does the training task really need a 6 Degree of Freedom motion platform? Does a foreign product meet your country’s safety legislation? Can the product be easily integrated with existing solutions? Asking the right questions early can save time and money and avoid disappointment. This paper reports the lessons-learnt during a series of training-related Technology Demonstrators undertaken under a MOD-funded research programme investigating COTS. The lessons are presented in a simple check-list to help providers and customers manage and mitigate risks early in planning and delivery phases, helping to maximize the benefits gained from exploiting COTS.
PERSPECTIVES ON EXPORTABILITY AND PROGRAM PROTECTION IN VIRTUAL TRAINING SYSTEMS
2014 IITSEC Paper No. 14265

Michael Coleman & Ricky Denny
Naval Air Warfare Center, Training Systems Division
Orlando, Florida, USA

Department of Defense (DoD) and industry acquisition integrated product teams delivering virtual training systems to international customers must consider exportability and program protection issues common to, and often beyond, those of the corresponding live platforms. DoD Instruction 5000.02 requires DoD program managers to consider exportability and program protection throughout the acquisition lifecycle, ensuring the ability for international partners to procure defense articles while mitigating risks of potential loss of critical program information or technology to potential adversaries. Virtual training systems may contain classified military information, controlled unclassified information, or proprietary information required to replicate or simulate the live platform and its behavior in a synthetic environment. DoD’s ability to provide Government-furnished information for International Armament Cooperative Programs and Foreign Military Sales programs is constrained by numerous DoD policies and issuances as well as federal law. Incorrect assumptions by industry, DoD, and international customers regarding DoD’s ability to provide classified military information, controlled unclassified information, or proprietary information may lead to cost and schedule overruns and inability to provide capabilities previously advertised to the customer. This paper defines perspectives on exportability and program protection in the DoD acquisition lifecycle and discusses the relevance of these perspectives to acquisition of virtual training systems. After defining methods of international acquisition of defense articles, the paper aggregates numerous DoD issuances regarding exportability and program protection into perspectives that DoD acquisition personnel may reference in drafting documents and conducting other program activities relating to virtual training system acquisition. The paper concludes with recommendations for DoD, industry, and international customers to consider with the mindset of delivering a valid training system within customer cost and schedule constraints.

TUESDAY, 2 DECEMBER, 2014 ROOM S320A
P-2 Commonality and Data Sharing in the LVC Environment

1600 LVC, Translating DoD Policy into Action (14059)
1630 Data Sharing: The Standard Specification is Just the Start (14130)
1700 Establishing Sharing for Geospatial Environment Data (14255)

Notes
LVC, TRANSLATING DOD POLICY INTO ACTION
2014 I/ITSEC Paper No.14059

LCDR Daniel Cain, USN; CAPT Robert Snyder, USN (Ret.)
OPNAV N980T
Arlington, VA

“I don’t know what the hell this "logistics" is that Marshall is always talking about, but I want some of it.”
- Admiral E. J. King (1942). As with WWII logistics, today’s Services’ leadership also “…want some of it…” when referring to Live, Virtual and Constructive (LVC) capabilities. They use the term ‘LVC’ to conceptualize a futuristic rendition of affordable, net-centric warfare training. However, current DOD policy on LVC minimizes actionable direction and definition that is needed to ensure a Joint as well as Service approach to LVC training. For example, DOD Directive 1322.18 Military Training policy does not identify an LVC Service lead, nor does it provide any guidance or standardization to ensure inter-Service LVC interoperability. Also, key technical elements such as a 5th generation waveform and security encryption have been left to each Service to solution/innovate independently. As a result, each Service has separately invested in LVC Modeling and Simulation (M&S). These individual, costly approaches are a barrier to interservice LVC compatibility.

Perhaps DOD, as well as individual Service LVC policy should include direction to exploit an integrated LVC approach to both Training and Test and Evaluation (T&E) requirements. In the past, the Services addressed separately LVC M&S investments to support either Training or T&E requirements. A common investment strategy to both Training and T&E requirements coupled with a cooperative LVC strategy would assure affordable inter-Service as well as Training and T&E LVC development.

This paper will first provide some background into the LVC journey from a Naval Aviation perspective. Next, the paper will identify key barriers to interservice LVC implementation. Finally, the paper will propose a clarified DOD-wide LVC definition along with policy direction to overcome LVC barriers and facilitate the translation of LVC policy into actionable, coherent, funded Programs of Record.

DATA SHARING: THE STANDARD SPECIFICATION IS JUST THE START
2014 I/ITSEC Paper No.14130

Robert F. Richbourg & George E. Lukes
Institute for Defense Analyses
Alexandria, Virginia

Data sharing across multiple lines of effort is an often-cited component of reducing costs, improving efficiency, supporting interoperability, and providing other potential benefits. However, achieving a state where data can be readily shared is far from trivial and, as a first step, requires standards to be universally accepted among the data users. To achieve real success, many other steps must follow.

The Multinational Geospatial Co-production Program (MGCP) is an international cooperative effort where 32 nations together are coordinating the production and sharing of digital geospatial data that will eventually provide high-resolution vector data at a scale equivalent of 1:50,000 or 1:100,000 for much of the world’s landmass. The MGCP is a successful data sharing program that continues to provide benefits for all member nations. As an example, much of the 1:50,000 data that was used in Afghanistan was produced by 7 different MGCP nations. All of the multi-purpose Atlas data the United States used to provide humanitarian relief in Haiti following the 2010 earthquake was produced from MGCP data. While there are many other success stories, the enduring value of the MGCP extends beyond its ability to provide timely, accurate geospatial data. The MGCP is a role model exemplifying the potential benefits of standards that are fully supported throughout the enterprise.

This paper describes key components of the MGCP effort, starting with the MGCP standard development processes and the importance of the supporting technologies that the MGCP has put in place to complete the standards. These include mechanisms for standards evolution, adjudication, compliance assessment, and enforcement. After developing these elements, the paper describes how they could be extended to provide similar benefits to other problem areas and thus form a domain-independent model for successful data sharing.
ESTABLISHING SHARING FOR GEOSPATIAL ENVIRONMENT DATA

Mark Faulk
Cornerstone Software Solutions
Oviedo, Florida

Robert Cox & Bill Reese
U.S. Army PEO STRI
Orlando, Florida

Live, virtual, constructive, and gaming (LVC-G) integrated training environments bring challenges to data providers with increased target formats for geospatial environment data and visual models. New sharing points along the processing pipeline support consumer expectations of both managed correlation for interoperability and fair fight and optimized runtime content. Sharing points now include cleaned source, intensified source, confederate differentiated source, and runtime formats providing benefit of increased interoperability and fair fight through managed, well-defined levels of correlation. While datasets available from a single provider have increased, so has the number of providers bringing differing standards and conventions. With this increased sharing comes the complexity of managing the number and variety of datasets and providing efficient search and retrieval by data consumers. Oftentimes consumers ask for data from one sharing point without fully realizing the intended use for that share, resulting in poor reuse performance and consumer frustration. Maximum reuse requires incorporating externally developed, value-added data submitted with a variety of formats, data models, dictionaries, fidelity, and specialization levels. Provider reuse policies must balance between accepting un-validated data, risking contaminating their repository and full data validation which may be as costly as using raw source data. Effective data sharing across this vast set of available data possesses potential for improved approaches to managing the acquisition of geospatial environment data for the M&S community. Multiple initiatives have been established or proposed to address the standardization of metadata, exchange protocols, and data product formats toward improved interoperability both between sharing sites and with consumers. This paper describes how some of those efforts are converging to support improved human and machine discovery and selection and interoperability between providers. We describe real world experiences solving these problems from the perspective of a large data provider and propose future direction for effective data sharing.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320F
P-3 Wave of the Future

1600
Agile Program Management on Software Intensive Training Systems (14311)

1630
Simulations in the Cloud – A Manager’s Challenge (14104)

1700
Continuous Monitoring of Cybersecurity in a Training System Environment (14121)

Notes
AGILE PROGRAM MANAGEMENT ON SOFTWARE INTENSIVE TRAINING SYSTEMS

2014 I/ITSEC Paper No. 14311

Gregory Owens, Petra L. Robinson, Barry Minchey
Naval Air Warfare Center, Training Systems Division
Orlando, Florida

For years, training systems acquisitions supporting Department of Defense (DoD) programs have used the Systems Engineering Technical Review (SETR) process to guide system development. Programs using SETR are driven toward traditional waterfall methodologies, leading to a development process that can be rigid, expensive and time consuming. The traditional SETR process may not be the best approach for software intensive training system development. The Information Technology (IT) industry makes widespread use of Agile practices in the management and development of software. This paper is based on the results from a literature review and interviews with program teams who recently used or are actively using Agile methodologies. The DoD programs can take advantage of these practices to reduce cost, deliver training capability to the warfighter sooner and with fewer overall technical defects. The intent of this paper is to inform the Defense Modeling and Simulation Training community on the possibility of shifting to Agile project management on DoD software intensive training systems. The paper will discuss benefits and possible drawbacks of shifting to Agile methodologies, applicability to software intensive training system projects, implementation concerns, contract development issues, and future activities which may lead to greater success. This paper may be of interest to a wider government audience that may be struggling with similar challenges and have a need to maximize budget effectiveness while delivering capabilities on a tight timeline.

SIMULATIONS IN THE CLOUD – A MANAGER’S CHALLENGE

2014 I/ITSEC Paper No. 14104

Lawrence A. Rieger, CMSP
U.S. Army Capabilities Integration Center
Fort Eustis, VA

In August 2013, The Army Capabilities Integration Center (ARCIC) Director challenged that ARCIC could save big dollars if we could put OneSAF “in the cloud” in the Army Battle Lab Collaborative Simulation Environment (BLCSE). What seemed like a simple technical migration was actually a significant change in the way simulations and simulation federations would be structured and operated within a major distributed simulation environment (BLCSE). Software (including M&S) as a service is the push of the DoD Cloud Computing strategy, and the necessary result of the decreasing resources available to military M&S for large distributed simulation federations and events. DoD must maintain a trained and ready force, relying on simulations to both define and design the future force as well as ensuring it is properly trained. Given Federal Government and DoD cloud policy, it’s not a matter of if, but when and how, our simulations will move to the cloud. This paper provides a detailed introduction to what it means to have your simulations “in the cloud” together with practical planning steps and lessons learned for the migration of a distributed simulation network into a community cloud environment, with particular attention to the Mission Analysis planning process and the federation management processes which require change. The author addresses the technical architecture problems associated with cloud computing, community issues of network redesign and the DoD Information Assurance Program (DIACAP)/Risk Mitigation Framework as well as the resource investment and cost benefit analysis for distributed workstations vice central blade servers or rack servers. The more demanding configuration management and configuration control issues of simulation federations in the cloud, providing Modeling and Simulation as a service, are also addressed. Virtualization is a major component of the ARCIC BLCSE Modernization initiative, with summer 2014 initial technical evaluations and detailed modernization technical review being addressed.
CONTINUOUS MONITORING OF CYBERSECURITY IN A TRAINING SYSTEM ENVIRONMENT

2014 IITSEC Paper No. 14121

Graham Fleener & Marco Mayor
U.S. Army PEO STRI Orlando, FL
Andrew Maxon
Cybernet Systems Corporation Orlando, FL

There are a number of upcoming paradigm shifts within Information Assurance (IA), to include policy and technical mandates, affecting IA in today’s training and simulation systems. Maintaining situational awareness of a system’s IA posture has been a challenge DoD wide. Specifically, in the training and simulation community it has been especially difficult given the closed, restricted networks the systems create or may intermittently traverse. A number of DoD wide policies and technical solutions have been developed and procured to ensure a system owner has continuous oversight of their system’s IA posture. Over the years the Defense Information System Agency (DISA) has provided tools and solutions to Project Managers (PMs) to easily assess a given systems IA posture at a given time. The most popular example of these tools was the Gold Disk. However, the Gold Disk program was discontinued in 2012. Next came a suite of products much more scalable and robust in capabilities, but also with significant complexity. Assured Compliance Assessment Solution (ACAS), Host Based Security System (HBSS), and Continuous Monitoring and Risk Scoring (CMRS) are a few of the latest DISA licensed Commercial Off The Shelf (COTS) and Government Off The Shelf (GOTS) solutions available to PMs for integration into their systems at no cost. These solutions were designed for an enterprise Information Technology (IT) environment, but must be scaled to integrate with training and simulation systems. This paper will discuss the continuous monitoring requirements, benefits, emerging security practices, implementation concepts, and a training system example. This paper will document how the U.S. Army Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) is addressing the growing cybersecurity threats through continuous monitoring and improved situational awareness by leveraging DISA licensed COTS and GOTS solutions to secure training and simulation systems. All DISA licensed COTS and GOTS described in this paper are available at no cost to the Government to implement.

TUESDAY, 2 DECEMBER, 2014 ROOM S320B

S-1 Leveraging Cloud and High Performance Computing Environments

1400 Embracing The Cloud – Providing Simulation as a Service (14018)
1430 Cloud Terrain Generation and Visualization Using Open Geospatial Standards (14308)
1500 Enabling External Player Connections To Kerberos-secured Systems (14202)

Notes
EMBRACING THE CLOUD – PROVIDING SIMULATION AS A SERVICE
2014 IITSEC Paper No. 14018

Dr. Daniel Lacks
Cole Engineering Services, Inc. (CESI)
Orlando, FL

Lawrence A. Rieger, CMSP
U.S. Army Capabilities Integration Center
Fort Eustis, VA

In August 2013, The Army Capabilities Integration Center (ARCIC) Director challenged that ARCIC could save big dollars if we could put OneSAF “in the cloud” in the Army Battle Lab Collaborative Simulation Environment (BLCSE). What seemed like a simple technical migration was actually a significant change in the way simulations would be structured and operated within a major distributed simulation environment (Battle Lab Collaborative Simulation Environment – BLCSE). While typical distributed simulation environments use either the High Level Architecture or Distributed Interactive Simulation protocols to exchange data between federates, a cloud environment seeks to remove as much of these data exchanges, and the resulting network infrastructure and latency, as possible. Software as a Service (SaaS) is the push of the DoD Cloud Computing strategy, and Simulation becomes the Software being provided as a service within cloud simulation. This paper details a simulation cloud testbed and several technical evaluations conducted to determine Simulation as a Service within the DoD Cloud Computing Strategy. It provides lessons learned and practical planning steps for the migration of a distributed simulation network into a community cloud environment with particular attention to the intricacies of establishing a robust Virtual Machine simulation environment. The authors also address the technical architecture problems associated with cloud computing, community issues of network redesign and the DoD Information Assurance Program (DIACAP) as well as the resource investment and cost benefit analysis for distributed workstations vice central blade servers. The more demanding configuration management and configuration control issues of simulations in the cloud, providing Modeling and Simulation as a service, are also addressed. The paper is based on an IRAD simulation cloud testbed and a series of distributed technical tests demonstrating SaaS over an Army secure simulation network.

CLOUD TERRAIN GENERATION AND VISUALIZATION USING OPEN GEOSPATIAL STANDARDS
2014 IITSEC Paper No. 14308

Samuel Chambers
Joint Staff J7 Environmental Development Division
Suffolk, VA

Jay Freeman
CAE USA
Orlando, FL

The Joint Training Data Services (JTDS) is a web-based set of services that provide Modeling and Simulation (M&S) ready data and scenario development tools to the DoD Enterprise to support Joint and Service theater level constructive & virtual training. JTDS provides persistent web access to an Order of Battle Service and a Terrain Generation Service (TGS) that leverage unique data repositories and tools to generate training scenario initialization files. Historically, the terrain generation service proved difficult to maintain and extend given its closed architecture, stove pipe terrain generation capabilities and stagnant source data collection. Given the lessons learned from the legacy terrain generation service, a technology update and refresh was undertaken to create an updated terrain generation service that supports open source formats, accessibility through an easy to use web interface, and dynamic terrain during runtime. The new terrain generation service heavily utilizes open simulation data standards and geospatial web mapping interfaces to share and distribute simulation products and geospatial data. The open source Common Database (CDB) structure is used as the underlying source data format based on its ability to promote sharing, reuse and utility by storing geospatial and simulation data sets in non-proprietary formats structured to facilitate rapid access, rendering and visualization. Open Geospatial Consortium (OGC) web standards are used to maximize connectivity to the CDB by enabling most geospatial tools to natively visualize and navigate the Terrain Repository. This paper will share the lessons learned and architectural updates of the new terrain generation service.
ENABLING EXTERNAL PLAYER CONNECTIONS TO KERBEROS-SECURED SYSTEMS
2014 I/ITSEC Paper No. 14202

Peter G. Raeth
Chinhoyi University of Technology
Zimbabwe, Africa

Sean B. Ziegeler
Engility Corporation
Stennis, Mississippi

Rhonda Vickery
Engility Corporation
Dayton, Ohio

For applications in real-time distributed simulation, it had previously been difficult for users of DoD's high-performance computer (HPC) shared resources to connect internal players with external players. Kerberos authentication and the resources' batch orientation were the main barriers. This paper describes the authors' method of overcoming such barriers. We show the approach we took to linking internal and external players via the public Internet. This approach is totally user driven, follows a standard process, and requires no system administrator interaction or special permissions. All Kerberos authentication requirements are met. Batch submittals are not required. Utility of the technology was demonstrated by linking two widely-used customer players, one on an external Windows PC with a player running on a remote Linux HPC compute node. The result of this effort makes previously inaccessible equipment available to an entirely new customer base. This result is important to the simulation community because it facilitates real-time access to a large already-funded collection of remote Kerberos-secured HPC resources. These resources enable higher-fidelity modeling and expanded throughput for complex players, processes, and automated interactions. Included are specialized hardware under test or evaluation, or performing some function within a real-time scenario. No additional capital expenditure was made, yet new computational and storage resources are now available to a much wider user community.

