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2015 FELLOWS PAPER: SIMNET AND BEYOND: A HISTORY OF THE DEVELOPMENT OF DISTRIBUTED SIMULATION

2015 IITSEC Paper No. IF1501

Duncan C. Miller, Sc.D.

Why Is SIMNET Important?

SIMNET stands for SIMulator NETworking. Initiated in 1983, it was the first “shared virtual reality” distributed simulation system, which continues to have significant influences. It was sponsored by DARPA, the Defense Advanced Research Projects Agency, the Department of Defense’s principal high-risk, high-payoff research and development organization, established in 1958. In 1991, a study of various DARPA initiatives by the Potomac Institute for Policy Studies listed SIMNET as one of six programs that have had the most profound effects on the DoD. To put this in perspective, the other five were the ARPANET (the predecessor of the Internet); the individual computer workstation; phased array radar; the stealth technology used to make aircraft such as the F-117 fighter and the B-2 bomber “invisible” on radar; and ATACMS, the low cost, long-range tactical artillery rocket system used successfully in Desert Storm to destroy enemy surface-to-air missile sites and other targets (Potomac Institute for Policy Studies, 1991). That’s quite a distinguished list in which to be included!

Notes
STRESS EXPOSURE TRAINING FOR THE DISMOUNTED SQUAD: THE HUMAN DIMENSION
2015 I/ITSEC Paper No. 15150

Dr. Jay Brimstin
Squad Overmatch Study Team
U.S. Army, Maneuver Center of Excellence
Ft Benning, GA

Today’s soldiers face a complex, unpredictable, and fluid operational environment encountering more stressors and trauma than ever before. Mental disorders account for more hospitalizations of U.S. service members than any other diagnostic category. The Army is aggressively pursuing programs to address these challenges, including revising the Comprehensive Soldier and Family Fitness Program and launching the Ready and Resilient Campaign to improve the performance, resilience, and readiness of soldiers.

While most of the emphasis has been on post-event treatment, preventative resilience training that focuses on the human dimension is a key priority for the Army. The Army Study Program Office provided funding for the Squad Overmatch Study in 2013 and 2014 as its top priority program. This study is focused on investigating how to improve existing training methodologies and technologies to better develop cognitive skills and mental resilience at the squad level with more combat realistic exercises and experiences.

The vision for the Squad Overmatch Study is to optimize performance by enhancing existing training—from basic individual skills to unit training prior to, during, and post-deployment—through early and continuous Stress Exposure Training (SET) to reduce post-traumatic stress and to better prepare soldiers for the stressful situations that are a natural part of combat operations. In June of 2014 the study team conducted a demonstration of graduated SET, as well as cognitive and situational awareness skills training. Of the soldiers who participated, 90% agreed that the use of virtual technologies is effective for training situational awareness and resilience and 100% agreed that training that provides realistic scenarios are helpful in preparing for stressful combat situations. This paper will describe the Squad Overmatch Study objectives, the squad-based SET gaming, virtual and live scenario exercises and technologies used, and present results of the 2014 demonstration at Fort Benning, Georgia.

DIFFERENTIATING MEASURES OF LEARNING (MOL) FROM MEASURES OF PERFORMANCE (MOP)
DURING AIRCRAFT CARRIER LANDING PRACTICE
2015 I/ITSEC Paper No. 15210

Jeffrey M. Beaubien & E. Webb Stacy
Aptima, Inc.
Woburn, MA

Sterling L. Wiggins
Aptima, Inc.
Fairborn, OH

Michael J. Keeney
Aptima, Inc.
Washington, DC

Amy E. Bolton
Office of Naval Research, Code 34
Arlington, VA

LCDR Jefferson D. Grubb
Naval Aviation System Program Office (PMA-205)
Patuxent River, MD

Melissa M. Walwanis, Heather Priest
Naval Air Warfare Center Training Systems Division
Orlando, FL

Christian S. Riddle
Naval Air Systems Command, Manned Flight Simulator
Patuxent River, MD

Measures of performance collected during initial skill acquisition can be misleading indicators of long-term retention or transfer (Soderstrom & Bjork, 2013). For example, previous research demonstrates that learning can occur in the absence of visible performance gains, and temporary performance gains can occur in the absence of long-term retention or transfer (Singer & Edmondson, 2006; Soderstrom & Bjork, 2013). Therefore, it is critical that authors clearly differentiate between Measures of Learning (MOLs) and Measures of Performance (MOPs) in their research. While this distinction was frequently made in the psychological literature until the 1950’s, it has been somewhat forgotten since then (Schmidt & Bjork, 1992). As part of a larger study on the effects of simulator cue fidelity on aircraft carrier landing skills, we collected both MOLs and MOPs. The sample included fifteen Navy F/A-18 pilots (8 novices, 7 experts), each of whom flew 24 landing passes in a high-fidelity simulator over two consecutive days. MOPs were calculated for each pass, and were operationalized as deviations (measured in degrees) from the ideal angle of attack, glide slope, and center line. The data were then aggregated across all 24 passes. In contrast, MOLs were operationalized as changes in performance over time. The two sets of analyses—learning vs. performance—provide very different interpretations of the data. In this paper, we describe the conceptual differences between MOLs and MOPs; show how the choice of analysis can have profound implications for interpreting the results; and provide the reader with actionable guidelines that they can use in their own work to better differentiate learning from performance.

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
YOU CANNOT HIT WHAT YOU DO NOT SHOOT
2015 I/ITSEC Paper No. 15209

Martin L. Bink & Elizabeth Uhl
U.S. Army Research Institute
Fort Benning, GA

David James
Northrop-Grumman Corp.
Columbus, GA

A training system can only be effective if it is appropriately utilized, regardless of whether the training system is a sophisticated full-motion simulator or steel targets on a small-arms range. However, without understanding how trainees use a training system and without clear performance feedback, it is not likely that desired training outcomes will be met. A recent example of training-system underutilization impacting training performance comes from the U.S. Army Sniper School (USASS). In the USASS, sniper teams spend a considerable amount of time at the beginning of the course conducting “data confirmation.” Data confirmation is accomplished by engaging static targets at varying distances on an unknown distance range. So, in the case of data confirmation, the training system is very simple: a small arms range with static targets at varying distances. It was observed over several iterations of USASS that shooters rarely engaged targets at distances beyond 600 m during data confirmation and that, when engaged, the hit percentage of targets over 600 m was very low. The consequence of failing to shoot at far targets (i.e., over 600 m) during data confirmation was low hit percentages on far targets in the record fire event that was a graduation requirement. An intervention was introduced to increase engagements with far targets that required USASS instructors to record and analyze individual shot data. By requiring instructors to document data, the instructor was able to determine if the shooter was spending too much time at closer distances (i.e., not fully utilizing the training system) and to intervene if necessary. The result was increased record-fire performance on far targets. Even though the intervention and results may seem intuitive, the need for such an intervention highlights the importance of trainer engagement to ensure proper training-system utilization and the importance of providing performance feedback during training.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320A
BP-2 Emerging Concepts and Innovative Technologies; Simulation; & Policy Standards Management and Acquisition