TUESDAY, 2 DECEMBER, 2014 ROOM S320B
S-2 LVC Interoperability

1600
Sensor Placement Optimization in LVC Environments for Training, Analysis, and Operational Applications (14314)

1630
Towards Interoperability of Simulations Systems of Ground Force: Progress and Challenges (14082)

1700
Integrating Distributed Virtual Command and Control Platforms into Live Training (14318)

Notes
SENSOR PLACEMENT OPTIMIZATION IN LVC ENVIRONMENTS FOR TRAINING, ANALYSIS, AND OPERATIONAL APPLICATIONS

2014 I/ITSEC Paper No. 14314

Jennifer Lewis and Joyner Livingston
Science Applications International Corporation
Huntsville, AL

Advances in specialized processor capabilities, such as Graphics Processing Units (GPUs), have contributed to the ability to efficiently process high density terrain. Using these technologies, the Aviation and Missile Research Development and Engineering Center (AMRDEC), System Simulation and Development Directorate (SSDD), Soldier Protection Laboratory (SPL) developed a physics-based sensor-terrain interaction model that accurately predicted and synthesized radio frequency (RF) coverage in dense foliage for the Army Expeditionary Warrior Experiment (AEWE) conducted at Ft. Benning in August 2013. Since that time, the development team has built upon the initial capability to include unique user features such as intuitive comparisons of the mathematically optimal placement for baseline and experimental sensor sets and the ability to respond on-the-fly to changes in the underlying terrain. This paper describes the capabilities of the Automated Sensor Placement Engine (ASPE) and potential operational applications, such as Intelligence Preparation of the Battlefield (IPB) and mission planning and rehearsal. It also describes the technical design of the tool and underlying models as well as its transparent middleware approach to integrating with existing toolsets and visualization options. During the past year, the SPL team has successfully integrated ASPE into a range of Live, Virtual and Constructive (LVC) environments, including networked tactical sensors, command and control (C2) nodes, constructive simulations such as OneSAF, and web-based interfaces such as Ozone Widget Framework (OWF). Integration leveraged the use of both tactical and simulation interoperability standards, including the Security Equipment Integration Working Group (SEIWG) Interface Control Document (ICD) series and Distributed Interactive Simulation (DIS). The paper will discuss lessons learned and document repeatable processes developed while integrating these multi-architecture environments.

TOWARD INTEROPERABILITY OF SIMULATION SYSTEMS FOR GROUND FORCES: PROGRESS AND CHALLENGES

2014 I/ITSEC Paper No. 14082

Sérgio Simas Lopes Peres, Jonathan Rosa Moreira
Brazilian Army
Brasilia, Brazil

This paper presents the Brazilian Army approach to simulation system based training and how it evolved in the course of time, from the development of GOTS, to the use of COTS and their integration. A particular focus is dedicated to the technical challenges faced during the integration of virtual and constructive simulators.
INTEGRATING DISTRIBUTED VIRTUAL COMMAND AND CONTROL PLATFORMS INTO LIVE TRAINING
2014 I/ITSEC Paper No. 14318

Ryan McLaughlin, Orlando Torres, Mike Aldinger
Northrop Grumman Corporation
Orlando, FL

As the United States Air Force’s budget continues to shrink, so does the budget for live fly training. This drives aircrews to increase their usage of virtual trainers. These reduced budget constraints will directly impact live training ranges such as the Pacific Air Force’s (PACAF) Joint Pacific Alaska Range Complex (JPARC) ability to fund live aircraft participation in joint exercises such as Red Flag-Alaska and Northern Edge. One approach to reduce live exercise costs is to provide critical Command and Control (C2) platforms such as E-3, E-8, and RC-135V/W as virtual assets. 

The JPARC has taken this approach and has integrated the Combat Air Force Distributed Mission Operations (CAF DMO) E-3 and E-8C mission training centers to support live training exercises. The integration of these virtual C2 platforms required the merging of two disparate training architectures, the CAF DMO Virtual-Constructive solution and the JPARC’s live range solution. A primary difference among these architectures is the standards each are based on. CAF DMO implements the Distributed Interactive Simulation (DIS) standard while the JPARC implements the Test and Training Enabling Architecture (TENA). The merging of TENA and DIS architectures has resulted in significant challenges. (1) How to accurately model live airspace in the DIS domain with multiple live aircraft data sources, (2) live-to-virtual and virtual-to-live radio communications, (3) tactical data links, and (4) inconsistencies of live data. These challenges proved vital to accurately representing the live battlespace for C2 assets.

To overcome the difficulties of merging two disparate architectures with individually unique standards, the JPARC utilized a progressive solution that enabled bi-directional information to be accurately exchanged, formatted, and processed between TENA and DIS architectures. Our paper will discuss this solution and lessons learned during the integration of virtual C2 platforms into live fly exercises.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320B

S-3 Simulated Movement

0830 Mission Integrated Simulation – A Case Study (14085)
0900 An Instructor Operating System (OIS) Framework for Interactive Instructor-Station (14112)
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MISSION INTEGRATED SIMULATION – A CASE STUDY

2014 I/ITSEC Paper No. 14085

Per Wikberg, Mirko Thorstensson, Peter Hammar, Gustav Tolt
Swedish Defence Research Agency (FOI)
Sweden

Currently available modeling and simulation technology has the potential to increase capability of military units. The purpose of this study was to explore the potential benefit of 3D modeling and simulation as mission integrated tools for preparing, executing and evaluating a ranger mission. The study was undertaken during an eight day exercise in which two ranger squads were tasked to ambush a communication hub. Access to an interactive 3D model of the mission area was expected to enhance planning and task force performance and also provide means for better debriefing. During the planning, virtual mission rehearsals and reconnaissance were undertaken in a virtual 3D model of the target area in the simulation system Virtual Battlespace 2. The execution in the real target area was documented by observers, questionnaires, GPS, voice recording, helmet mounted video cameras and interviews. Results indicated that “virtual reconnaissance” was a more appreciated function compared to “virtual mission rehearsal”. Results also indicated that the 3D model had given the rangers a spatial mental model which enhanced their execution. Finally, replaying the mission in the model enhanced the possibility to draw conclusions. One conclusion is that mission integrated simulation does not replace, but rather complements conventional tools or procedures. Possibly an urban terrain would render the “virtual mission rehearsal” more valuable compared to this case of forest with a limited number of significant artefacts. Still, a virtual 3D model which is “good enough” in terms of adequate level of detail in the mission area gives a supplementary perspective which increases the understanding of the limitations of 2D maps. Consequently, the concept of mission integrated simulation will be explored further. By utilizing already available tools and platforms and focusing on solutions that might be realized within 5-10 years it should be possible to enhance mission performance with limited investments.

AN INSTRUCTOR OPERATING SYSTEM FRAMEWORK FOR INTERACTIVE INSTRUCTOR-STATION

2014 I/ITSEC Paper No. 14112

Kim Leng, Koh & Shih Yeong, Wah
ST Electronics (Training & Simulation Systems) Pte Ltd
Singapore

Most training simulators engage a pool of experienced instructors to train and impart their invaluable skill sets to trainees. Simulator training hours have proven to help trainees to acquire the necessary skill sets more effectively. In most simulators, the instructor(s) preside over the instructor station while the trainee(s) is (are) housed in the respective simulated cockpit or cabin. Conventional instructor stations revolve around scenario planning, exercise execution control and communication to the trainees in the simulated cockpit or cabin. In any simulation training session, the instructor relies on his communication with the trainee(s) and the necessary skill sets are picked up over several (repeated) sessions. This paper explores an Instructor Guidance-Assistance Role (IG-AR) enabled instructor operating station (IOS) framework in building an instructor station. An instructor station built using this framework enables the instructor(s) to engage trainee(s) interactively and aims to bring forth an instructor’s demonstrative approach in imparting skill sets, thus enhancing the value of simulation training. This paper also presents two case studies where the IG-AR enabled IOS framework has been adopted to build the instructor station. The first case study illustrates how the instructor in a driving simulator guides the driver trainees to acquire skill sets in open terrain driving. The IG-AR enabled IOS shortened the number of training sessions required before driver trainees become proficient. A further focus study shows that the IOS helped to qualify drivers effectively. The next case study illustrates how the IG-AR enabled IOS facilitates an instructor playing an adversary role trains and assists maritime force crew in the Maritime Warfare Tactical simulator to be exposed to more exhaustive adversary tactics. The IOS enables the instructor to achieve greater learning synergy for the trainees. The paper concludes with a discussion on future expansion of this framework to enhance building future simulator trainers.
DEVELOPMENT OF A MICROSCOPIC ARTIFICIALLY INTELLIGENT TRAFFIC MODEL FOR SIMULATION

2014 I/ITSEC Paper No. 14003

Viral Raghuwanshi, Sarthak Salunke & Kevin F. Hulme
University at Buffalo, Buffalo, NY

Yunfei Hou
Department of Computer Science and Engineering
University at Buffalo, Buffalo, NY

Roadway safety continues to be a major public health concern. Recent statistics show that more than 30,000 fatalities occur due to motor vehicle accidents, and in the year 2012, motor vehicle crashes resulted in more than 2 million injuries. As a result of these ongoing trends, simulators continue to become more abundant in applications ranging from Intelligent Transportation Systems (ITS) research, autonomous driving, human factors studies, rehabilitation, and driver training and workload applications. However, many current simulators lack realism with regards to accompanying traffic, which often does not satisfactorily respond to the real-time actions of the human subject who is operating the simulation. Artificial traffic simulation models found within many modern-day driving simulators are often “macroscopic” in nature – they aggregate the description of overall traffic flow, which is based on “idealistic” driver behavior. This lack of network realism (particularly in the vicinity of the human subject operating the simulator) limits the application scope.

In this paper, we evaluate traffic simulation models for supporting next-generation ITS research applications. This survey justified the need for the design and development of a microscopic Artificially Intelligent Traffic Model (AITM) intended for civilian ground vehicle research applications. The AITM generates a fleet of semi-intelligent vehicles with which a human driver interacts within a virtual driving simulation environment. The behavior of the vehicles is based upon the basic principles of rigid body physics and real-time collision detection, and includes a rule-base for: road-appropriate travel speed behavior, behavior at intersections (e.g., stop signs, street lights), and interactions with other AI and human-driven vehicles on the virtual roads (i.e., lane changing, headway distance). In this paper, the design and development of the baseline AITM is described, and a use-case application is presented, along with recommendations for improvements required subsequent to the deployment of the preliminary model.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320B

S-4 Culture, Reaction and Movement: Simulating Human Behavior

1030 Teaching Cross Cultural Social Competence in a Dynamic, Synthetic Environment (14289)
1100 Advanced Animation Techniques in a Dismounted Soldier System (14136)
1130 Game-based Simulation for Philippine Post-typhoon Stability Operations Training (14329)

Notes
TEACHING CROSS CULTURAL SOCIAL COMPETENCE IN A DYNAMIC, SYNTHETIC ENVIRONMENT
2014 I/ITSEC Paper No. 14289

William Ferguson, Bruce Roberts, David Diller
Raytheon BBN Technologies
Cambridge, MA

Dan Shapiro, Michael Mateas
University of California Santa Cruz
Santa Cruz, CA

To prevail in modern, asymmetric conflicts, most warfighters must socially engage with people of diverse cultures to accomplish a variety of military missions. In spite of this pervasive need, no scalable solution exists for training social skills. Live role-playing is prohibitively expensive and dynamic social skills cannot be learned using traditional, virtual environment based training architectures that rely on carefully scripted scenarios and statically animated, synthetic characters. This paper offers a possible solution for social training by describing an exploitation of Expressive Artificial Intelligence (AI) and an adaptation of cognitive apprenticeship to create a synthetic, mentored, social practice environment. Expressive AI views AI as an expressive medium, and aims at the algorithmic and architectural research necessary to create highly interactive and generative experiences. To allow for true social interaction, our team focused on creating combinable chunks of behavior that enable synthetic characters to participate in a wide variety of jointly meaningful social activities with each other and with a human learner. To meet the challenge of mentoring in this environment, our team borrowed from the deep teaching method of cognitive apprenticeship, exploiting techniques such modeling and scaffolding. To this mix was added real time coaching using the same social simulation mechanisms that create the synthetic characters in the simulated world. A demonstration version of the system was developed under the Defense Advanced Research Projects Agency (DARPA) Strategic Social Interaction Modules (SSIM) program, which in part is designed to illustrate training of general social competence in unfamiliar contexts rather than culture-specific knowledge and skills, using computer controlled characters and instruction in synthetic environments. This work on the design and engineering trade-offs and innovations in simulation control structure should spark interesting debate in the education and simulation communities as well as serving as the basis for others heading in this same direction.

ADVANCED ANIMATION TECHNIQUES IN A DISMOUNTED SOLDIER SYSTEM
2014 I/ITSEC Paper No. 14136

Scott M. Johnson, John Carswell
Intelligent Decisions, Inc.
Orlando, FL

Pat Garrity
U.S. Army Simulation and Training Technology Center
Orlando, FL

The Dismounted Soldier Training System (DSTS) is a program of record with systems fielded by PEO STRI throughout the US Army. The system provides a hardware platform that instruments each Soldier trainee with eight worn Inertial Measurement Unit (IMU) based motion tracking sensors and a motion tracked, instrumented weapon. The U.S. Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED-STTC) is performing research and development to leverage the motion tracking capabilities of the DSTS system as well as emerging motion tracking technologies to develop a more seamless and natural fusion of soldiers’ physical movements with their body movement within the virtual environment and interactions with objects in it. Achieving this objective requires the injection of real-time data from the motion tracking system into the animation system of the underlying game engine in order to control the virtual avatar. Game engine frameworks provide mechanisms that support injection through features such as forward and inverse kinematic solvers and animation blending. Individually, these features are adequate to support simple representations of the soldiers’ actions, but more complex actions require a fusion of techniques. This paper describes our approach to solving the challenges in fusing many animation techniques together towards the goal of suspension of disbelief that the virtual avatar’s motion is entirely the motion of a single Soldier.
GAME-BASED SIMULATION FOR PHILIPPINE POST-TYphoon STABILITY OPERATIONS TRAINING

2014 I/ITSEC Paper No. 14329

Marjorie Zielke, Ph.D., Djakhangir Zakhidov, MFA, Gary Hardee, MA, & Michael Kaiser, MA
UT Dallas
Richardson, Texas

This paper discusses the use of The First Person Cultural Trainer (FPCT) platform to develop pre-deployment stability operations training scenarios for typhoons in the Philippines and other natural disasters which require Army humanitarian missions. The FPCT platform, sponsored by TRADOC G2 Intelligence Support Activity, is a composable game-based simulation system capable of representing the cognitive complexity of non-kinetic population engagement in zones affected by natural disasters. The platform utilizes a PMESII (Political, Military, Economic, Social, Infrastructure, and Information Systems) model as the design framework for modular and interconnected training scenarios -- engaging users in cultural and communications decision-making for specific geographic regions and cultures. Within FPCT game simulations, players must communicate with game characters in a culturally appropriate manner to achieve stability post natural disaster, create alliances and ensure balance and stability between conflicting cultural and political groups. Using the FPCT platform, FPCT Philippines was created -- inspired by events that followed Typhoon Bopha which occurred in December 2012. At the time of the storm, Bopha was the costliest and most severe typhoon to ever hit the Philippines. However, in November 2013, less than a year after the creation of FPCT Philippines, Typhoon Haiyan also hit the region, and was magnitudes greater in severity and aftermath. This paper explores the construct of the original FPCT Philippines model and potential enhancements necessary to accommodate scenarios for Typhoon Haiyan – thereby analyzing the overall use and flexibility of the FPCT platform for pre-deployment training of stability operations in an environment of uncertainty and the usefulness of game-based simulations to train for humanitarian missions using the PMESII model.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320E
S-5 Decision Support Systems & Methods

1030 A Decision Aid for Optimizing Experimental Design Involving LVC Environments (14139)
1100 A Practitioner’s Approach using MBSE in Systems of Systems (14383)
1130 Robotic Simulators: A Case for Return on Investment (14129)

Notes
A DECISION AID FOR OPTIMIZING EXPERIMENTAL DESIGN INVOLVING LVC ENvironments

Sylvain Bruni, Kenyon Riddle, Andres Ortiz, Danielle Dumond, Spencer Lynch, Aptima, Inc.

Increasingly, Modeling and Simulation (M&S) is playing a key part in the decisional process Program Managers (PM) make in the development of new systems, testing, doctrine, and other processes. Unfortunately, the PM must navigate their decisions about leveraging M&S without any supporting aids, making entry and efficient utilization difficult. There is currently no systematic method for assembling environments and designing experiments from multiple M&S perspectives like Live vs. Virtual vs. Constructive simulations to provide decisional data. This process typically requires multiple stakeholders to meet many times in an effort to assemble modeling and simulation-based experiments “that work.” As more models, simulators, and scenarios become networked and available to experimenters, a solution is needed to facilitate and accelerate the setup of complex experiments that involve these assets. To meet this need, research was conducted to develop the Live Virtual Constructive & Game - Assisted Experimental Designer tool (LVC&G-AED), an interface and software solution that guides individuals through a ten-step research process, from defining research questions and choosing variables of interest, to developing relevant measures and specifying the environment’s software and hardware apparatus. This process is designed to be high-level, capturing the questions of the various professionals involved in simulation development, while being sufficiently rigorous to ensure that specific research questions are addressed. Partially Observable Markov Decision Process algorithms, coupled with an intuitive user interface, allow for interactive exploration of the state space of experimental configurations of simulators, equipment, and other resources available to the user. Through the LVC&G-AED decision-aid, experimenters are provided with recommendations for optimal experimental design configurations. Ultimately, LVC&G-AED translates experimental and simulation requirements into machine-actionable constraints, to facilitate the complex setup of experiments that involve combinations of Live, Virtual, Constructive, and Game M&S environments. This paper focuses on the development lessons learned during this research and the way forward.

A PRACTITIONER’S APPROACH USING MBSE IN SYSTEMS OF SYSTEMS

Richard Deakins & Doug Parsons
US Army Aviation and Missile Research, Development and Engineering Center
Colorado Springs, CO

Recognizing the value of systems engineering (SE) as a key enabler of successful systems acquisition, and the growing importance of systems interdependencies affecting the ability for mission success of highly complex development systems, the Deputy Under Secretary of Defense for Acquisition and Technology developed the [2008] “Systems Engineering Guide for Systems of Systems.” While this guide provides excellent insight into the Systems of Systems (SoS) environment, as well as core SoS SE elements, the process to apply them in a DoD acquisition environment is not included. The purpose of this paper is to extend those concepts by defining a system of system acquisition process from receipt of modeling and simulation (M&S) needs through to development of individual requirements for the constituent systems by leveraging the power of Model Based Systems Engineering (MBSE) practices. Because it’s not atypical for constituent developers to read the same need statement and interpret what occurs and what is needed on opposite sides of an interface differently, severe issues can result of which are not discovered until the resolution is extremely costly. The use of MBSE and the Systems Modeling Language (SysML) provides formal methods and notations that can remedy SoS misunderstandings prior to development. Further, our proposed process will facilitate collaboration amongst the system constituents and other stakeholders using MBSE throughout the acquisition process will create a shared common understanding and agreement for the efforts required for success of the SoS mission. Included in the discussion of the proposed acquisition process will be conceptual modeling, architecture and design reviews. The nature of DoD missions and the simulations that describe them are becoming more complex with increasing interdependence among the systems involved. This paper intends to provide the practitioner with systems engineer processes that will result in avoidance of the unintended consequences impacting mission success.
ROBOTIC SIMULATORS: A CASE FOR RETURN ON INVESTMENT

2014 IITSEC Paper No. 14129

Roger D. Smith PhD
Florida Hospital Nicholson Center
Celebration, FL

Khara M. Simpson MD
Columbia University Medical Center
New York, NY

Simulation has been integrated into the education and certification process in aviation and military arenas with significant success in providing cost effective training. The transition from the apprenticeship model to simulation has been slower in the field of medicine with cost, lack of curricula and high fidelity exercises and equipment being the main reasons. With recent improvements in all areas, cost remains a significant challenge.

This report describes our novel analysis of the return on investment (ROI) that can be achieved through the inclusion of simulator use within a robotic surgery business practice and as an alternative source of training revenue. Information was gathered through an extensive literature review and expert interviews for the development of an interactive calculator for institutions to utilize when considering an investment in robotic surgery simulators.

This ROI model presents the core improvements to existing operations which may be realized through the use of simulators of robotic surgery. Category headings include simulator investment costs, surgeon productivity, surgeon health, hospital costs, and other training costs. The user of the model is able to enter their own numbers for their unique facilities. The spreadsheet model will calculate the costs and benefits associated with each area, create category subtotals, and then an overall total for all areas. Using these numbers, it can then calculate an ROI percentage for the simulators. This model represents one tool to assist organizations in making the investment in these devices and training programs.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320B

S-6 Innovative Approaches to Environment and Behavior Simulation

1400 Creating a Re-useable Knowledge Repository for UK MoD CGF Behaviours (14080)
1430 Improving Air-to-Air Combat Behavior Through Transparent Machine Learning (14298)
1500 Improving Material Classification Quality with Elevation-derived Metrics (14380)

NOTES
Creating a Re-Useable Knowledge Repository for UK MOD Cgf Behaviours

Mark Lewis
Centre for Simulation and Analytics, Cranfield University Defence Academy of the United Kingdom

Dan Allison
Discovery Machine Inc.
Williamsport, PA

The United Kingdom’s Ministry of Defence (MOD) has a large investment in both Computer Generated Forces (CGF) systems and in the supporting data and models that run within them. During the last audit over 20 different CGF were identified in use across the three service domains. A major concern is that the investment in behaviour modelling and data in one area is not easily re-useable due to the fundamental differences in implementation of that data in those systems.

To address this issue, the UK Defence Science and Technology Laboratory (dstl) under the Centre for Defence Enterprise (CDE) set a challenge to investigate the feasibility of achieving methods for capturing models and data within common knowledge repositories for re-use across CGF and common modelling services.

The purpose of this paper is to describe the work of Cranfield University at the Defence Academy to evaluate a new approach for knowledge capture and simulation agnostic execution of CGF Behaviours. It discusses the elements required to define a framework for the UK to develop a Behaviour Repository in the context of informing a possible future MoD CGF Service. This includes a discussion on the software architecture and processes; the lessons learned in the development of a multi-simulation behaviour authoring console; the skills required to populate such a repository and the governance required to provide a MoD CGF Service (including Non-run-time services). It describes the challenges both technical and non-technical in developing such a framework that enables greater re-use of verified and validated data models and behaviours across different simulation systems without being tied to a single CGF supplier.

Improving Air-to-Air Combat Behaviour Through Transparent Machine Learning

Armon Toubman, Jan Joris Roessingh
National Aerospace Laboratory NLR
Amsterdam, the Netherlands

Pieter Spronck
Tilburg University
Tilburg, the Netherlands

Aske Plaat, Jaap van den Herik
Leiden University
Leiden, the Netherlands

Training simulations, especially those for tactical training, require properly behaving computer generated forces (CGFs) in the opponent role for an effective training experience. Traditionally, the behavior of such CGFs is controlled through scripts. There are two main problems with the use of scripts for controlling the behavior of CGFs: (1) building an effective script requires expert knowledge, which is costly; and (2) costs further increase with the number of ‘learning events’ in a scenario (e.g., a new opponent tactic). Machine learning techniques may offer a solution to these problems, by automatically generating, evaluating and improving CGF behavior. In this paper the application of the dynamic scripting technique to the generation of CGF behavior for training simulations is described. Dynamic scripting is a machine learning technique that searches for effective scripts by combining rules from a rule base with predefined behavior rules. Although dynamic scripting was initially developed for artificial intelligence (AI) in commercial video games, its computational and functional qualities are also desirable in military training simulations. Among other qualities, dynamic scripting generates behavior in a transparent manner. Also, dynamic scripting’s learning method is robust: a minimum level of effectiveness is guaranteed through the use of domain knowledge in the initial rule base. In this research, the application of dynamic scripting for generating behaviors of multiple cooperating aircraft in air-to-air combat is investigated. Coordination in multi-agent systems remains a non-trivial problem. Explicit team coordination is enabled through communication between team members. This coordination method was tested in an air combat simulation experiment, and compared against a baseline that consisted of a similar dynamic scripting setup, without explicit coordination. In terms of combat performance, the team using the explicit team coordination was 20% more effective than the baseline. Finally, the paper will discuss the application of dynamic scripting in a practical setting.
IMPROVING MATERIAL CLASSIFICATION QUALITY WITH ELEVATION-DERIVED METRICS
2014 I/ITSEC Paper No. 14380

Christopher Fink, Ph.D.
JRM Technologies, Inc.
Fredericksburg, VA

The goal of material classification is to identify the type of surface material present at each pixel of a satellite image or aerial photograph, given metadata specific to the image and imaging sensor (e.g., geodetic area, day-of-year, time-of-day, sensor channel wavelength ranges, etc.). Typically, automated spectral algorithms are employed which attempt to separate this large cloud of pixels into specific clusters representing different material classes (e.g., soil, vegetation, road, rooftop, water, etc.), but often there are too few available channels to guarantee unambiguous identification. It is well-known that RGB space data alone is typically insufficient to provide such distinction, because most of the spectral reflectivity variation among these material types exists at higher wavelengths (near infrared [NIR] channels). The problem is compounded when the classifier is asked to also find “artificial” (i.e., contextual) distinctions, e.g., between asphalt roofs and asphalt roads. As much of the available satellite image data is captured during daytime, additional ambiguities arise as the result of strong shadows over much of the terrain.

Fortunately, spatially-correlated Digital Elevation Map (DEM) data are also often available with the RGB imagery. Such data can provide not only a means by which image shadows can be identified and corrected, but also additional contextual axes along which distinctions can be sought. In this paper, the author describes the algorithms behind a novel tool capable of preprocessing such elevation data for two purposes: (1) to identify and remove shadows prior to material classification, and (2) to define and compute a pair of normalized statistical metrics which can be put into the same form as the color-channel data, such that the downstream clustering algorithms can use them as additional axes of distinction. Finally, the author will present results showing the increased level of classification certainty achieved by this method.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320B
S-7 Improving Healthcare with Simulation

1600 Improving and Proving Healthcare Quality and Value through Physical Simulation (14144)
1630 Employing Modeling and Simulation to Improve Patient Care (14034)
1700 The Effect of Difficulty Levels within a Virtual Medical Simulation (14228)

Notes
IMPROVING AND PROVING HEALTHCARE QUALITY AND VALUE THROUGH PHYSICAL SIMULATION
2014 I/ITSEC Paper No. 14144

Timothy R. Brock, PhD, CPT
The Institute 4 Worthy Performance
Winter Park, FL

Mary Holtschneider, RN-BC, BSN, MPA, NREMT-P, CPLP
US Department of Veterans Affairs
Durham, NC

Healthcare providers world-wide are discovering how simulation modalities in clinical care settings change practice behaviors. Not only must new behaviors result in improved and safer patient care, but the investment of limited resources must prove worth the tangible and intangible outcomes. This paper presents an Organizational Change Management (OCM) framework used by two healthcare provider systems (one government and the other private) to satisfy this dual imperative—to improve healthcare quality through physical simulation; then prove its value. The first example involves the US Department of Veterans Affairs (DVA) hospital in Durham, NC. To meet current American Heart Association (AHA) guidelines for resuscitation, the DVA used an OCM framework to guide physical simulation efforts during the rollout and implementation of three, necessary changes: 1) a stroke code emergency policy; 2) use of new emergency code carts; and 3) intraosseous needle (IO) use for cardiac arrest patients. The OCM framework positioned grassroots stakeholders to increase adoption and sustained commitment by role-playing emergency response situations requiring decision-making. The second example involves a healthcare system in Birmingham, AL with an objective to reduce central line blood infections in intensive care units at local hospitals. This healthcare system also implemented a comprehensive value stream measurement methodology which generated six types of quantitative and qualitative metrics to prove the value (including Return on Investment (ROI)) of quality care and patient safety culture change initiative. Both the OCM framework and the ROI value stream evaluation methodology assisted with planning and proving the value of simulation to support organizational and behavioral change initiatives as well as address organizational education and training requirements.

EMPLOYING MODELING AND SIMULATION TO IMPROVE PATIENT CARE
2014 I/ITSEC Paper No. 14034

James Thomas & Allen J. Giannakopoulos, Ph.D.
Baptist Health South Florida
Miami, FL

In a Labor & Delivery (L&D) environment, new mothers that experience hemorrhages are a medical emergency. How clinicians deal with that emergency is critical for the mother’s health. Computer modeling software provides an effective tool to simulate and understand how different treatment processes affects patient care. In order to improve patient safety and quality of care, the department developed a new protocol to request blood and medication supplies for a hemorrhagic mother. This protocol required requesting an additional nurse for the patient and one phone call to the lab for supplies. However, clinicians did not follow the protocol uniformly. This paper describes the data and the model developed at the request of the Medical Director of the Patient Simulation Lab. The model uses data collected from an Electronic Health Record (EHR) system that describes a patient’s encounter from admission to discharge. The model compares instances of two patient care scenarios for coping with a hemorrhagic emergency. The first scenario represented the original state, which included multiple phone calls to the lab. The second scenario employed the communication protocol developed to improve the speed of delivering lab and pharmacy supplies. The pharmacy and lab are included as Labor & Delivery informs them of the patient’s clinical information collected when the mother-to-be arrives in the Labor & Delivery unit alerting both departments of needed supplies quickly. The simulation clearly demonstrated that following the new protocol decreased time from ordering to administering blood supplies and medication. The model provided Labor & Delivery opportunities to experiment with changing variables within the simulation to deliver better care to new mothers and hemorrhagic emergencies.
WEDNESDAY, 5 THE EFFECT OF DIFFICULTY LEVELS WITHIN A VIRTUAL MEDICAL SIMULATION
2014 I/ITSEC Paper No. 14228

Matthew Hackett, Kevin Fefferman
ARL HRED-STTC
Orlando, FL

Steve McIlwain, Bradley Willson
Raleigh, NC

Virtual environments provide medical professionals a risk-free setting to practice their skills. Within these environments, medical professionals receive training to reinforce triage, communication, and treatment protocols. Recently, researchers created a medical virtual environment geared towards Combat Medics, focusing on step-by-step training for individual medical procedures. The software requires trainees to manage their aid bag and utilize the appropriate equipment for each procedure. To introduce a ‘crawl-walk-run’ training modality, researchers implemented a difficulty system into the simulation. In the novice level, simulated patients present readily apparent symptoms with no complications. In the intermediate level, simulated patients have multiple injuries with complications occurring throughout the scenario. The advanced level includes multiple casualties, requiring triage skills, in addition to the skills required at the intermediate level. By altering the difficulty level, researchers studied the impact on trainees in terms of cognitive load and performance. Researchers then conducted a usability study to further evaluate the performance of the system. The results of these studies are reported, including conclusions and discussion regarding successful implementation of difficulty systems within virtual training applications.