1400
Safe Testing of Autonomous Systems Performance (15348) (Emerging Concepts and Innovative Technologies)

1430
Cyber Operational Architecture Training System – Cyber for All (15108) (Simulation)

1500
Measuring Virtual Simulation’s Value in Training Exercises – USMC Use Case (15114) (Policy Standards Management and Acquisition)

Notes
SAFE TESTING OF AUTOMONOUS SYSTEMS PERFORMANCE
2015 I/ITSEC Paper No. 15348

David Scheidt, Robert Lutz, William D’Amico, Dean Kleissas, Robert Chalmers, Robert Bamberger,
Johns Hopkins University Applied Physics Laboratory, Laurel, MD

The role of unmanned platforms is rapidly expanding across a wide range of defense and homeland security missions. Currently operational unmanned vehicles are “tele-operated”, using a command and control link to a remotely located pilot. However, operational complexity, operational pace, and a need to function in communication denied environments necessitate a trend toward autonomous unmanned vehicles. Autonomous systems that make independent decisions in complex engagements, such as the Navy’s Autonomous Aerial Cargo Unmanned System, are currently under development and will require development and operational testing within the next 3-5 years.

Testing of autonomous systems presents some unique and vexing challenges. For instance, the infinite number of variations of test conditions that can exist to stimulate autonomous behaviors and the complexity of the interactions that can occur among multiple autonomous systems combine to make comparative measurement of autonomous system performance extremely difficult. Also, the inherent unpredictability of decision making by autonomous systems may result in decisions that are considered unsafe by managers of live test ranges. Advanced test and evaluation techniques that focus on the unique challenges of autonomy represent a clear and increasing need within the DoD.

The Safe Testing of Autonomy in Complex, Interactive Environments (TACE) Program is a research initiative to develop an advanced test infrastructure that can measure the performance of autonomous systems operating in complex Live-Virtual-Constructive (LVC) environments while ensuring that the autonomous system does not violate range safety policy. This paper will provide an overview of the TACE hardware and software architecture and will highlight the LVC testing that has been performed at the Aberdeen Test Center to validate TACE capabilities. A discussion of anticipated transition activities with DoD partner programs will also be provided.

CYBER OPERATIONAL ARCHITECTURE TRAINING SYSTEM – CYBER FOR ALL
2015 I/ITSEC Paper No. 15108

Dr. David “Fuzzy” Wells, IPA, CMSP
USPACOM J81 / Cyber War Innovation Center
Camp H.M. Smith, H

Derek Bryan
USPACOM J81 / Ingenia Services, Inc.
Camp H.M. Smith, H

Current methods for conducting cyber training are incompatible with the traditional, simulation-based training architectures used to conduct battlestaff training. As a result there is little to no interaction between the cyber domain and the traditional warfighting domains during exercises. This situation does not accurately reflect the current operational environment nor does it address the Secretary of Defense’s (SECDEF) and the Chairman of the Joint Chiefs of Staff’s (CJCS) directives and guidance for incorporating realistic cyberspace conditions into major Department of Defense (DoD) exercises. The Cyber Operational Architecture Training System (COATS) is a U.S. DoD Modeling & Simulation Coordination Office (M&SCO) High-Level Task (HLT) that integrates existing cyber range environments, traditional simulation architectures, operational networks, and cyber emulations to safely and securely synchronize and deliver realistic cyber effects to the entire battlestaff – cyber for all. In doing so COATS provides an integrated and contested training environment where operators plan, execute and experience realistic cyberspace operations and conditions in all domains. This paper describes the key components of the COATS architecture, including the application of network guards and the first draft of a cyber data exchange model, lessons learned from the demonstration and employment of COATS during three U.S. Forces Korea exercises, and recommendations for future cyber and traditional modeling and simulation capability research, development, test and evaluation.
MEASURING VIRTUAL SIMULATION’S VALUE IN TRAINING EXERCISES - USMC USE CASE
2015 IITSEC Paper No. 15114
Nathan Jones & Greg Seavers
MCSC PM TRASYS
Orlando, FL
Christin Capriglione
NAWCTSD
Orlando, FL

In 2013, Lieutenant General (LTGen.) John A. Toolan, former Commanding General (CG) of First Marine Expeditionary Force (I MEF), requested incorporating previously non-interoperable and ‘stove-piped’ virtual and constructive Training Aids, Devices, Simulators and Simulations (TADSS) at I MEF’s First Marine Expeditionary Brigade’s (1st MEB’s) Large Scale Exercise 2014 (LSE-14) to demonstrate that Live, Virtual, Constructive (LVC) TADSS could collectively stimulate a Marine Air Ground Task Force (MAGTF) Commander’s Common Operational Picture (COP). The expected outcome would be an operationally-effective MEF with capabilities to conduct full-spectrum military operations with a COP stimulated with data feeds from LVC entities; while providing training to both the primary (battlestaff) and secondary (supporting unit) training audiences. The objective of this assessment was to measure the training value gained. A measurable training value of utilizing virtual TADSS in a live exercise could have the potential to impact the historical and traditionally biased paradigm to train everything live whenever possible within the Marine Corps.

This paper presents the results of the training value assessment of augmenting the live training event with virtual TADSS. It provides impacts of virtual integration on training efficacy achieved for primary and secondary training audiences. Included is the training value construct, defined assessment approach, limitations, results (both immediate and post event impacts), and efficiencies in terms of cost plus cost avoidance. Recommendations and discussions focus on: (1) identified needs for improvements in exercise planning and tools to facilitate more efficient satisfaction of training objectives for primary and secondary training audiences, (2) develop training-related human performance measures in TADSS to measure performance against training objectives, and (3) define an encompassing methodology for assessing training value of training solutions to inform requirements and acquisition decision makers.

NOTES
STUDENT RETENTION IN STEM CAREER PATHS: PRIMARY INFLUENCES ON THE DECISION TO STAY OR LEAVE
2015 I/ITSEC Paper No. 15018

Jennifer Winner
Air Force Research Laboratory
Wright Patterson Air Force Base,
Dayton, OH

Michael D. Coover,
University of South Florida
Tampa, FL

LT Christopher Faxon
United States Air Force
Wright Patterson Air Force Base,
Dayton, OH

Extracurricular programs for science, technology, engineering and mathematics (STEM) content for middle and high school students are growing in number and are distributed utilizing in-class learning, after school clubs and activities and summer internship programs. It is often the case that anecdotal evidence of an internship program’s effectiveness is plentiful but quantitative data to support this evidence is lacking. In this paper we discuss how the existing organizational turnover literature may be leveraged to explore student interest and retention in STEM career paths. This approach was inspired by the summer modeling and simulation (M&S) program conducted by the Air Force Research Laboratory’s (AFRL) Gaming Research Integration for Learning Laboratory (GRILL®). We describe the basic features of the GRILL™ program and classify dimensions in behavioral change that have emerged over four years of the program. By interpreting these data through the theoretical framework of retention and turnover, specifically focused on organizational commitment, job satisfaction, fit, stress, and career intentions, we develop a more complete picture of factors associated with student entrance into STEM disciplines, continuance through educational and training programs, and entry into the STEM workforce.