THURSDAY, 4 DECEMBER, 2014 ROOM S320B
S-8 Synthetic Environment

0830 A Paradigm Shift in the Test and Evaluation of Terrain Databases (14200)
0900 Measuring the Impact of Natural Environment Representation on Combat Simulation Outcomes (14305)
0930 Implementation of Real-time Snow Layers in Game-based Simulation (14361)

Notes

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
A PARADIGM SHIFT IN THE TEST AND EVALUATION OF TERRAIN DATABASES

Thomas Kehr, Trey Godwin
US Army – PEO STRI
Orlando, FL

Ryan McIntire
Leidos, Inc.
Orlando, FL

The Synthetic Environment Core (SE Core) program is a primary provider of Terrain Databases (TDB) for the US Army’s training and simulation systems. Through an open format, non-proprietary, image generator independent TDB generation process, SE Core produces terrain and models to link Live, Virtual, and Constructive domains into a common operating environment. The test and evaluation processes of these Terrain Databases for US Army virtual simulators have taken many forms over time. Until recently, this process has been disjointed and often far removed from the system level testing of the major database consumers. As a primary TDB provider for the US Army simulation and training, the SE Core program has taken steps to improve the testing process by developing the Major Evaluation of Geospatial Areas (MEGA) Review. By incorporating the test procedures of SE Core’s primary virtual customers, the Close Combat Tactical Trainer (CCTT) and the Aviation Combined Arms Tactical Trainer (AVCATT), SE Core has developed an efficient test process that incorporates incremental system-level testing early on in the TDB test schedule. The new process also involves a series of set milestone review events designed to gather input from Subject Matter Experts (SMEs) and site representatives. To better understand the new process, this paper will first provide a brief historical background on test and evaluation of Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) virtual TDBs followed by its evolution into the current MEGA Review process. Additionally, the paper will present lessons learned throughout the development of this process along with the cost, schedule and performance benefits realized.

MEASURING THE IMPACT OF NATURAL ENVIRONMENT REPRESENTATION ON COMBAT SIMULATION OUTCOMES

Karl D. Pfeiffer
Atmospheric and Environmental Research
Hampton, VA

Theresa Tamash
Dignitas Technologies
Orlando, FL

Weather affects military operations, and simulated military operations should be similarly affected if these simulations are to deliver value to training, mission rehearsal, acquisition and other simulation-enabled communities across the DoD. Immersive simulations must derive human visibility with explicit or implicit assumptions about temperature, dew point and aerosol content in the space between player and target. Simulations of land, sea and air vehicles must make some set of assumptions about trafficability, wave heights, and turbulence or wind shear, even if the assumption is that these conditions are benign. The space environment, ionosphere and sensible weather (e.g., rain showers or thunderstorms) dramatically impact real command, control, communications, and computers (C4), and simulated C4 systems should be similarly, realistically affected. Achieving this level of fidelity in constructive simulations requires an authoritative representation of the natural environment driving a set of validated, calibrated behaviors within these simulations.

In this study, the Army OneSAF simulation system is used to revisit combat operations in the early days of Operation Iraqi Freedom during a severe and extended dust storm event (March 25-27, 2003). With the passage of a long, dry cold front through the region, sand and dust obscured visibility in the lower atmosphere in a wide swath down to the Arabian Gulf. This event limited ground, air and maritime operations and drove commanders in the field to operational and tactical improvisation. Using an authoritative representation of weather in southern Iraq, OneSAF simulation outcomes are examined and these results compared to known combat outcomes and mission limitations. These results provide insight and a starting point for improving model behaviors in OneSAF and other simulation systems.
IMPLEMENTATION OF REAL-TIME SNOW LAYERS IN GAME-BASED SIMULATION

2014 I/ITSEC Paper No. 14361

Dr. Michael D. Woodman & Peter Morrison
Bohemia Interactive Simulations
Orlando, Florida

While many games have “snow” environments, they are only artists’ representations. There is a requirement for game-based simulations to provide a realistic, real-time virtual snow environment for militaries that operate in snow. Among the many considerations for simulated snow are changing snow depth over time; depth of snow based on slope angle and direction relative to sun and wind; and varying snow depths on and around buildings, under trees, and on roads (which may be plowed). Because of these considerations, the snow layer is not uniform; it will require a tremendous amount of data, especially for large maps. Therefore, we decided to generate the snow procedurally, using optimized rendering. A simulation is not static; we have to consider the interactions: vehicles must have particle effects from driving through snow, they must leave tracks, they may sink into the snow, and they may plow through the snow. We need to calculate the force acting on each wheel for PhysX vehicles with a defined “floating zone” from the top of the snow layer which will depend on snow density. Of course, this also affects the snow height where the vehicle has driven, so we must update the height of the snow each time we simulate an object. The equation will take into account the mass of the object and the snow density. Similarly, soldiers are affected by the snow simulation; we must consider the increased difficulty of foot movement as well as the tracks left behind. This paper will discuss the tradeoff decisions, engineering solutions to creating snow layers, and lessons learned in developing snow layers for simulation. It will be of great interest to attendees who are considering implementing snow in their simulations, as it is important to understand the complexity of such a task.
INTEGRATION OF LOW-COST HMD DEVICES IN EXISTING SIMULATION INFRASTRUCTURE

2014 I/ITSEC Paper No. 14190
Tomer J. Michael, Yaniv Minkov & Rami Rockah
IDF Ground Forces Command Battle-Lab
Tel-Aviv, Israel

Recent years have seen a sharp increase in the availability of low cost Head Mounted Display Devices or, as they are colloquially referred to, "VR Goggles". These devices pair the live tracking of the orientation of their user's head, with a full stereoscopic view of a 3d environment. Thus, providing users with the illusion that they been transported to a virtual world where they are free look around in a realistic manner. It is this functionality that brought the HMD to the attention of the research simulation world, in particular because of the field's vested interest in providing its test subjects with the most realistic experience possible within a virtual environment.

However, the task of integrating the HMD presented a set of unique challenges. From the logistical, such as the lack of visibility between the human subject and input devices, to the physiological, such as the potential and prominent increase in so called "simulation sickness" (a subset of motion sickness), sometimes associated with even short encounters with the device. These phenomena raise questions in regards to the HMD's usefulness in research environments, where unintended side effects directly clash with the realism of the virtual environment and, by extension, with the validity of a given experiment's results.

This paper describes an attempt made between 2013 and 2014 to integrate Oculus VR's "Rift" HMD with the IDF Ground Forces Command Battle-Lab's existing simulation infrastructure. It discusses solutions and lessons learned for the integration of the device, technical hurdles encountered in making an HMD work with simulators built on existing frameworks like Vega Prime and Virtual Battlespace, and the application of different methodologies - explored for setting up or converting different simulators for use with an HMD - and their respective effectiveness with human participants.

SIMULATING REALISTIC LIGHT LEVELS IN NEXT GENERATION IMAGE GENERATORS

2014 I/ITSEC Paper No. 14233

Brett Chladny
Renaissance Sciences Corporation
Richardson, TX

Kenny Hebert
Renaissance Sciences Corporation
Birmingham, AL

Brad Colbert
Renaissance Sciences Corporation
San Diego, CA

The dynamic range of modern day display systems have greatly improved over the past few years. However, they are still not capable of displaying the full intensity range that the human eye is capable of perceiving. The computational power of Graphical Processing Units (GPUs) that are incorporated into modern day Image Generators (IGs) have greatly improved over the past few years, particularly when operating on floating point values. Rendering the entire scene as accurate in-band radiance values enables sophisticated processing to be applied that can help compensate for the limited dynamic range of modern day display systems. The resulting realism can significantly improve training when high contrast scene content is present. Examples include landing on an aircraft carrier that is steaming into the sunset and spotting an entity that is in the direction of the sun. Furthermore, rendering light points using in-band radiance values improves training by providing pilots with realistic visual representations that can take the display’s limited dynamic range into account. This can be critical to training when displaying navigational, runway, and anti-collision lights is required. This paper shows results from a new experimental IG that incorporates both accurately rendering the scene using floating point radiance values as-well-as post processing the resulting values to compensate for the dynamic range of the display system. This processing is accomplished by mimicking various aspects of the Human Vision System while still maintaining the commonly required 60 Hz update rate.
VERGENCE AND ACCOMMODATION IN SIMULATION AND TRAINING WITH 3D DISPLAYS
2014 I/ITSEC Paper No. 14147

David L. Page, PhD; C. E. (Tommy) Thomas, PhD; Steve L. Kelley; Paul G. Jones
Third Dimension Technologies
Knoxville, TN

David A. Miller
AYA Associates, Inc.
Savannah, GA

Mismatches in vergence and accommodation cues can lead to visual discomfort and possibly display sickness. Conventional 3D glasses-based—and more recently lenticular-based—displays create unnatural conflicts between vergence and accommodation. Accommodation and vergence cues differ for a far object compared to a near object. The cues are based on object depth and thus are an important consideration that is often ignored in 3D displays. When vergence and accommodation cues are not correctly reproduced, the information conflict inside the human brain can lead to asthenopia, i.e., visual fatigue, headaches and sickness. Accommodation and vergence responses are normally coupled, which is to say their cues are not independent of one another. Specifically, accommodative changes evoke vergence changes (accommodative vergence), and vergence changes evoke accommodative changes (vergence accommodation). Thus, having correct or nearly correct vergence-accommodation cues is important to comfortable, long-term viewing of 3D displays. Holographic 3D displays, as a step beyond glasses-based and lenticular-based approaches, offer the promise of reproducing all human visual cues, including matched vergence accommodation cues, to enable 3D displays to provide truly immersive environments for simulation and training. This paper presents the vergence-accommodation problem in the context of conventional 3D displays as well as with emerging holographic 3D displays, specifically holographic stereogram-based displays. The paper defines holographic stereography and discusses the principles using an electronic version developed by the authors, known as the Holographic Angular Slice 3D Display (HAS3D). The paper concludes with experimental results based on an operational prototype of the HAS3D display relative to game-based simulation and training environments.

THURSDAY, 4 DECEMBER, 2014 ROOM S320B
S-10 IG, Synthetic Environment and Scalable Simulation

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A DISTRIBUTED SCENE GRAPH APPROACH TO SCALED SIMULATION-BASED TRAINING APPLICATIONS

Douglas B. Maxwell
U.S. Army Research Laboratory, Human Research and Engineering Directorate
Orlando, FL

Joe Geil, William A. Rivera
University of Central Florida
Orlando, FL

Dr. Huaiyu Liu
Intel Research
Hillsboro, OR

Current infantry training simulators are based on first person shooter gaming products and have been used for many years for individual and small unit training. There is a need for a broader application of simulation-based training systems to train multiple small teams in concert or larger unit operations. Additionally, the systems will need to accurately present the operational area with larger numbers of civilian and opposing forces. This requires a simulation-based trainer to scale from currently tens of users to hundreds of users and entities in the same virtual space at the same time. The biggest limiting factor for this activity has been the inability for the backend simulation architectures of the first person shooters to simultaneously broker the large numbers of entities needed to support the scaled simulation. The U.S. Army Research Laboratory’s Simulation and Training Technology Center (ARL STTC) and the Intel Corporation entered into a Cooperative Research and Development Agreement (CRADA) in February of 2013 to address core simulation scaling issues. The ARL/STTC and Intel Corp. performed a series of five joint scalability experiments over the summer of 2013 to test new prototype architectures that support scaled operations. These scalability experiments were open to the public and included volunteers from industry and academia. The experiments were able to show significant increases in the number of humans who could log into a coherent training simulation and interact with each other while performing a mission. This paper will present the results of one of the events, including the data collected from the distributed simulators which were located at various locations across the continental United States. We will discuss the architecture of the prototype simulator, provide performance findings, the statistical approaches used to analyze this data and provide an interpretation of findings. Finally, we discuss a model developed from the autonomous agent simulator loads and compare it to the performance of the simulators when loaded with large numbers of human users.

PSEUDO-SPECIFIC HIGH-RESOLUTION DATA BOUNDARY TECHNIQUES

Daniel J. Lowe & Michael A. Cosman
Rockwell Collins
Salt Lake City, UT

Training requirements for a variety of platforms are quickly expanding to include larger and larger gaming areas in response to customer demand and the availability of data. However, there still remain several drawbacks to using worldwide high-resolution photo-specific data: size of the data, the ability to correlate data with sensor and SAF versions, the time required to validate and correct data. Instead using auto-generated simulation models coupled with real-world data to quickly and economically create training environments remains an attractive option.

This paper describes two techniques recently developed to build realistic terrain texture that is pseudo-specific data (from low resolution data, i.e., Feature Identification Codes, or FICs). When using low resolution theme data resulting textures can appear "blocky" and unnatural. One way to improve this is to super-sample the boundaries between themes to a higher resolution in such a way that they appear more natural and less blocky when viewed up close. Stencils are defined for blending two or more theme types to create natural looking edges. Multiple stencils applied in specific ways are used to vary edges thereby avoiding repeating image patterns. Next, the super-sampled theme data is used with correlated templates of three-dimensional features to generate 3D content on-the-fly without the need of "pre-compiling" or "publishing" the database. The end result is the appearance of higher resolution terrain texture with accurately correlated 3D features.
SOLVING THE INNOVATOR’S DILEMMA FOR SIMULATION AND TRAINING IMAGE GENERATOR ARCHITECTURES
2014 IITSEC Paper No. 14373

Bob Grange, Michael Cosman, Nephi Lewis, & Brad Southwick
Rockwell Collins
Salt Lake City, UT

Today, high performance image generators can be built utilizing Commercial, Off-The-Shelf (COTS) PC hardware, graphics cards and operating systems, leveraging custom software at several system levels. Image generators (IGs) based solely on COTS PC technology and custom software produce impressively powerful simulations within the COTS constraints on memory size, processor speed, processor algorithms, multi-threading, and PC graphics video outputs. This technology is being employed for fast-jet training for the F-35 “Lightning II” Joint Strike Fighter (JSF), FAA/EASA level D, ground warfare, part-task trainer, unmanned aerial vehicle (UAV) and dismounted infantry applications.

Purpose-built rendering hardware also delivers impressive and powerful simulations by employing COTS Field-Programmable Gate Array (FPGA) technology to create targeted rendering solutions that exactly meet specific simulation and training requirements. Considering baseline hardware costs, these systems are expensive (today), but deliver higher quality imagery and more effective training scenarios because they are uninhibited by third party PC graphics card constraints. Today, this technology is being delivered on various devices, including those requiring FAA/EASA level D fidelity, weapons and targeting simulations in various sensor domains, and for multi-crew tactical helicopter training devices like the Apache Longbow Crew Trainer for the pilot and copilot gunner stations.

PC graphics technology, largely driven by the video game industry and its variants, is here referred to as gameCOTS. FPGA technology, when delivering purpose-built image generation systems, is here referred to as simCOTS because it specifically emphasizes simulation training requirements. This paper compares and contrasts these two innovative rendering approaches to highlight the need for the simulation industry to employ a broad variety of solutions in effecting world-class training solutions, across the training spectrum, that remain squarely positioned on the cost-value curve.

THURSDAY, 4 DECEMBER, 2014 ROOM S320F
S-11 Automation and Autonomy

1030 A Framework for Enabling Virtual Observer Controllers in Synthetic Training (14268)
1100 UAV Flight Control Software Development based on COTS Product (14206)
1130 Lessons Learned in Creating an Autonomous Driver for OneSAF (14106)

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Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
A FRAMEWORK FOR ENABLING VIRTUAL OBSERVER CONTROLLERS IN SYNTHETIC TRAINING

2014 I/ITSEC Paper No. 14268

Mandira Hegde, Dan Allison, Todd W. Griffith, Ph.D.
Discovery Machine, Inc.
Williamsport, PA

This paper presents a modeling framework to enable the creation of custom virtual observer controllers (VO/Cs) to help naval students meet training objectives. First, we describe an approach to create behavior models to drive the behavior of automated entities used in synthetic training. Next, we describe an approach to create behavior models supporting the functions of intelligent VO/Cs. Specifically, we describe the development of an authoring console and training task blocks used to create custom VO/C architectures as well as the creation of student cognitive process models representative of varying training proficiency levels. We also describe a method to integrate these models into simulations used in synthetic training and a communication architecture supporting communication between VO/Cs and our behavior-driven automated entities. We end with a use case of a custom VO/C running end-to-end in the Joint Semi-Automated Forces™ (JSAF) simulation in a Navy Anti-Submarine Warfare (ASW) training scenario. Although the Navy ASW training domain is the focus of the examples described in this paper, the modeling framework described is not domain specific.