OVERCOMING THE CHALLENGE OF EVALUATING SKILLS TRANSFER FROM TRAINING TO JOB
2015 I/ITSEC Paper No. 15151

Ms. Toummakone (Annie) Hester & Dr. Jay Brimstin
Maneuver Center of Excellence
Fort Benning, GA

One of the long-standing challenges in the academic community has been evaluating the transfer of learning from the classroom to on the job performance (McDonald, 2010). Although billions of dollars are spent on training annually, some studies suggested that only 10-15% of training content is transferred to behavioral changes on the job (Lancaster, Milia, & Cameron, 2013). This has also been a challenge in the military training setting. The 19D One Station Unit (OSUT) training course is the initial entry training for the Army’s Cavalry Scouts that combines both basic combat training and advanced individual training. Among the skills taught to these new soldiers is land navigation, which is a fundamental skill necessary for successful performance of all Cavalry Scouts. The land navigation training provided to these soldiers in OSUT was significantly changed in late 2014 in an effort to improve the competence of graduating soldiers. An evaluation of this new training curriculum showed a significant improvement in soldier competence, but the challenge was to determine whether the improved learning outcomes resulted in improved job performance for these soldiers once they arrived in their first unit of assignment. This paper describes the methodology used to evaluate the degree to which newly assigned Cavalry Scouts were able to apply the land navigation skills learned in initial entry training in their first unit of assignment. The methodology applied in the evaluation consisted of establishing a baseline assessment, provided by unit leaders of newly assigned soldiers in selected units, and then using the same measures and leaders to assess newly arrived soldiers who had experienced the improved land navigation curriculum. Further, this paper reports on the degree to which the improved curriculum resulted in improved soldier performance in their first unit of assignment and the challenges soldiers encountered in applying their skills.
MEASURING A MOVING TARGET: VALIDATING DEPLOYED TRAINING COURSES
2015 I/ITSEC Paper No. 15189

Timothy R. Brock, PhD, CPT, ID(S&L+) & Denise R. Stevens, EdD
General Dynamics Information Technology
Orlando, FL

The Veteran Benefits Administration implemented a new requirement to validate the effectiveness of new or revised e-learning courseware after deploying it to the field using the total population as samples of the target audience. In the past, the validation effort occurred in a controlled environment using a small sample of the population prior to fielding the course. The methodologies used with the small sample population were the U.S. Army’s Sequential Validation or Fixed Validation. Because of the push to deploy the required entry-level and refresher/recurring training quicker (as well as cheaper without sacrificing quality), course effectiveness validation is now conducted post-deployment. This mandate poses several challenges, one of which is how to determine whether a training course is effective when it is deployed to the field and completed by government employees expected to simultaneously meet their fast-paced daily production requirements in a high-stress work environment. This paper reports how an argument-based approach is being assessed as an alternative courseware validation process that provides practical evidence to allow reasoned, data-driven interpretations and conclusions regarding the effectiveness of a deployed course. The approach uses both qualitative and quantitative data to establish reasoned arguments to make the evidence-based interpretations of the data. This paper discusses how this argument-based framework for measuring, analyzing, and reporting validation results is evolving to make reasoned determinations about the effectiveness of deployed e-learning products conducted in uncontrolled work environments.
ENHANCING GOOD STRANGER SKILLS: A METHOD AND STUDY
2015 IITSEC Paper No. 15071

Robert Hubal, Mike van Lent, Bob Marinier, Chris Kawatsu, Bob Bechtel
Soar Technology, Inc.
Ann Arbor, MI

A good stranger (GS) is a professional who can effectively integrate tact and tactics, in order to create positive outcomes in difficult social encounters. For military personnel, creating positive social outcomes enhances mission effectiveness and force security, and supports broader strategic and tactical objectives. Some evidence suggests that military personnel may come into situations with preconceived ideas, or frames, about how to behave, not all of which involve GS tactics. Deliberate training in a variety of such situations is required to gain more effective control of people and situations. As part of a large DARPA-funded program maximizing especially high-risk, high-consequence interactions occurring in unfamiliar social terrain, we investigated how to train military personnel on GS skills in order to adapt to and successfully manage these interactions. Training was based on a theoretical structure for GS skills-based interaction; generally this flow maps to the basic sequencing for most interactions that produce positive end states: An approach, a period of framing, orientation and sensemaking, followed by engagement in the evolving business of the encounter. This engagement often involves necessary rapport-building, trouble recovery, and appropriate departure. We conducted an experiment with students at the Infantry Basic Officers Leader Course at Ft. Benning using a browser-based tool developed under the DARPA funding. We presented 32 students with a series of storylines, some having multiple injects, and asked the students to demonstrate their perception of relevant cues in a scene as they observed the interaction depicted by the storyline. We found this training to have a positive effect in increasing behaviors associated with a GS frame. In this paper we detail the training approach, describe our study, and offer recommendations on improving GS skills training in military personnel.

CURRICULUM GPS: AN ADAPTIVE CURRICULUM GENERATION AND PLANNING SYSTEM
2015 IITSEC Paper No. 15369

Mustafa Ilhan Akbas, Prateek Basavaraj
Ozlem Garibay, Ivan Garibay
Office of Research and Commercialization
University of Central Florida
Orlando, Florida

Michael Georgioupolos
Department of Electrical Engineering and Computer Science
University of Central Florida
Orlando, Florida

In educational systems, there has been an increasing interest for the innovative applications such as educational data mining and predictive analytics. These applications are utilized by the institutions for fulfilling academic missions and for improving the utilization of institutional resources. In this paper, we propose the “Curriculum GPS”, an adaptive curriculum generation and planning system, to provide a quantitative model and an interactive system that helps to grow and maintain programs with high retention and satisfaction rates in college, military or corporate education. The Curriculum GPS is composed of three main components: Curriculum analysis, historical data mining and an adaptive course sequence generation. The existing literature demonstrates how curricular efficiency correlates to student academic success in terms of graduation and retention rates. Therefore we first use an approach from the literature to analyze the curriculum under discussion as a directed graph by considering the conditions among courses such as prerequisite requirements. We conduct network analysis in this graph and compare our results with the catalog of courses currently in use. Then we combine this analysis with the historical data of the students and courses to train our model and develop our system’s database. The resulting system uses this training to create a set of quantitative recommendations for each student depending on her individual data such as passed/remaining courses, grades and time to graduate. The system also allows running what-if scenarios to test the outcomes of different choices by students. Therefore it is advantageous for students, instructors and advisors. The system is being developed for the Information Technology based departments of one of the largest universities in US by using the curricula and student datasets from the last thirty semesters. Initial results suggest this novel system provides both insight and improvement for the institutional education.
MARS GAME: CREATING AND EVALUATING AN ENGAGING EDUCATIONAL GAME

2015 I/ITSEC Paper No. 15105

Kevin Dill & Spencer Frazier
Lockheed Martin Mission Systems & Training
Burlington, MA

Barbara Freeman
Standards Work / UC Berkeley
Quincy, MA

Juan Benito
Cooperative Entertainment Inc.
Raleigh, NC

Games have been studied for some time as a possible supplement to classroom-based learning and training, yet questions remain about how best to create the content. How can learning and gaming be merged in a way that does not diminish the positive aspects of either? Games that poorly integrate the educational component suffer for failing to teach, and games that poorly design the entertainment component suffer because they fail to engage the student. The content, and its comprehension by students, must then be evaluated to determine whether learning actually occurred. This paper describes the design, implementation, and evaluation of a game – the Mars Game prototype – that has been crafted from the beginning with the intent of emphasizing the educational content and the player’s engagement (i.e. the “fun”) in equal measure. The game teaches 9th and 10th grade math and programming concepts, and aligns to the Common Core State Standards for Mathematics. The results of a randomized control study performed with students from a U.S. high school are provided. The study evaluated the effect of the Mars Game prototype on students learning and engagement. The study demonstrated that the game statistically significantly improved learning outcomes against a comparison group. The study also showed that the treatment group scored significantly higher than the control group on engagement and deep immersion in the gameplay. These evaluations provide encouraging results reinforcing the design goals set out for the game as well as the efficacy of game-based learning – when you have a truly engaging game.
THE SECRET FOR STEM SUCCESS: EMPLOYING TECHNOLOGY FOR MATH PROFICIENCY

Edward P. Harvey, Jr.  
ATLTL, LLC  
Virginia Beach, VA

Marvin G. Fuller, Ph.D.  
Oglethorpe Charter School  
Savannah, GA

Edward P. Harvey, III  
Harvard University  
Cambridge, MA

This paper proposes an effective, affordable, and practical approach to increasing the number of successful Science, Technology, Engineering and Mathematics (STEM) high school and college graduates. Currently, the primary barrier for U.S. students pursuing STEM degrees is math proficiency, and the problem is ubiquitous among secondary schools systems and colleges. The paper presents experiences and use cases that provide an insight as to why the math proficiency problem exists. The paper highlights considerations as to why the U.S. is ranked 27 out of 34 Organization of Economic Co-operation and Development (OECD) countries in math proficiency; why only 40% of U.S. high school graduates who attend college are prepared for college-level math; and why only 13% of math proficient middle school students become college graduates with a STEM degree. The paper also addresses costs to students, schools, and the government in terms of time, tuition, and subsidies for students to earn STEM degrees. It then presents an educational strategy for the integrated use of serious games, software tutoring agents, and web-based technologies to improve math instruction, review, and remediation.

This paper provides an in-depth discussion on the design, development, testing, validation, and deployment of a comprehensive algebra readiness program. The program integrates serious game technologies, software tutoring agents, online math content, and web-based student performance reports. The program was developed by integrating state and national mathematics standards with commercial game and U.S. DoD training system technologies. It includes 130 foundational arithmetic and algebraic skills students must master to achieve and maintain STEM proficiency. Efficacy study results presented in the paper highlight use of the program by middle school, high school, and college students. Finally, lessons learned are described that can assist in the development of a set of best practices for developing and using technology-based STEM educational tools.

INQUIRY AND DESIGN APPROACH TO STEM EDUCATION USING PROJECT-BASED LEARNING

Danielle McNeely & Robert Seltzer  
NAWCTSD  
Arlington, VA  
Orlando, FL

Dr. Stephen Priselac & Dr. Nancy Priselac  
nCASE  
Uniontown, Pennsylvania  
Orlando, FL

Heather Norton & Alicia Frascati  
Orlando Science Center  
Orlando, FL  
Orlando, FL

Susan Nelson  
AUVSI Foundation  
Arlington, VA  
Orlando, FL

Eileen Smith  
University of Central Florida  
Orlando, FL  
Orlando, FL

Abdul Siddiqui  
PEO STRI  
Orlando, FL

In the 21st century it is time to effectively apply the Chinese Proverb, “Tell me and I’ll forget; show me and I may remember; involve me and I’ll understand” to Science Technology Engineering and Mathematics (STEM) K-12 education (Edwards and Muir, 2004). An effective means to apply this proverb to STEM learning is through the use of combining Project-Based Learning (PBL) with Inquiry and Design (I&D) Instruction. PBL is accomplished by conducting a comprehensive study of a particular topic by means of engaging at several different decision making junctures (Moursund, Kafai, Sandoval, Enyedy, Nixon, Herrera, and Stewart, 2002). Currently PBL activities are used extensively in post-secondary academia and by industry (internships). Learners who are exposed to PBL environments not only actively apply engineering and science understanding, but also tend to obtain a more concrete foundation of science and mathematical knowledge (Lou, Shih, Diez, and Tseng, 2011). Research indicates it is essential to engage a learner’s interest in a technical career path by establishing a link between the theoretical knowledge and its application to solve real life problems early on in the learning experience (Verma, 2011). I&D, which is attracting interest among STEM educators nationwide, emulates the scientific method in the classroom. I&D is a student-centered approach emphasizing the integration of inquiry (science, technology and mathematics) and design (engineering) elements. The intent of this paper is to illustrate how three existing PBL programs can be successfully combined with the I&D teaching methodology to effectively teach K-12 STEM education curricula. The three programs are: 1) Engineering our Future, 2) Materials World Modules, and 3) SeaPerch. From these exemplar programs, schools can better decide with confidence how to adopt these or similar STEM programs into their formal and informal STEM programs.
ED-4 Getting In Front of It

1030
Antecedents of Adaptive Collaborative Learning Environments (15211)

1100
Adaptable Resilience Training for Transitioning Veterans Using Existing Technologies (15285)

1130
The Changing Face of Military Learning (15327)

Notes

ANTECEDENTS OF ADAPTIVE COLLABORATIVE LEARNING ENVIRONMENTS
2015 IITSEC Paper No. 15211

Robert A. Sottilare, Ph.D., Joan H. Johnston, PhD., & Anne M. Sinatra, Ph.D.
US Army Research Laboratory
Orlando, FL