UAV FLIGHT CONTROL SOFTWARE DEVELOPMENT BASED ON COTS PRODUCT

2014 I/ITSEC Paper No. 14206

Jung-ho Moon & Da-hyoung Jeon
Korean Air, R&D Center
Republic of Korea

Yeong-cheol Kim
Agency for Defense Development
Republic of Korea

Flight management and control software is the most safety-critical software of Unmanned Aerial Vehicle (UAV) and it has to be verified by several development steps such as simulation, unit test, formal test, stand-alone test and hardware integrated test based on hardware-in-the-loop simulation environment. To support these activities, a variety of software packages are required such as flight control software, flight dynamic software, avionics model, image generator, software test tool and operation training simulator. To increase development efficiency, these tools have to be integrated and share a core data and models with various embedded hardware components. Model-based development (MBD) technology and commercial off-the-shelf (COTS) products could be helpful for engineers to cover various areas of software development and test where there are limits to costs and time. This paper describes MBD application on the flight control software, hardware-in-the-loop simulator, software test, and operation training simulator (OTS). The flight control software was developed using Matlab/Simulink®, and engineers performed unit testing and system testing using a Hardware-In-The-Loop Simulator (HILS), and an operation training simulator. The HILS was embedded on dSPACE® integrated with image generator based on PrePar3D®. HILS real time data is distributed using equipment based on AGI STK® to visualize communication links and flight data. Most of the dynamic and subsystem models were developed in Simulink and then C-code generated to reduce development efforts dramatically. This includes the development of gimbal dynamics, aircraft dynamics, avionics model, data link model, target calculation, and tracking models. This paper presents an integrated development environment for UAV flight control software that uses model based development technology and COTS software. It further details the software development environment, testing, hardware integration and verification capabilities. This environment was linked with an operational training simulator to evaluate the camera guided modes and radar based automatic landing system verification and the results are presented as part of this paper.
LESSONS LEARNED IN CREATING AN AUTONOMOUS DRIVER FOR ONESAF
2014 I/ITSEC Paper No. 14106

Dr. Jonathan Stevens, Latika Eifert
Army Research Laboratory (ARL)
Orlando, FL

Dean Reed, Eugenio Diaz
Institute for Simulation and Training
Orlando, FL

Oleg Umanskiy
STILMAN Advanced Strategies
Denver, CO

The high cost of live training has always been a major challenge for the military. This challenge will only grow as current fiscal uncertainty leads to declining training budgets. Constructive simulations, such as One Semi-Automated Forces (OneSAF), have shown to partially reduce some costs associated with warfighter training. However, further cost reductions in simulation are always sought to ensure that simulation remains an attractive training option for the Commander. The Army Research Laboratory-Human Research and Engineering Directorate, Simulation and Training Technology Center focused on an effort to lessen costs by creating an automatic ‘driver’ for OneSAF with less need for human intervention. For this initial effort, we describe how the Linguistic Geometry Real-Time Adversarial Intelligence and Decision-making (LG-RAID) lightweight simulation generated and sent to OneSAF tactically valid cooperative entity behaviors for an entire company-size-force of friendly and enemy combatants. We discuss how this was accomplished, for both scenario creation as well as scenario execution. For this initial paper, our results primarily focused on scenario creation, with follow-on studies concentrating on scenario execution. This paper describes key principles developed behind the ‘driver’ and offers potential areas for future research based upon our lessons learned in this study.

THURSDAY, 4 DECEMBER, 2014 ROOM S320B
S-12 Engineering Based Modeling

1330 How the U.S. Navy is Migrating from Legacy/Large Footprint to Low Cost/Small Footprint Sonar Simulation Systems (14090)

1400 Use of Automated Intelligent Entities in ASW Simulation (14109)

1430 A Physics-Based Approach to Simulate Jet Engines (14030)

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HOW THE U.S NAVY IS MIGRATING FROM LEGACY/LARGE FOOTPRINT TO LOW COST/SMALL FOOTPRINT SONAR SIMULATION SYSTEMS

2014 IITSEC Paper No. 14090

Mr. Sean M. Reilly
The AEgis Technologies Group, Inc.
North Kingstown, RI

Mr. Jonathan Glass
Naval Air Warfare Center Training Systems Division
Orlando, FL

This paper describes the migration process undertaken by the US Navy to migrate from legacy, large footprint mainframe computer-based sonar simulation systems to next-generation sonar simulation systems with a smaller footprint, lower costs and better accuracy than the legacy models. The paper will describe the development efforts to create a faster and more accurate acoustic transmission loss (TL) and reverberation model for sonar simulation/stimulation systems in littoral environments based on ray theory for active sonar frequencies (above 1000 Hz). The paper also describes how the next-generation model augments ray theory with Gaussian beam techniques (based on the Gaussian Ray Bundling or GRAB), which enables simulation of frequencies as low as 150 Hz. The paper will detail the integration challenges faced by the US Navy to migrate from the legacy models to the next-generation sonar simulation model into the Navy’s Live Virtual Constructive Modeling and Simulation (LVCMS) product line that includes PACT3, BATTT, and EFAAS simulators/simulations. The paper will also describe the results of these integration efforts, including the ability to provide trainees with improved training via more complex scenarios in the LVCMS training suite without increasing their hardware costs or footprint.

USE OF AUTOMATED INTELLIGENT ENTITIES IN ASW SIMULATION

2014 IITSEC Paper No. 14109

Morten Kolve
Kongsberg Defence Systems
Kongsberg, Norway

Jared Snyder
Discovery Machine Inc.
Williamsport, Pa, USA

Geoff Tompson
Decisive Encounters Limited
London, UK

As defense budgets are cut, assets and personnel are being increasingly stretched to meet operational tasks, making it ever more difficult to allocate platforms and subject matter experts (SMEs) to train the next generation of operators. One key area where there is a shortage of platforms and experienced SMEs is in anti-submarine warfare (ASW). At the very time when many countries are purchasing sophisticated submarines and the potential submarine threat is increasing, fewer operational submarines and SMEs are available for training tasks. An innovative solution to these shortages is to use an ‘expert system’ ASW simulator employing automated intelligent entities to generate realistic threat actions. This innovative solution provides added benefits as it improves the quality of simulator training whilst reducing the workload on the available ASW simulator instructors. This Paper describes the process used for collecting expert knowledge and then using that knowledge to create the automated intelligent behaviors employed by automated intelligent entities in simulators. The collection process enables SMEs to ensure the behaviors represent tactically realistic actions and, for the highest quality simulation, that they do not become predictable. Therefore, for any tactical situation, the system must select the most appropriate behavior and the entity should react realistically to the tactics employed against it by the student. Such autonomous entities allow instructors to perform complex maneuvers and actions with a low level of interaction with the simulation. An additional benefit of the low level of interaction with the simulation is the reduction in the instructor's workload, giving them more time to focus on the overall simulator exercise objectives. As an illustrative example, we present a case study of a system created for the Royal Norwegian Navy (RNoN), which now uses such automated intelligent behaviors in its ASW simulator.
A PHYSICS-BASED APPROACH TO SIMULATE JET ENGINES
2014 I/ITSEC Paper No. 14030
Sami S. Mina
Rockwell Collins Simulation and Training Solutions
Sterling, VA

Creating jet engine simulations that replicate the behavior of actual engine parameters at finite flight conditions is only one step toward meeting the requirements for pilot training. Reproducing realistic performance trends throughout the flight envelope and generating proper responses to malfunctions and pilot-initiated events, including secondary and cascading effects, is critical to achieving positive pilot training.

Traditionally, jet engine simulation for pilot training purposes is based on table-lookup of steady-state engine parameters, such as rotor rotational speed, fuel flow, exhaust gas temperature, engine pressure ratio and net thrust. This approach does not inherently meet all the aforementioned requirements and exhibits the following shortcomings:
The dynamic engine performance has to be approximated as a lagged transition between steady-state points. It is unreliable to predict the behavior of the engine parameters when excursions outside the bounds of the tables take place. Malfunction effects have to be programmed individually for each engine parameter and for different flight and operational conditions. Additionally, the interdependencies between the different engine parameters can be violated during the model tuning process. Accordingly, a new approach to model jet engines is needed.

The objective of this paper is to present a physics-based jet engine simulation approach which addresses the shortcomings of table-lookup solutions, is data-driven and generic, while also distinguishing itself from other physics-based simulations (Claus, Townsend, 2010) by being computationally efficient. This approach can be used to simulate any turbojet or turbofan engine by accounting for the physical processes and the geometric and mechanical characteristics that govern the performance and behavior of the engine. These include the fan, compressors and turbines maps, the rotors inertia, and the thermodynamics of the flow entering the engine from its free-stream state ahead of the engine intake, through the intake duct, the fan, the compressors, the combustion chamber, the turbines and the nozzles.

The paper discusses the methodology used in applying the physics-based approach to simulate a two-spool turbofan engine, the technical challenges involved and demonstrates how this new approach advantageously compares with a table-lookup model in matching actual flight test data and in providing realistic performance trends.

The paper also assesses the physics-based approach’s ability to meet the requirements of the different levels of flight simulators and flight training devices, as defined in FAR 14 CFR Part 60.
DECLARATIVE KNOWLEDGE ACQUISITION IN IMMERSIVE VIRTUAL LEARNING ENVIRONMENTS
2014 I/ITSEC Paper No. 14005

Rustin Webster, PhD
Intuitive Research and Technology Corporation
Huntsville, AL

Motivated by a learners’ general lack of engagement and passive receiving of information from lectures, and the increased use of interactive media from the millennial generation, the author investigated the interaction effect of immersive virtual reality (VR) in the classroom. The objective of the project was to develop and provide a low-cost, scalable, and portable VR system containing purposely designed and developed immersive virtual learning environments for the U.S. Army. The purpose of the mixed design experiment was to compare lecture-based and immersive VR-based multimedia instruction, in terms of declarative knowledge acquisition (i.e. learning) of basic corrosion prevention and control with military personnel. Participants were randomly assigned to the control group (N = 115) or investigational group (N = 25) and tested immediately before and after training. The author accessed learning outcomes from the pre- and post-exam scores and VR system usability from exit questionnaires. Results indicate that both forms of instruction will increase learning. VR-based did produce higher gain scores and there was a statistically significant interaction between instruction type and time. Lecture-based instruction continues to be a cheaper and more efficient method for large group settings while VR-based instruction advocates individual training, active learning, and condensed training time.

VIRTUAL WORLD ROOM CLEARING: A STUDY IN TRAINING EFFECTIVENESS
2014 I/ITSEC Paper No. 14045

Stephanie J. Lackey, Julie N. Salcedo, & Gerald Matthews
Institute for Simulation & Training
University of Central Florida
Orlando, FL

Douglas B. Maxwell
U.S. Army Research Laboratory
Simulation and Training Technology Center
Orlando, FL

Large-scale live training exercises require significant funding investments in personnel, equipment, and other resources. Given the current state of budget constraints, Simulation-Based Training (SBT), specifically, Game-Based Virtual Environments (GBVE), represents an opportunity to alleviate such challenges. However, from the SBT perspective, scalability (e.g., the number of simultaneous trainees supported) and flexibility (e.g., resources required to build and render new scenarios, real-time scenario adaptation) hinder the ability of GBVEs to address large-scale training. Virtual Worlds (VW) offer a viable solution to resolve the challenges facing the U.S. Army’s existing training paradigm. Emerging research in the field of VW training for operational tasks seeks to understand where in the training cycle such technology is most beneficial, how to implement such capabilities, in addition to the return on investment. The U.S. Army Research Laboratory Simulation and Training Technology Center has entered into a cooperative agreement with the University of Central Florida to conduct research that includes a series of empirical evaluations of VW training through 2017. Ultimately, this body of research will result in empirically-driven recommendations for designers, developers, and decision-makers within the training systems acquisition community. This paper presents the findings from the initial field study focused on the effectiveness the VW training provided during a refresher room clearing battle drill event involving 64 reserve unit Soldiers. This Training Effectiveness Evaluation (TEE) compared the impact of traditional classroom training to VW training on performance outcomes, stress, and workload. The results reported from this inaugural TEE provide the foundation for future research.
SIMULATING PARTICIPANT TRAINING DATA TO TEST MIXED-REALITY TRAINING SYSTEMS

2014 IITSEC Paper No. 14252

Ken Kopecky, Eliot Winer
Iowa State University
Ames, Iowa

Julio de la Cruz
Army Research Laboratory HRED-STTC
Orlando, FL

As simulation-based, mixed-reality, and virtual reality training systems are more widely adopted in the military, the process of verification and validation (V&V) for these systems becomes similarly more complicated and time-consuming. It is critical to verify and validate these simulation-based training systems so they operate properly and as expected. Often, live trainees are brought in, hardware set up, and different configurations of a system tested as part of the V&V process. No actual training has occurred. In much the way that these simulation systems act as a substitute for live action, the subsystems and trainees that use training systems can also be replaced with simulations to dramatically speed-up V&V. This paper examines the potential for replacing live trainees and hardware with virtual simulations in a mixed-reality training environment for the purposes of V&V of a simulation training system. A case study is presented, composed of a method that allows multiple tracking systems, from different vendors, to be combined into a single system. The system, used in a large mixed-reality training environment, allows different aspects of the physical layout to be tracked depending on the training being performed. In order to test the system’s robustness, virtual tracking data was generated, having been calibrated from actual tracked entities, to test metrics including positional error correction and data throughput capability. Comparing this data with results obtained using real tracking hardware allowed the development of models to predict the system’s behavior in new situations, such as the introduction of a new tracking system, or introducing a second tracked space to the training simulation. Using simulated tracking data, errors were identified in the system without the need for testing with humans or additional equipment. Finally, the virtual data was used to test the simulation itself, to ensure it would handle the data requirements encountered during actual training. Results indicated that simulated data can be used to test the various factors necessary for V&V of a simulation-based training system. The training system behavior was the same whether actual or simulated data was used. The use of simulated data allowed scenarios to be tested without the need to bring in additional human and equipment resources.

TUESDAY, 2 DECEMBER, 2014 ROOM S320D
T-2 Nothing Here To See

1600 Enhancing the Utility and Effectiveness of Combat Medic Simulation (14075)
1630 Training Effects for First-responder Competency in Cholinergic Crisis (14241)
1700 Simulation Environments for Offshore Oil and Gas Emergency Training (14344)

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ENHANCING THE UTILITY AND EFFECTIVENESS OF COMBAT MEDIC SIMULATION

2014 I/ITSEC Paper No. 14075

Danielle Julian, John Killilea, Patricia Bockelman, Margaret Nolan
Orlando, FL

Teresa Sotomayor
ARL-HRED STTC
Orlando, FL

The U.S. Army Research Laboratory (ARL), Human Research and Engineering Directorate (HRED), Simulation and Training Technology Center (STTC) enhances warfighter readiness through research and development of engineering solutions by placing the right technology in the hands of soldiers in the shortest time. To accomplish that goal, the STTC supports training transformation and the promotion of learning to reach diverse Army specialties, such as medical training. Contributing to the efforts of specialized Army medical training, the present work expands on research the team conducted under a 2013 Front-End Analysis (FEA) examining Army nursing training gaps and best practices. Participants reported the largest barrier to using the available simulators is in creating and implementing appropriate scenarios.

To determine whether other military medical training personnel report the same barrier, a follow-on FEA was conducted targeting combat medics (also known as 68W), who serve as specialized warfighters tasked with providing pre-hospital care under the complex and stressful conditions of conflict. Scenario-based training is an integral part of their required course for the 68W designation. Effective scenarios that incorporate best practices in the use of available simulators create the conditions to maximize Return on Investment (ROI).

The data collected from the combat medic FEA will be leveraged to provide recommendations for best practices in scenario design and Simulation-Based Training (SBT). These recommendations are intended as practical, jargon-free considerations that training developers and decision makers can apply to combat medic training. The best practices include, but are not limited to, the following areas: integrating simulation into training curriculum, methods for debriefing and achieving skill acquisition, methods for achieving critical thinking, confidence and perceived competency, and evaluation/assessment. The paper will close by mapping out the relationship between successful scenario development and return on investment for simulation technologies to support the larger STTC mission.