Shawn Burke, Ph.D.
University of Central Florida
Orlando, FL

Eduardo Salas, Ph.D.
Rice University
Houston, TX

Heather Holden, Ph.D.
Mount Washington University
Manchester, NH

This paper explores the effect of critical precursors to realizing successful collaborative instructional environments in terms of their interaction within the learning effect model (Sottilare, 2012; Fletcher & Sottilare, 2013; Sottilare, 2013; Sottilare, Ragusa, Hoffman & Goldberg, 2013) and measurable relationships to team learning in the literature. We evaluated potential antecedents of successful collaborative instruction in the literature through a large-scale meta-analysis. Adaptive collaborative learning environments are group or team instruction where the challenge level of the learning experience is driven by the shared states (e.g., cognitive, affective, physical) and team performance. Independent of the computer technology, the methodology we used examined team behaviors which included, but were not limited to: cognition, communications, coordination, conflict resolution, cooperation, coaching, and leadership. Recommendations about which team behaviors are critical antecedents to the optimal selection of instructional strategies, tactics, and techniques (policies) during adaptive training and educational experiences are also discussed with respect to their effect on team learning. This research is important to the development of effective software-based agents for adaptive systems (e.g. Intelligent Tutoring Systems) where these agents are responsible for planning and executing actions based on the needs of each unique team.
ADAPTABLE RESILIENCE TRAINING FOR TRANSITIONING VETERANS USING EXISTING TECHNOLOGIES
2015 I/ITSEC Paper No. 15285

Ms. Jill Shepherd & Ms. Jennifer Ukwa
Booz Allen Hamilton
McLean, VA

Suicide rates among Military Service Members (SM) and Veterans remain a crisis despite the efforts of the Pentagon and Department of Veteran Affairs (VA) to connect these individuals to support, prevention, and emergency resources. According to the 2012 VA Suicide Data Report, roughly 8,000 veterans are thought to die by suicide each year. Many contributing factors are directly associated with military experiences such as battle wounds, deployment stress, grief, anxiety, depression, post-traumatic stress and other mental disorders. This paper describes how, recognizing that transitioning SMs need a personalized set of resilience skills that change as their circumstances change, the Defense Suicide Prevention Office (DSPO) and Transition to Veterans Program Office (TVPO) collaborated to develop training that reaches SMs at one of the most suicide-vulnerable points in their careers, the transition to Veteran status. Without an option to deliver this sensitive content in a face-to-face setting, DSPO and TVPO had to work within the constraints of deploying their resilience training on an existing Sharable Content Object Reference Model (SCORM)-compliant Learning Management System (LMS). The team aspired to create training that could adapt to individuals’ needs, while also adapting to the audience needs over time. The paper describes how the designers created a Resilience Gauge that, when taken at the beginning of the course, customizes the content to the learner’s needs. The paper describes the research behind the Resilience Gauge, which was developed with experts in both resilience and survey design. The Resilience Gauge is a tool that allows learners to self-report their current resilience skill by answering 25 scenario-based multiple-choice questions, then assembles a custom set of content based on four domains of resilience (mind, body, spirit, social) and three proficiency levels (beginner, intermediate, advanced). The paper describes how designers can repurpose this gauge as an efficient way to create adaptable content.

THE CHANGING FACE OF MILITARY LEARNING
2015 I/ITSEC Paper No. 15327

Sae Schatz, Ph.D
ADL Initiative
Orlando, FL

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

Julian Stodd
SeaSalt Learning
Bournemouth, UK

Emilie Reitz
Alion
Suffolk, VA

Globalization, social media, ever-increasing computing power, and the proliferation of low-cost advanced technologies have created a level of worldwide complexity and rapid change never before seen. To remain competitive in this environment, the US Department of Defense and our coalition allies must identify new ways to empower our forces. In this paper, we assert that part of that solution includes increased investments in our Human Dimension. Specifically, we argue that military personnel require an expanded set of competencies, higher levels of nuanced skills such as critical thinking and emotional intelligence, and more efficient and agile pathways to expertise, and that achieving these outcomes depends, at least in part, on revising the military learning enterprise.

Towards this end, we outline a vision for the future of military learning, painting a picture of the “art of the possible” and proposing a roadmap that outlines five enabling conditions needed to achieve this future vision. The conditions include: (1) Cultivate ubiquitous learner-centric, technology-enabled instruction; (2) Build upon the foundations of data-driven learning; (3) Foster a learning culture at the organizational level; (4) Encourage and empower social learning; and (5) Draw upon deliberate practices and the evidence-based body-of-knowledge from learning science. Enacting any one of these conditions will pose significant challenges, and particular science or technology gaps associated with each condition create additional hurdles. Nonetheless, we argue that the time is right, in terms of understanding and demand, to take action. One major step in that direction is to agree upon a shared grand strategy, that is a vision for our Human Dimension and the military learning system that empowers it. That is the professional dialog this paper attempts to help inform and encourage.

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
WEDNESDAY, 2 DECEMBER, 2015 ROOM S320D
ED-5 Challenging the Game

1400
Game-Based Training for Human-Intelligence Skills (15067)

1430
A Conceptual Model of Pedagogic Design to Support Critical Thinking in Commanders (15075)

Notes

GAME-BASED TRAINING FOR HUMAN-INTELLIGENCE SKILLS
2015 I/ITSEC Paper No. 15067

John T. Miller, II
Consortium Research Fellows Program and
Capella University
Fort Benning, GA

Martin L. Bink
U.S. Army Research Institute
Fort Benning, GA

The U.S. Army increasingly relies on game-based training as a tool for skill development in nontraditional areas such as moral–ethical decision-making, social–cultural awareness, and cognitive reasoning. The use of game-based exercises is nonetheless a novel approach for training human-intelligence tasks. Human-intelligence tasks are the actions related to collecting information from people and other sources (i.e., social networks, print and visual media) to identify elements, intentions, composition, strength, dispositions, tactics, equipment, personnel and capabilities. In U.S. Army, human-intelligence skills are taught in a week-long resident course called the Attack the Network (AtN) course. In order to determine the extent to which game-based training provides a meaningful and effective contribution to the development human-intelligence skills, two forms of scenario-based practical exercises were compared in the AtN. Course performance and perceptions of training were compared across students who completed traditional paper-based practical exercises to students who completed game-based practical exercises in the Army’s Enhance Dynamic Geo-social Environment (EDGE) desktop training environment. The EDGE practical exercises did no better in increasing end-of-course test scores than did traditional paper-based practical exercises. In addition, the paper-based practical exercises were perceived as more beneficial to learning and course outcomes as compared to the EDGE practical exercises. These results add to the growing literature that fails to find a relative advantage of game-based training. However, these data as well as insights from AtN instructors were used to determine how EDGE may have a greater impact on human-intelligence skills. These insights may have wider applicability for increasing game-based training effectiveness in other contexts.
A CONCEPTUAL MODEL OF PEDAGOGIC DESIGN TO SUPPORT CRITICAL THINKING IN COMMANDERS
2015 I/ITSEC Paper No. 15075

Kia Hong Tan, Teng Howe Lim & Boon Kee Soh
DSO National Laboratories
Singapore

The use of serious games as a potential training solution has found traction in the militaries of many countries to meet the complex training needs of soldiers. Games repurposed as training platforms have become more immersive, emotionally engaging, and significantly less expensive as compared to full-fledged simulators. They can also be highly customizable, allow for easy and consistent repetition, and when designed well, create intrinsic motivation in users. Coupled with advances in cognitive and learning sciences which shed light on how humans learn as an individual and in a team, it is therefore timely for us to leverage on these emerging technologies for the next generation of training and learning systems in the military.