TRAINING EFFECTS FOR FIRST-RESPONDER COMPETENCY IN CHOLINERGIC CRISIS MANAGEMENT

2014 I/ITSEC Paper No. 14241

Andreatta P, Klotz J
University of Minnesota Medical School
Minneapolis, MN

Madsen JM, Hurst CG
U.S. Army Medical Research Institute for Chemical Defense (USAMRICD)
Aberdeen, MD

Talbot TB
Teledmedicine & Advanced Technology Research Center (TATRC)
Fort Detrick, MD

Background: Military and civilian first-responders must be able to recognize and effectively manage mass disaster casualties. Clinical management of injuries resulting from nerve agents provides different challenges for first responders than those of conventional weapons. We evaluated the impact of a mixed-methods training program on competency acquisition in cholinergic crisis clinical management. Methods: We developed a multimedia and simulation-based training program based on the more comprehensive USAMRICD courses. The training program was designed to provide first-responders with the necessary abilities to recognize and manage a mass casualty cholinergic crisis event. Training included a learner controlled multimedia iPad app and hands-on instruction using SimMan3G™ mannequin simulators. We evaluated the impact of the training through a purposively selected sample of 204 civilian and military first-responders who had not previously completed either of the referenced USAMRICD courses. We assessed knowledge, performance, affect, and self-efficacy measures pre- and post-training using previously validated assessment instruments. We calculated results using analysis of variance with repeated measures, and with statistical significance set at p < .05. Results: Analyses demonstrated a significant improvement (p = .000) across all domains (knowledge, performance, self-efficacy, and affect). Knowledge scores increased from 60% to 81% correct. Performance scores increased from 16% to 68% correct. Self-efficacy scores increased from 51% to 87% confidence in ability to effectively manage a cholinergic crisis event. Affect scores increased from 75% to 81% personal comfort during procedures. Conclusions: These findings could aid in the selection of instructional methodologies available to a broad community of first-responder personnel in military and civilian service. Although less comprehensive than the USAMRICD courses, training outcomes associated with this easily distributed instruction set demonstrated its value in increasing the competency of first responders in recognizing and managing a mass casualty cholinergic event. Retention outcomes are in process.
SIMULATION ENVIRONMENTS FOR OFFSHORE OIL AND GAS EMERGENCY TRAINING

2014 I/ITSEC Paper No. 14344

Mr. Randy Billard & Captain Anthony Patterson
Virtual Marine Technology Inc.
St. John’s; NL, Canada

Emergency Response and evacuation training for offshore oil and gas workers has traditionally been performed using land-based test facilities and live exercises. Due to risks associated with practicing drills using live exercises, this training has been limited to controlled environments and benign weather conditions. As offshore oil and gas activities move into harsher environments including deeper waters and ice covered waters, operators are required to demonstrate to regulators that personnel are prepared for emergencies in these conditions. Simulation technologies have been specifically created for offshore personnel to practice emergency scenarios in harsh environments using representative equipment and immersive virtual environments. A specific example includes the use of a simulator to practice launching lifeboats in severe sea states and ice. As simulation is adopted by the oil and gas industry as a supplement to existing training or as an alternative to replace specific drills, operators will be required to demonstrate that simulators are effective training tools. Human factors studies have been performed to assess how simulation technologies improve the performance of offshore personnel. These studies assess the value of simulation as a means to reduce time-to-competence. Validation studies are carried out to measure how students become immersed in the simulation environment and how accurately the virtual environment matches the real world. This paper discusses a case study of how a lifeboat simulator was created for the oil and gas industry and how the technology is used to allow oil and gas personnel to practice safely and effectively to increase the competence of offshore personnel. The paper also addresses the design philosophy for developing training technologies to maximize value to the operators, which includes designing simulators to achieve learning objectives which are derived from recognized training standards and regulated courses.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320D

T-3 Comparative Analysis for Clinical Training

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Notes
COMPARISON OF THE USABILITY OF ROBOTIC SURGERY SIMULATORS

2014 IITSEC Paper No. 14168

Alyssa Tanaka, M.S., Courtney Graddy, M.S., Roger Smith, Ph.D.  
Florida Hospital Nicholson Center  
Celebration, FL

Haider M. Abdul-Muhsin, M.D.  
Mayo Clinic  
Scottsdale, AZ

The introduction of simulation into minimally invasive robotic surgery is relatively recent and has seen rapid advancement; therefore, a need exists to develop training curriculums and to identify systems that will be most effective at improving surgical skills. Several robotic simulators have been introduced to support these aims, but their effectiveness has yet to be fully evaluated.

Currently, there are three simulators -- the daVinci Skills Simulator, Mimic dV-Trainer, and Surgical Simulated Systems’ RoSS. While multiple studies have been conducted to demonstrate the validity of each system, no studies have been conducted which compare the value of these devices as tools for education and skills improvement. This paper presents the results of an experiment comparing value, usability, and validity of all three systems. Subjects who were qualified as medical students or physicians (n=105) performed one exercise on each of the three simulators and completed two questionnaires, one regarding their experience with each device and a second regarding the comparative effects of the simulators. This data confirmed the face, content, and construct validity for the dV-Trainer and Skills Simulator. Similar validities could not be confirmed for the RoSS. Greater than 80% of the time, participants chose the Skills Simulator in terms of physical comfort, ergonomics, and overall choice. However, only 55% thought the skills simulator was worth the cost of the equipment. The dV-Trainer had the highest cost preference scores with 71% percent of respondents feeling it was worth the investment. This work is the second component of a three-part analysis. In the previous study, the simulators were objectively reviewed and compared in terms of their system capabilities. The third part will evaluate the transfer of training effect of each simulator. Collectively, this work will offer end users and potential buyers a comparison of the value and preferences of robotic simulators.

FORCES APPLIED ON LARYNGOSCOPE DURING INTUBATION: A STUDY ON AIRWAY SIMULATORS

2014 IITSEC Paper No. 14203

Matthew Mui, M.S.  
University of Central Florida  
College of Medicine

Christine Allen, Ph.D.  
Army Research Laboratory (ARL)

Mojca R. Konia, M.D., Ph.D.  
University of Minnesota Department of Anesthesiology  
Directorate (HRED) Simulation and Training Technology Center (STTC)

Jack Stubbs  
SimPORTAL & CREST University of Minnesota  
David Hananel

Excessive forces applied during endotracheal intubation may cause damage to laryngeal structures leading to patient morbidity and mortality. Simulators are widely used for intubation training, but recent studies have shown significant differences in airway anatomy as well as forces applied during intubation when compared to humans. This study assessed the differences in intubation training on three partial-task trainers, TruCorp AirSim Standard, Laerdal Airway Management Trainer, and VBM Air Management Simulator Bill I, against cadavers. Objective force measurements and subjective ratings of difficulty and force used were measured. Using ANOVA and paired t-tests, endotracheal intubation on simulators was found to have significantly different force profiles (i.e., locations and magnitudes of the applied forces in comparison to cadavers. In particular, the Laerdal Airway Management Simulator differed in all three measurement variables, namely torque applied on the laryngoscope, force applied at the laryngoscope tip, and force exerted on the simulator’s teeth. These findings are further supported by the surveys of the participants in the Laerdal group. For the TruCorp and VBM simulators, significant differences are found only in torque and tip forces, respectively. These results suggest that a simulator that offers more realistic endotracheal intubations may be necessary for airway management training. In addition, this study sets a foundation for future studies to further elucidate the effects of various airway simulators on intubation training.

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
OUTCOMES FROM TWO FORMS OF PEDIATRIC AND NEONATAL INTUBATION TRAINING

2014 I/ITSEC Paper No. 14240

Andreatta P, Klotz J
University of Minnesota Medical School
Minneapolis, MN

Dooley-Hash S, House J
University of Michigan Medical School
Ann Arbor, MI

Background: Contextually relevant factors within a training environment facilitate performance transfer to applied clinical settings. Live animals are often used for pediatric and neonatal intubation training because the scale of their airways and the living condition of the animal are assumed to facilitate transfer of acquired skills to intubating infants and children, despite species-specific anatomical variation. Mannequin simulators provide an alternative for training, but have anatomical, physiological, and tissue limitations. We evaluated the impact of two clinical training methods (live animal v. simulation) on the acquisition of performance abilities in pediatric and neonatal intubation.

Methods: We implemented a quasi-experimental design with purposive sampling to assess performance differences between 294 subjects after completing a training intervention that included either direct interaction with a (1) live animal or (2) mannequin simulator. All other training elements were identical and followed American Heart Association (PALS/NRP) clinical protocols. We used validated instruments to assess knowledge, performance, and self-efficacy outcomes before and after training, and at three retention intervals (6, 18, and 52 weeks). Results: Post-training outcomes were significantly better than pre-training outcomes for both groups (p < .001), and there were no significant differences between the outcomes for the two types of training. There were significant differences between the performance outcomes after 18 and 52 weeks (p < .01), and for cognitive outcomes after 52 weeks (p < .01), all favoring the simulator training. Conclusions: These findings could aid in the selection of instructional methodologies that minimize the uses of live animals for instruction in pediatric and neonatal intubation without sacrificing the quality of training. Variation in retention outcomes are likely due to opportunity for repeated deliberate practice using a simulator rather than associated with fidelity issues. Improvements in simulator technology would likely improve training outcomes.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320D

T-4 “Assess”-orizing Your Training and Performance Outcomes

1030 Data & Analytics Tools for Agile Training & Readiness Assessment (14064)
1100 Lessons Learned Integrating Mobile Technology into Two Army Courses (14128)
1130 Experience API and Team Evaluation: Evolving Interoperable Performance Assessment (14157)

NOTES

Papers are available on the 2014 I/ITSEC CD ROM included in the Conference Attendee meeting bag, or visit the I/ITSEC Website (www.iitsec.org) for ordering information. (Limited numbers of CDs from 1998-2014 are also available.) All papers from 1966 through 2000 are available in the I/ITSEC Compendium. Individual papers from 1966 through 2014 may also be ordered through the www.iitsec.org portal.
DATA & ANALYTICS TOOLS FOR AGILE TRAINING & READINESS ASSESSMENT
2014 IITSEC Paper No. 14064

Jared Freeman
Aptima, Inc.
Washington, DC

Denise Nicholson
Soar Technology, Inc.
Orlando, FL

Peter Squire & Amy Bolton
Office of Naval Research
Arlington, VA

The return of American warfighters to their bases and their garrisons presents an opportunity to bolster scarce training resources and expertise with new assessment technologies. America made a similar investment in the 20th century as it shifted its intelligence budget to supplement human intelligence gathering with technologies that unobtrusively captured data concerning the activities of foreign powers. Here, we present a unifying vision of several emerging technologies that can improve military training. Following a human systems engineering approach, we first define the functional requirements of future training and readiness assessment systems, describe the architectural requirements for providing those functions, and then describe systems for the Marine Corps and Air Force that instantiate this architecture. Next we focus on two fundamental and new components of this emerging architecture: sensors that capture human performance data unobtrusively, and big data analytics that make sensor data meaningful and actionable. Finally, we identify several scientific and technical challenges encountered during the initial implementation and planned testing of these architectures.

LESSONS LEARNED INTEGRATING MOBILE TECHNOLOGY INTO TWO ARMY COURSES
2014 IITSEC Paper No. 14128

Gregory A. Goodwin
Simulation and Training Technology Center,
Orlando, FL

Michael Prevou
Holly C. Baxter
Strategic Knowledge Solutions
Leavenworth, KS

Heather Wolters
U.S. Army Research Institute
Fort Belvoir, VA

Mike Hower
Engility Corporation
Leavenworth, KS

Linda McGurn
Strategic Knowledge Solutions
Colorado Springs, CO

As the Army considers using mobile computing to improve training and assessment, it must be confident in the benefits of that technology and more importantly, it must be able to articulate the requirements needed to achieve those benefits. Although mobile devices and software have proven to be extremely popular in the commercial market, research is needed to identify both the benefits and requirements of this technology before the Army considers its wholesale adoption for training and education. This paper reports on the results of using mobile devices in two Army courses: the Signal Captains Career Course (SCCC) and the School for Command Preparation (SCP). The software developed for the SCCC was an interactive performance assessment tool for the topic of power distribution while the software developed for the SCP was a practice tool for media engagement. In the first experiment, 182 SCCC students either took the traditional paper and pencil practical exercise or the interactive tablet-based version. The tablet-based version significantly reduced the time needed to complete the exercise (1h vs. 3h) without affecting student understanding of the topic. In the second experiment 161 SCP students practiced for the final exercise (mock media engagement) with and without the aid of a tablet-based practice tool. Although the group using the app reported practicing more, their performance on the final exercise was the same as those who practiced without the app. These findings indicate that although mobile technologies have the potential to benefit students and instructors, neither the magnitude nor the type of benefit is easy to predict at this point. These findings and other lessons learned are used as the basis for a proposed strategy for developing mobile applications for use in Dept. of Defense training.
EXPERIENCE API AND TEAM EVALUATION: EVOLVING INTEROPERABLE PERFORMANCE ASSESSMENT

2014 I/ITSEC Paper No. 14157

Michael Hruska
Problem Solutions
Johnstown, PA

Charles Amburn, Rodney Long
United States Army Research Laboratory
Human Research and Engineering Directorate
Simulation and Training Technology Center
Orlando, FL

Tara Kilcullen
Raydon
Daytona Beach, FL

Tiffany R. Poeppelman
Google (Contractor)
London, England

Simulation and training technologies continue to advance the ways we assess individual and team performance on a range of skills. Given that training is costly, military organizations are developing solutions for tailored learning since they represent a path to larger efficiencies. While many training systems can assess and report a trainee’s performance, most have no way to share collected learner data with other training systems. Collecting data in a complete profile of performance could lead to the ability to leverage performance data to save time and money training personnel or increase training effectiveness.

Limited interoperability of performance assessment and tracking across training systems continues to constrain the ability of these solutions to adapt, or personalize, across a lifeline continuum of the learning experiences. The Advanced Distributed Learning Initiative is supporting community developed specifications and tools, such as the Experience Application Programming Interface (xAPI). The Army Research Laboratory (ARL) is exploring the use of the xAPI for Interoperable Performance Assessment (IPA) to support the assessment of individuals and teams across multiple training systems. These efforts are beginning to establish best practices to create a “universal language” for Live, Virtual, Constructive, and Gaming systems to share performance data and provide adaptive learning regardless of the technologies or platforms used. Previous work established example methods, an architecture, and tools to capture interoperable data to support individual adaptations. In this paper, we will describe and provide best practices for this evolving approach of tracking and using team performance data. Tracking this data in an interoperable way can provide the basis to support both macro and micro adaptations at the individual level. Practical examples using a single gunner simulator along with team-based data from a crew trainer will be provided. Lessons learned will also be outlined to inform considerations for approach and usage.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320D

T-5 Critical Flight Decisions

1400 Developing and Evaluating Performance Measures for Manned-Unmanned Teaming (14024)

1430 Using Temporal Occlusion to Assess Carrier Landing Skills (14171)

1500 Distributed Live/Virtual Environment to Improve Joint Fires Performance (14041)

NOTES
DEVELOPING AND EVALUATING PERFORMANCE MEASURES FOR MANNED-UNMANNED TEAMING
2014 I/ITSEC Paper No. 14024

John E. Stewart & Scott E. Graham
Army Research Institute
Fort Benning, GA

Courtney R. Dean
Aptima, Inc.
Woburn, MA

Troy Zeidman
Imprimis, Inc.
Huntsville, AL

The role of U.S. Army unmanned aircraft systems (UAS) is becoming increasingly important in tactical combat missions. Consequently, training critical skills required for manned-unmanned teaming (MUM-T) becomes more important, especially for UAS operators. In order to effectively train MUM-T skills, reliable and valid performance measures are required. Scaled observer-based performance measures can add objectivity to the process of assessing training outcomes, providing formative feedback, and tracking team progress. To this end, 36 performance measures were developed and evaluated to assess training-critical MUM-T skills. Draft performance measures were developed and refined with input from senior UAS operators and scout-attack pilots with MUM-T experience. For each performance measure, five-point behaviorally-anchored rating scales were produced representing “good,” “average,” and “poor” performance of the skill. The content validity of the measures and the usability of the rating scales were determined by a second group of senior UAS operators and scout-attack pilots. Most MUM-T measures were deemed relevant to the mission and observable. Six measures with low consensus by participants on relevance and/or observability were determined not to be practically usable. Some of these unusable measures did not reflect the role of UAS aircrews in current MUM-T operations. The measures were designed to be collected as “over the shoulder” observations. As such, a trainer, in the live or the virtual environment, could easily apply the measures. Because the resulting measures use quantitative scales that include exemplars of good-to-poor performance, they can be easily applied to unit performance assessment sessions, such as training “hot wash” and after action reviews.