In this paper, a conceptual model of pedagogic design is proposed to support the development of a serious game targeted at critical thinking for commanders. The paper explains how the model is used to represent theoretical approaches and to support game design. Key components to train critical thinking are distilled from the review of learning theories and game design recommendations. This establishes the starting point towards selecting appropriate processes, tools and resources to develop the game and learning scenarios. Components of the learning scenarios will be described and related to the appropriate theoretical approaches. Our assertion is that application of pedagogical processes, tools and techniques is useful to support a serious game development that is targeted at critical thinking for senior commanders.

ED-6 Instructors for the Force of Future

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320D

1600 Designing Instructor Support Tools for Virtual Shiphandling Training (15133)
1630 Hey, Remember to Add Motivational Design to Your E-learning (15030)
1700 Achieving Educational Excellence: What do Effective Instructors do? (15226)

Notes
DESIGNING INSTRUCTOR SUPPORT TOOLS FOR VIRTUAL SHIPHANDLING TRAINING
2015 IITSEC Paper No. 15133

Martin Voshell, Ryan Kilgore, Christopher Hogan, Timothy R. McEwen, David Young
Charles River Analytics
Cambridge, MA

Practice and experience are fundamental to seamanship and shiphandling training, but are significantly limited by platform availability and at-sea time. With hands-on experience and at-sea assignments available only to a subset of personnel at a given time, virtual environments (VEs) have the potential to provide a complementary and cost-effective method to support task mastery without putting lives and platforms at risk. VE training systems, such as the Conning Officer Virtual Environment (COVE) currently used by the US Navy for training ship-handling skills, have great potential value to increase training exposure. However, even these virtual systems are resource-intensive because they require highly trained instructors to closely monitor individual students’ progress and provide targeted coaching and feedback. The growing popularity of VE-based training approaches is rapidly outpacing the number of available instructors, who need better tools to support their delivery of high-quality training to larger numbers of students. In this paper, we describe ongoing research and development efforts to extend the Navy’s VE training capabilities by creating work-support tools and dashboard displays that enable COVE instructors to efficiently monitor and manage larger numbers of students with VE training. Based on design principles that support attention management, we have created a series of linked alerting displays to support improved instructor supervision across multiple student training sessions. We also present our analytic approach, provide design implications and initial instructor support concepts, and discuss how our approach and initial results are generalizable to other VE-based instructional settings.

HEY, REMEMBER TO ADD MOTIVATIONAL DESIGN TO YOUR E-LEARNING
2015 IITSEC Paper No. 15030

Geir Isaksen
Commander, NoD University College
Oslo, Akershus Fortress

Siren Elise Frøytlog Hole
Project Manager, Transform AS
Oslo

Student motivation is an essential component of all educational and learning processes. Without motivation, students lack cognitive presence resulting in little, if any, learning. In the traditional classroom setting, it’s up to the teacher to facilitate and maintain student motivation. In an e-learning course however, there is less teacher or facilitator presence and the learner is left alone to interact with the instruction mostly alone. E-learning designers and developers must integrate appropriate motivational elements to ensure the learner sustains his/her motivation throughout the entire instruction to maximize the learning outcome. Over the past few years the Norwegian Armed Forces (NoAF) has incorporated motivational design elements focused on promoting and sustaining motivation into our e-learning courses based on John Keller’s ARCS Model of Motivational Design. This paper outlines the rationale, methodology, and resulting implementation.
ACHIEVING EDUCATIONAL EXCELLENCE: WHAT DO EFFECTIVE INSTRUCTORS DO?

2015 I/ITSEC Paper No. 15226

Heidi Keller-Glaze, Jonathan Bryson & Ray Morath
William R. Bickley
U.S. Army Research Institute

With the publication of the Army Learning Model (ALM; U.S. Army Training and Doctrine Command, 2011), the Army seeks to shift the nature of instruction from instructor-centric to learner-centric and integrate technology into training and education to a greater extent than has been done in the past. Specifically, the ALM directs course proponents to: □ Use more problem-solving approaches in the classroom, with instructors adopting a facilitator role rather than a lecturer role. □ Customize content and methods to learners’ needs. □ Increase the use of interactive technology in learning.

Recent research efforts to develop a framework to select, develop, and evaluate Army instructors revealed a lack of requirements for instructors of adult learners in an environment of interactive, engaging, and learner-centric education. Through a review of military and education literature and a workshop with subject matter experts, a definition of an effective instructor was developed initially. Subsequently, 13 work behaviors and 32 knowledge elements, skills, abilities, and other characteristics (KSAOs) were identified as being necessary for an instructor to be effective in a learner-centric environment. These behaviors and KSAOs were then used to generate tasks performed by instructors in a learner-centric classroom. Data were gathered from instructors regarding the importance of these tasks, the frequency with which they are performed, and the effectiveness of instructor training in teaching these tasks. The behaviors, KSAOs, and tasks can be used in the selection, development, and evaluation of instructors who can effectively implement learner-centric practices and technology into their instruction. The framework developed through the research and analysis will be described along with the next steps to identify training for Army instructors. Follow on work with the behaviors, KSAOs, and tasks is focused on identifying training for Army instructors to prepare them to implement the directives of ALM. This training is intended to complement the training Army instructors currently receive.

THURSDAY, 3 DECEMBER, 2015 ROOM S320D
ED-7 It’s All About the Learning

0830 Using a Skill Acquisition Theory as a Framework for the Army Learning (15125) 0915 Transmedia (Social) Learning in the Wild: DoD SkillBridge for Transitioning Service Members (15162)

Notes

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
INNOVATIVELY APPLYING SKILL ACQUISITION THEORY TO THE ARMY LEARNING MODEL
2015 IITSEC Paper No. 15125

LTC Glenn A. Hodges, Ph.D.
Human Dimension Division (HDD)
Army Capabilities Integration Center (ARCIC)
Training and Doctrine Command (TRADOC)
FT Eustis, Virginia

The Army Learning Concept (ALC) for 2015 discusses a continuous adaptive learning model and multiple 21st century competencies that have been described as critical for U.S. Army Soldiers if the Army is to maintain its competitive advantage into the future. Unfortunately, neither the ALC for 2015 nor the Army Training Concept (ATC) for 2012-2020 provide an instantiation of a model or a description of how to integrate or employ new ideas or approaches into training and education programs and activities to obtain the desired 21st century competencies. Attempts at transitioning training and learning environments from traditional “brick and mortar” settings to the “point of need” leveraging new multi-media technologies and approaches are numerous and ongoing. These efforts have not been coordinated, synchronized or similarly assessed due to the lack of an integrated framework. This paper conveys a possible solution derived using experiential learning theory and skill acquisition research conducted by Dreyfus and Dreyfus (1980). The Dreyfus model is inlaid into a current military career, creating the framework for the development and use of experiential learning inventories (ELI) and competence-based assessments (CBA). Examples of existing CBA are provided and recommendations supporting the development of ELI are discussed. The data implications of this proposal are acknowledged. It is believed that if ELI and CBA are used and punctuate a career (e.g. upon initial entry, upon arrival to and exit from duty assignments, pre- and post- training/education, prior to promotions, etc.) they will help to inform the development and refinement of new and existing instructional methods and technologies useful for training and educating the current and future force. Additionally, the information obtained from ELI and CBA will help to support the efforts of human resource managers and commanders in their efforts to manage their human capital talent.

TRANS MEDIA (SOCIAL) LEARNING IN THE WILD: 
EXPLORING A CONTINUUM OF SUPPORT FOR TRANSITIONING SERVICE MEMBERS
2015 IITSEC Paper No. 15162
Elaine M. Raybourn, Ph.D.
Sandia National Labs/ADL
Orlando, FL
Frank C. DiGiovanni, SES
DASD, Force Readiness & Training
Washington, DC
MajGen Tom Jones, USMC (Ret)
Outdoor Odyssey
Boswell, PA

While social learning is not a new construct, we now have the ability to extend learning across place and time instantaneously with social media and digital tools. As we interact in new ways with multiple media we discover new approaches like transmedia learning, which leverages both social learning and social media. Transmedia learning is engagement-driven, learner-centric, unfolds across multiple media, and is designed to promote social learning. An IITSEC paper published in 2013 utilized the example of Warrior-Diplomat and was the first in a series introducing transmedia strategies to meet the demands of next generation learning. The present paper is the second in the series and expands on theories discussed in the 2015 IITSEC tutorial “Transmedia Learning in the Wild.” While the tutorial uses Warrior-Athlete as an example, the present paper departs from the tutorial and the 2013 paper by honing in on one aspect of transmedia learning—the practice of social learning as it applies to two approaches for preparing Veterans and transitioning Service members for the civilian workforce. In the spirit of the definition of transmedia learning provided above, conference participants who review the 2013 paper and attend both the 2015 paper and tutorial presentations will obtain unique and complementary information from each presentation about transmedia (social) learning in the wild, or as it naturally occurs in a cultural context. The present paper is divided into three sections. The first section introduces the need to retrain transitioning members of the Force and provides a description of the Instruction (DoDI) 1322.29 issued in 2014, titled “Job Training, Employment Skills Training, Apprenticeships, and Internships (JTEST-AI) for Eligible Service.” DoD SkillBridge implements this instruction and is a Deputy Assistant Secretary of Defense (DASD) Force Readiness and Training initiative to connect transitioning Service members with civilian training opportunities. Semper Fi Odyssey, a 6-day intensive transition-assistance and career advancement program for injured veterans, is also presented to illustrate a range of social learning experiences presented as a continuum. The next section introduces three theories from learning science, cognitive psychology, and communication that support a social learning continuum. The theories support 5 key design features: Learning context, culture & community, calibration, and connections. The last section suggests a data collection plan for future measurement of digital engagement as it applies to transmedia (social) learning in the wild.
THURSDAY, 3 DECEMBER, 2015 ROOM S320D
ED-8 Make a Mobile

1030 Innovative Mobile Technologies for Assessing and Enhancing Soldier Performance (15082)

1100 A Reference Model for Designing Mobile Learning and Performance Support (15225)

1130 Development and Evaluation of Mobile Adaptive Training Technologies (15231)

Notes

INNOVATIVE MOBILE TECHNOLOGIES FOR ASSESSING AND ENHANCING SOLDIER PERFORMANCE
2015 I/ITSEC Paper No. 15082

Krista L. Ratwani & Scott Flanagan
Courtney R. Dean
Aptima, Inc.
Washington, DC

Sophia Speira
Carthage, NC

Camilla Knott & Frederick Diedrich
Aptima, Inc.
Washington, DC

Jennifer S. Tucker
Army Research Institute
Ft. Benning, GA

A key element of the Army’s Human Dimension Concept is the need to prepare Soldiers to thrive in conditions of uncertainty while they contend with ambiguous and amorphous threats. To prepare for such conditions, advanced talent management strategies are needed to facilitate Soldier development across the cognitive, physical, and social domains. Comprehensive talent management systems must ultimately leverage assessment tools to gather large amounts of data to enable a detailed determination of Soldier strengths and weaknesses and facilitate continuous learning. The question remains, however, about how best to achieve this goal. This paper reports lessons learned from research with the Army Reconnaissance Course (ARC), Ft. Benning, GA, to assess and track student performance over time in both performance outcomes (e.g., fundamental skills, understanding information needs) and leader attributes (e.g., anticipation, accountability). The final ARC performance assessment system included a mobile application to record student observations, a method to link those observations to key competencies, and a method for presenting trends over time. The trending method enabled student data to be aggregated across instructors and over classes to demonstrate larger changes in performance over time. In this paper, we present the methodology for developing this assessment system, results from an evaluation of the system, and reactions to employing the full assessment system during a course. The findings reflect the results from the in situ testing and use of the assessment system to include additional features which facilitate future utility and promote usability. Implications of the research are discussed to provide suggestions and future research questions to inform the creation of a comprehensive Soldier assessment system as the Army strives toward effective talent management strategies.

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
A REFERENCE MODEL FOR DESIGNING MOBILE LEARNING AND PERFORMANCE SUPPORT

2015 I/ITSEC Paper No. 15225

Peter Berking, Jason Haag
Advanced Distributed Learning (ADL) Initiative

During recent years of increased smartphone and tablet adoption there has been a growing interest in how to improve training and performance opportunities with mobile learning and mobile performance support. Increasingly, instructional designers and developers of traditional eLearning are realizing that the design paradigms for mobile learning are significantly different. Results from a needs assessment conducted for the Advanced Distributed Learning (ADL)'s Mobile Training Implementation Framework (MoTIF) project in 2014 identified a strong demand for a mobile learning design model that can effectively inform, situate, and invite consideration of tactical learning approaches, mobile usage patterns, and mobile affordances.

This paper is based on nearly three years of research findings on mobile learning and performance support as part of the MoTIF project. The findings led to the development of a reference model that could improve the design of training and performance support solutions for mobile devices. The reference model components were substantiated by the quantitative and qualitative data collected during the needs assessment and will be iteratively refined and evaluated for improvements in the future. While the model will continue to capture new considerations as an innovative mobile learning design strategy, it can actually be leveraged and adopted by DoD education and training initiatives today as either a conceptual framework or decision support tool.