USING TEMPORAL OCCLUSION TO ASSESS CARRIER LANDING SKILLS
2014 I/ITSEC Paper No. 14171

Webb Stacy, Jeff Beaubien, Sterling Wiggins
Aptima, Inc.
Woburn, MA & Dayton, OH

Melissa Walwanis
Naval Air Warfare Center Training Systems Division
Orlando, FL

Amy Bolton
Office of Naval Research
Arlington, VA

Military skills often have perceptual and motor components that need to be trained and measured. An emerging approach for doing so is temporal occlusion. In this approach, videos are played and stopped just before a key event, and the participant is asked to make a judgment about subsequent events. The term temporal occlusion refers to the blacking out of the time period following the key event, forcing the participant to use available perceptual cues to correctly anticipate what will happen next. The paradigm has been used successfully in research on sports such as tennis (Ward, Williams, & Bennett, 2002) and baseball (Fadde, 2006) but has not yet found widespread use in military training (Williams, Ericsson, Ward, & Eccles, 2008).

In this paper, we will discuss the use of a temporal occlusion paradigm to assess the perceptual skills of expert and novice pilots as they land on an aircraft carrier. Videos were created from expert landings in a simulator, and subject matter experts (SMEs) identified the situations that would most clearly require either standard or aggressive corrections in order to stay on track for a skilled and safe landing. The resulting stimuli were used in tests administered on an ordinary laptop computer before and after training sessions. The temporal occlusion test was embedded in an overarching experiment concerning the relation of simulator fidelity to training effectiveness, and it was used to assess pilots’ implicit perceptual learning during the experiment. Test results were used to measure the degree to which expert-novice differences on the pretest were reduced in the posttest; that is, the degree to which novice perceptual performance moved in the direction of expert perceptual performance. We will discuss the temporal occlusion results from the experiment and will conclude by discussing several other promising uses of the approach.

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DISTRIBUTED LIVE/VIRTUAL ENVIRONMENTS TO IMPROVE JOINT FIRES PERFORMANCE
2014 IITSEC Paper No. 14041

Emilie A. Reitz, Kevin Seavey
JS J6, Joint Fires Division, CTR support
Alion Science and Technology, Suffolk, VA

An infantry platoon maneuvers toward a village; above them, an unmanned aerial system (UAS) provides a video feed to the operations center. The platoon reacts to nearby mortar strikes, while a Joint Terminal Attack Controller (JTAC) assigned to the company Tactical Operations Center (TOC) confirms the target with radio communication and the UAS’s video. The platoon leader is relieved when an AC-130 takes out the mortar pit, but has to handle additional hostile contact from the village itself as the insurgents inside are emboldened by the mortar fire. It takes only a few moments for the situation to spiral out of the platoon leader’s control; the company commander calls mission end to the virtual scenario. The pilot in the AC-130 simulator continues his own training mission. After the after action review (AAR) with the ground forces, the JTAC turns his attention from the virtual mission and resumes controlling live aircraft from his observation post (OP) in the desert, 1,500 miles away from the ground forces.

Building on three years of live and virtual environment development during Bold Quest (Reitz & Richards, 2013), BQ 14.2 will assess methods to improve joint fires performance using a mix of distributed live and virtual training systems. As a first for the Bold Quest live-virtual event, seasoned JTACs will be inserted into the virtual environment while they are still at their live OP, allowing them to control virtual aircraft in their natural environment with their real equipment.

This paper discusses the planning, execution and initial results of using a mixed live/virtual environment to improve individual and team performance in joint fires.

WEDNESDAY, 3 DECEMBER, 2014 ROOM S320D
T-6 Combating Stress: Performance Under Fire

1600 Accelerating Unit Adaptability: A Principle-based Approach to Unit Communication (14038)
1630 Utilizing Simulation and Game-based Learning to Enhance Incident Commander Training (14148)
1700 Inducing Stress in Warfighters during Simulation-based Training (14201)

NOTES
ACCELERATING UNIT ADAPTABILITY: A PRINCIPLE-BASED APPROACH TO UNIT COMMUNICATION
2014 I/ITSEC Paper No. 14038
Tara Rench, Zachary Horn, Alexander Walker
Aptima, Inc.
Woburn, MA
Steve Zaccaro
George Mason University
Fairfax, VA
Mission success in today's decentralized military relies increasingly upon highly adaptive decision-making by small units. Successful adaptation requires units to communicate in ways that facilitate coordination and shared understanding within and outside of the unit (Marks, Zaccaro, & Mathieu, 2000). However, communication breakdowns are prevalent within small units, especially when operating in highly stressful environments. While unit leaders and members are formally trained in communication basics (e.g., how to operate communication devices, preparing and delivering orders, etc.), it is possible that additional training on the deeper principles of team communication can promote improved unit awareness, decision-making, and adaptation. In response, a framework was developed to support training, monitoring, and assessment of Coordinated Tactical Communications in Teams (CONTACT), particularly in the face of situational stressors that create a need for unit adaptation. Leveraging existing Navy-funded team communication research (e.g., Bowers, Jentsch, Salas, & Braun, 1998; Entin & Serfaty, 1999; Smith-Jentsch, Zeisig, Acton, & McPherson, 1998; Waller, 1999) and operational expertise from active duty Marines, six distinct communication principles were identified: Relevance; Quality; Timeliness; Frequency; Information Flow; and Confirmation and Response. These principles provide a common language that help leaders and units align pre-mission communication expectations, assess and adjust within-mission communication, and conduct post-mission reviews of communication strategy. Additionally, six situational stressors are described that significantly affect the application of these communication principles: Uncertainty, Risk, Time Demand, Mental/Physical Demand, Lack of Unit Familiarity, and Broken Communications. Present to varying degrees in most situations, units must recognize these stressors and adapt communications appropriately. Feedback from Marine Corps instructors highlights the promise and utility of the CONTACT framework to help leaders set communication expectations, assess communication during missions, and hold more efficient after-action reviews (AARs). The CONTACT framework and its intended training and assessment applications will be discussed in depth in the current paper.

UTILIZING SIMULATION AND GAME-BASED LEARNING TO ENHANCE INCIDENT COMMANDER TRAINING
2014 I/ITSEC Paper No. 14148
Ronald W. Tarr, Eileen Smith
Institute for Simulation and Training/UCF
Orlando, FL.
Eric Totten, Michael Carney
IST/UCF
Chief Michael Wajda
OCFRD
Across the country, Incident Commander training is viewed as a critical part of Fire Officer readiness and safety. However, this training can often vary from department to department and be rather passive and static. This is the exact opposite of most fireground scenes, which require Fire Officers to make split second life and death judgments in rapidly changing environments.
Unsatisfied with traditional training techniques, the Orange County (FL) Fire Rescue Department (OCFRD) partnered with the University of Central Florida’s Institute for Simulation and Training (UCF-IST) to create a modernized training program for Lieutenant, Captain and Battalion Chief Incident Commanders (IC). For this project, UCF-IST conducted a rigorous performance and needs analysis on OCFRD’s Incident Command Academy. This analysis identified key environmental cues and critical skills that led to specific decision points and tactical direction for ICs. With this in hand, UCF-IST created an engaging, performance oriented, multimedia training program and unique immersive simulator that allowed ICs to learn and practice critical skills through scenario-based learning. In addition, the open-ended nature of the simulation allows for multiple personnel to participate, increasing crew coordination through collective team training.
Since completion OCFRD trainers have run over 400 Fire Officers through the program which employs pre-training web modules, step by step instruction and e-learning activities designed to gradually ramp the Incident Commander into the instructional material and interactive technology, thereby improving their comfort level and acceptance of the program. The training academy classes were organized by Battalion, which improved unit cohesion while raising the tactical knowledge level of participating Fire Officers. OCFRD reports near unanimous improvements in the tactical IC performance and morale of Battalions and their acceptance of this modernized training academy.
INDUCING STRESS IN WARFIGHTERS DURING SIMULATION-BASED TRAINING

Meredith Carroll, Brent Winslow, Christina Padron, Glenn Surpris
Design Interactive, Inc.
Orlando, FL

Jason Wong, Peter Squire
Office of Naval Research
Arlington, VA

Jennifer Murphy
Quantum Improvements Consulting, LLC
Orlando, FL

Over the past decade, the U.S. Marine Corps has shifted its training focus towards enabling effective and efficient decision making in its small unit leaders. Small unit leaders with relatively little experience are increasingly required to make tactical decisions with critical second and third order effects. These near strategic level decisions are not being made in a Command Operations Center (COC), but in the heat of the battle, where the decision maker is surrounded by high levels of physical and emotional stress. Studies have shown significant adverse effects of combat stressors on cognitive performance (Lieberman et al., 2005) as well as persistent changes in brain functional connectivity (Van Wingen et al., 2012). To ensure military success, and the health and wellness of our veterans, it is critical that these small unit leaders receive training necessary to develop strategies which enable them to make effective decisions under stress and mitigate long term physiological and psychological impacts of stress. However, a challenge with implementing such training in the military is the ability to induce high enough levels of stress to elicit physiological and psychological responses similar (maybe not in magnitude, but in nature) to those experienced in combat. Simulation-based training provides a less resource-intensive alternative to live exercises and greater opportunity for variation in decision dilemmas, situations, and stressors. Unfortunately, there is little empirically-validated guidance on how to utilize simulation to train decision making under stress. An approach for integrating cognitive, emotional, and socio-evaluative stressors into simulation-based training was developed and evaluated in a study conducted with experienced Marines. The results found significant increases in both physiological stress response (i.e., increased electrodermal activity), and perceived stress (i.e., State Trait Anxiety Index responses) during this simulation based training approach, suggesting the method may be an effective means of inducing stress in experienced Warfighters.

THURSDAY, 4 DECEMBER, 2014 ROOM S320D
T-7 Intelligent Tutors: Just How Smart Are They?

0830 Developing and Evaluating an Intelligent Tutoring System for Advanced Shiphandling (14014)
0900 Developing Models of Expert Performance for Support in an Adaptive Marksmanship Trainer (14214)
0930 A Digital Tutor for Accelerating Technical Expertise (14272)

NOTES
DEVELOPING AND EVALUATING AN INTELLIGENT TUTORING SYSTEM FOR ADVANCED SHIPHANDLING

Jason H. Wong, Lauren Ogren
Naval Undersea Warfare Center
Newport, RI

Stanley Peters, Elizabeth O. Bratt
Stanford University
Stanford, CA

The goal of an Intelligent Tutoring System (ITS) is to improve training efficiency by monitoring student performance and providing automated tutoring advice with the goal of increasing student learning and throughput. Traditional ITS development has focused on static problems, such as math and physics (Koedinger, Anderson, Hadley, & Mark, 1997; VanLehn, et al., 2005). Recent systems have targeted dynamic environments, such as Navy shipboard damage control and basic shiphandling maneuvers (Iseli, Koenig, Lee & Wainess, 2010; Peters, Bratt & Kirschenbaum, 2011). The research described here examines the advanced shiphandling task of mooring to a pier, which is the graduation exercise at the Surface Warfare Officers School (SWOS). To develop an ITS for mooring, many variables were considered, including ownship parameters (e.g., engine and rudder status), predicted future paths, and student behavior (e.g., number of orders, gaze direction). This development process involved creating and vetting a task analysis with SWOS subject matter experts (SMEs) and several iterations of system prototype testing. An effectiveness evaluation of the prototype was conducted with twenty novice shiphandling students at SWOS, split into groups that received either human or ITS tutoring only for a mooring to a pier scenario. Afterward, all students completed another mooring scenario without any tutoring. Across both runs, performance was evaluated using ship parameters, student behavior, and instructor scoring metrics. Analyzing a wide variety of performance measures showed no differences between the two groups, suggesting that the ITS was able to tutor as effectively as human instructors. Future work will involve developing additional advanced shiphandling scenarios and examining how the student-to-teacher ratio can be increased using a combination of ITS tutoring and instructor supervision.

DEVELOPING MODELS OF EXPERT PERFORMANCE FOR SUPPORT IN AN ADAPTIVE MARKSMANSHIP TRAINER

Benjamin Goldberg, Charles Amburn, Keith Brawner
U.S. Army Research Laboratory—Human Research and Engineering Directorate
Orlando, FL

Marko Westphal
German Federal Office of Bundeswehr Equipment—Information Technology and In-Service Support
Koblenz, Germany

The U.S. Army’s Engagement Skills Trainer (EST) uses sensors on simulated weapons to collect valuable data about a soldier’s performance during marksmanship exercises. That data is available to an instructor for coaching and remediation purposes. However, experience shows that accessing the data, reviewing the data, and providing feedback to a trainee can be a time consuming process. This environment presents challenges when considering the number of trainees who must complete this training and the limited number of instructors available. This also assumes that instructors are capable of accurately interpreting the data and applying effective remediation. Simulators like the EST are prime candidates for the incorporation of an Intelligent Tutoring System’s (ITS) capabilities. The goals of an ITS are to collect data from a system, make inference on that data as it relates to defined metrics, and to provide formative feedback when data is found to deviate from a specified standard. For this purpose, a system requires models to compare data against. In this paper, we will present the results of the first phase of a study to apply ITS technology to the fundamentals of marksmanship. Models created in this phase will be integrated into an adaptive training system prototype built within the Generalized Intelligent Framework for Tutoring (GIFT) for future experimentation. Data was collected across eight experts from the U.S. Army Marksmanship Unit’s service rifle team as they conducted marksmanship tasks. These models are built around sensor data collected during execution, with each sensor being selected based on their link to the fundamentals of marksmanship. We will review the techniques applied to the data for model construction, trends found in the data that are generalized across each expert, and how the models will be used to diagnose error and trigger remediation.
A DIGITAL TUTOR FOR ACCELERATING TECHNICAL EXPERTISE
2014 I/ITSEC Paper No. 14272

J. D. Fletcher
Institute for Defense Analyses
Alexandria, VA

William D. Casebeer
Lockheed Martin Advanced Technology Laboratories
Cherry Hill, NJ

Information Technology is as vital and ubiquitous in the national economy as it is in military operations. A 16-week Digital Tutor for the Navy Information Systems Technicians (IT) rating was produced for DARPA as a way to accelerate the development of expertise in IT and related areas. Graduates from the DARPA Tutor program were found by independent, third-party assessment to exceed significantly (p < 0.01) and practically (effect sizes ranging as high as 3.00 standard deviations) the knowledge and practical troubleshooting skills of IT graduates with 35 weeks of classroom training and sailors averaging over 9 years of IT experience in the Fleet. The Tutor was revised and extended to 18 weeks in order to include preparation for higher-level IT certifications and topics relevant to civilian employment. Ninety-seven veterans have completed the newer 18-week version. Eighty-three of these veterans were unemployed after an average 5 years of separation from active duty. There were no academic dropouts from the course. Nearly all who sought employment after finishing the course have found jobs averaging $65,000 per year. This paper briefly reviews learning and economic findings from the Navy assessments, and provides up-to-date information on learning, quality of life, and economic findings from the veterans’ project, including returns to government investment at various scales of implementation. It also provides an overview of strategies underlying intelligent tutoring systems, those used to develop the Digital Tutor, and practical tactics the Tutor applies to accelerate acquisition of technical expertise. This paper is important to the community because it addresses an important topic (Information Technology); the promise of the Tutor’s technology; the perennial military need to accelerate development of technical expertise; the magnitude of the assessment findings; and the responsibility to prepare people likely to be separated from the military in the near future.

THURSDAY, 4 DECEMBER, 2014 ROOM S320D
T-8 Aviation Training: The Ups and Downs!

1030 Evolving Aviation Live Training in the Future (14078)
1100 Training Fidelity of an Unmanned Aerial Systems Complementary Family of Trainers (14135)
1130 ASOC Training Research: Joint Theater Air Ground Simulation System (14166)

NOTES
Evolving Aviation Live Training in the Future

2014 I/ITSEC Paper No. 14078

Wanda Fuentes, Anne Dunlap, Jim Grosse, Tien Pham, Patrick Sincebaugh
U.S. Army PEO STRI
Orlando, FL

Army Aviation is evolving from over a decade of training aircrews with aircraft using analog systems to an era of digitization, simulation, and embedded processing. Training Centers are adapting to this changing environment characterized by a common operating environment by reusing hardware and software across platforms. This evolving environment not only enhances individual aircrew skill levels, but collective air to ground integrated (AGI) operations training.

The Army’s Aviation Tactical Engagement Simulation System (Aviation TESS) is capable of conducting individual, crew, and collective training to facilitate unified land and air operations training at the Combat Training Centers (CTCs) and Home Stations. Aviation TESS material developers must plan for life-cycle upgrades to adapt and integrate new technology, new tactics, techniques, and procedures (TTPs), and new training venues. Aviation TESS is currently used to collect aviation data across existing Army Aviation platforms (Apache, Black Hawk, Kiowa, and Chinook) and, in the future, from the ground component of the Unmanned Aircraft Systems (UAS).

This paper provides information on current aviation training capabilities, challenges faced by live aviation training stakeholders, and how PM TRADE will use the principles of Better Buying Power to evolve training systems to meet long-term Army aviation training requirements.

Training Fidelity of a Unmanned Aerial Systems Complementary Family of Trainers

2014 I/ITSEC Paper No. 14135

Sharon L. Conwell, Christine M. Covas-Smith, Leah J. Rowe
Air Force Research Laboratory
Wright-Patterson AFB, OH

Andrew Shepherd
Sinclair Community College
Dayton, OH

John B. Bridewell
University of North Dakota
Grand Forks, ND

The use of Unmanned Aerial Systems (UAS) in the National Airspace System (NAS) is of concern by a number of entities. The public is concerned about safety and privacy issues. The private sector is interested in how to exploit the technology to drive down operational costs and create profit. Finally, the public sector is concerned about air safety, privacy, and policy issues, as well as making use of the technology to drive down operational costs for numerous oversight activities from traffic monitoring to fighting forest fires. Private and public sector implementation pioneers will be faced with unique challenges. Despite the name unmanned, there is a plethora of people in the UAS operational loop from air support crews to pilots to air traffic controllers which creates an extraordinarily complex training requirement. Adding to complexity is the size and mission of the UAS as each size dictates airspace considerations, location of Ground Control Stations (GCS) and operational environments. While the US military has invested in UAS training and research, it is a new area constrained by limited resources. Thus it is incumbent on early UAS adopters to address their complex training challenges and leverage the training resources and research done by the US military. One critical NAS integration issue is training pilots to safely operate UAS, particularly medium altitude, long range UAS which will share airspace with private aircraft and amateur pilots. This paper discusses the need for and creation of a complementary family of UAS trainers. The authors draw on the training research, and training simulators and technologies developed and used at the Air Force Research Laboratory, and the commercial simulators used at University of North Dakota, and Sinclair Community College. The findings from the training fidelity assessment are presented and conclusions are drawn.
ASOC TRAINING RESEARCH: JOINT THEATER AIR GROUND SIMULATION SYSTEM

Leah J. Rowe & Sharon L. Conwell
Air Force Research Laboratory
Wright-Patterson AFB, OH

Across the armed forces, warfighters are required to perform in complex, dynamic, networked environments. Adequate preparation requires training in robust simulations that replicate these situations. Designing a training environment for Air Support Operation Center (ASOC) personnel comes with a unique set of challenges. The ASOC warfighters are required to work within their team of nine as well as, with an undefined number of personnel external to their location. The problem in creating a simulated training environment for local training at the operational unit is that it has been proven to be difficult to access, on a regular basis, thirty role-playing warfighters across different locations in order to staff an exercise. The purpose of this paper is to introduce an ongoing effort to create a robust ASOC training environment – the Joint Theater Air Ground Simulation System (JTAGSS) – which overcomes this limitation. JTAGSS incorporates the nine personnel who work within the ASOC, as well as, reflex agents playing the role of team members external to the ASOC (e.g., Joint Terminal Attack Controllers, F16, Joint Fires, etc.). Reflex agents are software-generated role players which are smart, synthetic, team members. Using Mission Essential CompetenciesSM (MEC) the research team identified the primary competencies, supporting competencies, knowledge, skills, and developmental experiences that an ASOC warfighter requires for successful mission completion. The MECs were then leveraged to design and create JTAGSS to provide a training platform to address current ASOC training gaps. This paper presents the successes and lessons learned through creating this unique training environment.

THURSDAY, 4 DECEMBER, 2014 ROOM S320E
T-9 A Variety of Training Approaches

1030 Fusing Self-Reported and Sensor Data from Mixed-reality Training (14158)
1100 A Competency Based Approach to Marine and Weapons Engineering Training (14224)
1130 Scenario-based Training for Development of Leader-Subordinate Mental Models and Cohesion (14333)

NOTES
Military and industrial use of smaller, more accurate sensors are allowing increasing amounts of data to be acquired at diminishing costs during training. Traditional human subject testing often collects qualitative data from participants through self-reported questionnaires. This qualitative information is valuable but often incomplete to assess training outcomes. Quantitative information such as motion tracking data, communication frequency, and heart rate can offer the missing pieces in training outcome assessment. The successful fusion and analysis of qualitative and quantitative information sources is necessary for collaborative, mixed-reality, and augmented-reality training to reach its full potential. The challenge is determining a reliable framework combining these multiple types of data. Methods were developed to analyze data acquired during a formal user study assessing the use of augmented reality as a delivery mechanism for digital work instructions. A between-subjects experiment was conducted to analyze the use of a desktop computer, mobile tablet, or mobile tablet with augmented reality as a delivery method of these instructions. Study participants were asked to complete a multi-step technical assembly. Participants’ head position and orientation were tracked using an infrared tracking system. User interaction in the form of interface button presses was recorded and time stamped on each step of the assembly. A trained observer took notes on task performance during the study through a set of camera views that recorded the work area. Finally, participants each completed pre and post-surveys involving self-reported evaluation. The combination of quantitative and qualitative data revealed trends in the data such as the most difficult tasks across each device, which would have been impossible to determine from self-reporting alone. This paper describes the methods developed to fuse the qualitative data with quantified measurements recorded during the study.

Within the United Kingdom Ministry of Defence a number of competency based models for training have been introduced. Unlike traditional systems based approaches the use of competency is less mature – producing a number of significant challenges. The increasing popularity of Competency Frameworks stems from their stated ability to deliver a breadth of outcomes relating not only to training but also to issues such as professional development, talent management, appraisal and organisational development. This paper reports on the progress of a pathfinder project to redefine all Marine and Weapons Engineering training conducted for the UK Royal Navy within a competency based approach to both career management and training. The paper describes the evolution of that approach – focusing upon why the previous Systems Approach and its job focused Operational Performance Statement (OPS) behaviourist methodology was judged too limited to underpin future training requirements. It will describe what new outputs and deliverables a competency based approach will offer and how, in a training environment utilizing significant contractor led training delivery, the project has evolved in conjunction with the key prime contractor. The approach being taken is that of a hybrid – with significant linkage to Job Analysis based thinking. Support for the traditional behaviourist based systems approach remains strong in many areas of maritime training in the UK. As competency based approaches gain in popularity the result is increasingly the use of hybrid approaches. Some fuse elements of competence/competency models with elements of systems based models – others seek simply to align the two processes. The paper will describe the evolution of current policy and thinking within the Royal Navy. Finally the paper will present a sequence of “Lessons Learned” and outline a generic model for the application of competency to the training and HR environment of the Royal Navy over the next 5 years.
SCENARIO-BASED TRAINING FOR DEVELOPMENT OF LEADER-SUBORDINATE MENTAL MODELS AND COHESION
2014 I/ITSEC Paper No. 14333

Kara L. Orvis
Aptima, Inc.
San Diego, CA

Gregory A. Ruark
U.S. Army Research Institute
Ft. Leavenworth, KS

Krista L. Ratwani
Aptima, Inc.
Washington DC

Mission Command doctrine emphasizes that command is a human endeavor in which leaders help develop their supporting teams through instilling cohesion and shared understanding (ADRP 6-0). One of the six principles of mission command is to provide a clear commander’s intent. Whereas the communication and interpretation of tactical orders can be relatively straightforward, the same cannot be said of commander’s intent. Misinterpretations of commander’s intent can lead subordinate leaders to take inappropriate or ineffective actions that compromise mission success – outcomes that have been demonstrated in the laboratory, field training exercises, and the operational environment. Pigeau and McCann (2000) differentiate between two aspects of command intent: explicit and implicit. Explicit intent is the actual content of the order expressed by the words that are used to convey what the leader wants a subordinate to do (e.g. command intent statement). Implicit intent, on the other hand, constitutes the underlying meaning of the command as it is conceptualized by the leader. Implicit intent communicates the expectations and idealized solution that the leader envisions. The purpose of the research was to investigate how shared interpretation of command intent is developed within Army company leadership teams. Research findings led to the development and validation of a straightforward, scenario-based, leader led, hip pocket training tool to enhance shared understanding of implicit command intent between company commanders and their subordinate leadership team. This paper describes the development of the training tool, the benefits of scenario-based training for developing shared mental models of command intent, and findings from a field validation study conducted with 166 Soldiers (49 teams). Validation results showed an increase in team cohesion and shared interpretation of commander’s intent after two hours of use. The implications of this research for military readiness and suggested future use will be discussed.

THURSDAY, 4 DECEMBER, 2014 ROOM S320D
T-10 Evaluating Training Effectiveness

1330 Post-fielding Training Assessment of Dismounted Infantry Simulation (14022)

1400 Evaluating the Impact of Individual Training on Units’ Operational Performance (14123)

1430 Using LMS Technology for Kirkpatrick Level 3 Evaluation on Human Trafficking Training (14162)

NOTES
POST-FIELDING TRAINING ASSESSMENT OF DISMOUNTED INFANTRY SIMULATION

2014 I/ITSEC Paper No. 14022

Martin L. Bink & Victor J. Ingurgio
U.S. Army Research Institute
Fort Benning, GA

David James
Northrop-Grumman
Columbus, GA

The assessment of training effectiveness for virtual-training systems is best accomplished with two complimentary approaches: experimentation and post-fielding assessment. Obviously, experimentation involves the controlled assessment of system capabilities that should have an impact on training. By contrast, a post-fielding assessment determines the practical advantages and limitations of the system in the context of mission training and can be used to discover ways to increase system utilization and effectiveness. This paper reports the results of a post-fielding assessment of the U.S. Army’s recently fielded dismounted infantry simulator: Dismounted Soldier Training System (DSTS). The goal of the assessment was to collect input on DSTS training effectiveness and training issues from Leaders and Soldiers who have used DSTS at home station. A total of 58 surveys and 122 interviews from Leaders (82), Soldiers (90), and DSTS Operators (8) were collected over six months from five U.S. Army installations. On the surveys, respondents indicated that DSTS is capable of providing a training environment for collective task training and assessment. The after action review (AAR) system, as a training tool, received the most positive responses. Respondents were equally vocal in identifying training distracters. Technical issues and simulator sickness were identified as causes of suspended training, while over half of the Soldiers reported less than a complete feeling of immersion. The interview responses echoed these themes and provided insights on effective planning, preparation, and execution of DSTS training. Overall, the results showed that dismounted infantry simulation showed promise as an effective training device. However, improvements to the technology were still needed to provide a reliable training environment. The results also highlighted the positive impact of effective AAR capabilities on training. Future development of dismounted infantry simulation training should formalize the unique AAR capabilities of the technology to provide formative feedback to Soldiers.

EVALUATING THE IMPACT OF INDIVIDUAL TRAINING ON UNIT’S OPERATIONAL PERFORMANCE

2014 I/ITSEC Paper No. 14123

Dr. Jay Brimstin & Toum nackone Annie Hester
U.S. Army, Maneuver Center of Excellence
Ft Benning, GA

The evaluation of training programs has long been considered one of the critical components of the analysis, design, develop, implementation, and evaluation (ADDIE) process. Typically though, training evaluations at best measure learning, with no measure of the learner’s ability to apply what they learned on the job and no measure of the impact on organizational performance. This is especially true for military training programs designed to prepare soldiers for combat operations, as it is difficult to trace the results of the training program to organizational performance. This paper describes a project that implemented a robust training evaluation of an Army institutional training program that was designed to better prepare soldiers in units to deal with the improvised explosive devices (IED) threat. The Dismounted Counter IED Tactics Master Trainer (DCT-MT) course provided a unique opportunity to pilot an evaluation method using Kirkpatrick’s four-level model for an institutional training course. The course’s mobile training team conducted training for soldiers from the same brigade combat team prior to their deployments to Afghanistan. The evaluation employed a mixed method design to evaluate Levels I and II during the training and Levels III and IV during and after the unit’s deployment. The findings from this evaluation that spanned a two-year period showed positive soldier reaction to the learning experience and significant improvement in their knowledge. Soldiers applied their knowledge in their units under certain conditions. A comparison of specific variables between units that did and did not receive the DCT-MT training showed a positive impact on the units’ operational performance. This evaluation project demonstrated the ability to quantify the impact that training had on units’ operational performance in a combat environment by using Kirkpatrick’s model, and provides an evidence based approach for conducting future training program evaluations.
USING LMS TECHNOLOGY FOR KIRKPATRICK LEVEL 3 EVALUATION OF HUMAN TRAFFICKING TRAINING
2014 IITSEC Paper No. 14162

Jill Shepherd, Lewis Harris, Casey O’Conor
Booz Allen Hamilton
McLean, VA

Traditional methods of gathering Kirkpatrick Level 3 evaluation data, such as observation, interview, work reviews, and focus groups, are resource and time-intensive; consequently, this level of data is often not gathered. To assess its training for law enforcement professionals using the Kirkpatrick Four Levels of Evaluation model at Levels 1, 2, and 3, the Department of Defense (DoD) Combating Trafficking in Persons (CTIP) Program Management Office (PMO) created an evaluation plan to make non-traditional use of existing Learning Management System (LMS) technology. Course effectiveness was assessed using an immediate post-course evaluation (Level 1), a post-test to assess mastery of the learning objectives and perceived learning (Level 2), and a six-month follow-up evaluation (Level 3). This paper describes how the CTIP PMO designed a new course for DoD law enforcement professionals, a one-hour, scenario-based web-based training intervention that models a realistic and complicated crime investigation, and an evaluation plan to use existing functions available on multiple LMSs to gather Kirkpatrick Level 3 evaluation data. The paper discusses the background of the CTIP PMO and its efforts to train law enforcement professionals and the background of the use of LMSs to gather Level 3 Kirkpatrick evaluation data. The paper describes the CTIP PMO’s design of a new course and evaluation plan, the evaluation plan itself, the advantages and disadvantages of non-traditional uses of LMS technology to gather Kirkpatrick Level 3 data, the preliminary Level 3 data gathered, lessons learned, tips for implementing a similar plan, and next steps.

TRAINING PUBLISH ONLY: RESEARCH DIRECTIONS FOR FUTURE SIMULATION-BASED TRAINING DESIGN IN DEFENCE
2014 IITSEC Paper No. 14017

Luke G. Thiele, Ph.D.
Rheinmetall Simulation Australia Pty Ltd
Adelaide, South Australia

New technologies provide potential increases in operational capability through improved survivability, mobility, and lethality. For technologies with a human in-the-loop, however, this potential is only translated to actual combat power through the expertise of the human controllers. This places training on the critical path for maximising the return on investment for technologies of this type. Modern systems also support distributed command and control through increased connectivity. To exploit this technology and seize the operational initiative, commanders must have the mental agility to respond as the situation changes and new information becomes available. This includes creating novel solutions when faced with unexpected situations. This places an emphasis on training to support greater personal adaptability. This paper discusses collaborative research by Rheinmetall Simulation Australia and the Australian Defence Science and Technology Organisation Land Division to investigate the impact of these issues on future training needs analysis and simulation-based training design in Defence. It discusses training as the selected sampling of the environment to provide the experience and feedback opportunities required for the accelerated development of expertise. Using this model, it evaluates the requirements for future Defence training, compares this with current approaches, and identifies a series of future research questions/“roadblocks” for supporting the goal of more efficient, effective, and responsive simulation-based training. The discussion is intended to share Australian research with the international audience.
PDF FILES OF THE 2014 TUTORIAL PRESENTATIONS ARE INCLUDED ON THE PROCEEDINGS CD. PLEASE SEE THE TUTORIALS SECTION OF THIS BOOK FOR SCHEDULE AND SYNOPSIS DETAILS.

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