DEVELOPMENT AND EVALUATION OF MOBILE ADAPTIVE TRAINING TECHNOLOGIES

2015 I/ITSEC Paper No. 15231

Rodney Long
Army Research Laboratory
Orlando, FL

Jessie Hyland & Joanne Barnieu
ICFI International
Fairfax, VA

This research involves development and evaluation of adaptive training strategies. The current prototype mobile training technology was designed to include an adaptive feature within one instructional cycle (at the Terminal Objective or Module level). Based on pre-assessment questions, the learner’s sequence within the instructional cycle will be adapted accordingly. Should certain learning objectives be considered mastered via determined pre-requisite knowledge, those associated lessons will be collapsed in the curriculum yet accessible if desired by the learner. Additionally, after completing a lesson, the learner can receive guidance from the system if he or she answers the intermittent assessment item (Check on Learning) incorrectly and is also prompted to return to the lesson content should the guidance not assist the learner in answering the assessment item. To examine the effectiveness of the adaptive training, we conducted an experiment to compare students receiving the adaptive version of the prototype (i.e., treatment condition) versus those receiving the non-adaptive version (i.e., control condition). Specifically, participants were compared on the following dimensions: learner reactions; training efficiency; and training effectiveness. On learner reactions, we found some preliminary descriptive evidence that participants in the treatment condition were more engaged and held more favorable perceptions of the training adaptability than those in the control condition but the difference was not statistically significant. Evidence on the potential unintended negative consequences of the adaptive training was inconclusive. On training efficiency, we found the adaptive training to be more efficient than its non-adaptive counterpart, as expected. On training effectiveness, participants in the treatment condition performed as well as their counterparts in the control condition on an independent hands-on performance test. Our findings are encouraging but highlight the need to continue robust research in tandem with the development and integration of new technologies in order to realize the full potential of adaptive training.
AUTOMATED SIMULATION CREATION FROM MILITARY OPERATIONS DOCUMENTS

2015 I/ITSEC Paper No. 15227

John Balint, Jan M. Allbeck, Michael R. Hieb
George Mason University
Fairfax, VA

The creation of virtual reality simulations for training or analysis is an arduous process requiring specialized knowledge. Graphical models and even animated, articulated figures can now be obtained from websites or hired artists. Even after these assets are obtained, putting scenes together and authoring character behaviors can be a lengthy process. Furthermore, ensuring that character behaviors will be successfully performed in a virtual environment is often a trial-and-error process. Automating the creation of these behaviors and facilitating their modification by Subject Matter Experts (SMEs) – as opposed to technicians – will shorten the time required and reduce costs.

This paper presents a framework (VerbsEye) for using descriptive texts, such as military operations documents to semi automate simulation creation. While previous research, such as the WordsEye system, have created static scenes from natural language inputs, our framework further automates the process and includes the generation of agent behavior scripts from the text. Specifically, we present a text-to-scene system that generates 1) scene scripts and 2) agent behavior scripts for virtual environments. The spatial information required for the scenes is obtained both explicitly through prepositions found in the input text and implicitly from the described agent behaviors. Motion data used to depict agent behaviors is exploited to provide additional spatial constraints and assure the behaviors will be possible.

Automated scene creation is challenging and unlikely to result in perfection. The VerbsEye framework is evaluated in terms of how well sample military operations documents can be used to generate scenes and behaviors. The specific metrics used are the percentage of scenes and behaviors in the sample operation documents successfully processed. Our framework shows how additional automation can be used to enable SMEs and technicians to better and more quickly create training tools and environments.
SCHEDULING TRAINING TO MANAGE ACQUISITION & DECAY
2015 I/ITSEC Paper No. 15340

Mohammed Eslami, Ph.D. & Jared Freeman, Ph.D.  
Aptima, Inc.  
Washington, DC

Scott Pappada, Ph.D.  
Aptima, Inc.  
Dayton, OH

The accelerating effects of adaptive training systems are well established (Lesgold, 2012; Cohn & Fletcher, 2010). This power might be enhanced further by scheduling training to accelerate acquisition and scheduling re-training to reduce decay. Models of acquisition and decay have been available to support scheduling since the early days of memory research (Ebbinghaus, 1913). But these models are derived mainly from laboratory tasks that are learned and executed over seconds or minutes, and performed in isolation from competing tasks. The models are much less explanatory or predictive over real world tasks that are complex, learned and executed over hours and days, and situated in a river of daily assignments that impose the scientifically acknowledged cause of skill decay: interference with memory retrieval (Farr, 1987; Arthur, et al., 1998). In this paper, we propose a new approach to acquisition and decay modeling to make the science of skill acquisition and decay more useful and usable. The approach applies machine learning techniques to model skill acquisition and decay. We apply these methods to a large dataset from a game-ified working memory exercise, compare the performance of these methods with a conventional technique, and present the argument for applying these methods to predict learning and schedule training for realistically complex tasks such as system diagnosis and corrective maintenance.

M&S AS A SERVICE: PARADIGM FOR FUTURE SIMULATION ENVIRONMENTS
2015 I/ITSEC Paper No. 15324

Robert Siegfried  
aditerna GmbH  
Riemerling/Munich, Germany

Tom van den Berg  
TNO  
The Hague, Netherlands

This paper presents results of NATO activities in the area of “M&S as a Service” (MSaaS). It illustrates potential benefits with regards to quality, efficiency, and interoperability that may be achieved by MSaaS and provides an insight how some of the existing challenges are currently being addressed.

As M&S products are highly valuable to NATO and military organizations it is essential that M&S products, data and processes are conveniently accessible to a large number of users as often as possible. This requires a new “M&S ecosystem” that has to support stand-alone use as well as integration of multiple simulated and real systems into a unified simulation environment whenever the need arises. Due to many factors, service-based approaches are considered to be very promising for realizing future simulation environments. This idea is known as “Modeling & Simulation as a Service” (MSaaS).

NATO Modeling and Simulation Group 131 (“Modelling and Simulation as a Service: New concepts and Service Oriented Architectures”) has investigated the idea of “M&S as a Service” as a 1-year Specialist Team. MSG-131 defined a consistent MSaaS terminology and placed MSaaS into the wider context of the NATO C3 Classification Taxonomy. Second, an exhaustive overview about service-based approaches used in the M&S domain in NATO and Partner Nations was produced. Third, a comprehensive overview of existing service-oriented (reference) architectures in the M&S domain was produced.

A more detailed investigation of MSaaS and first steps towards an incremental implementation of a “Federated M&S Eco-System” are objectives of MSG-136 (“Modelling and Simulation as a Service - Rapid deployment of interoperable and credible simulation environments”) which started its 3-year term in November 2014. This paper presents results of MSG-131 and current work done by MSG-136.
TUESDAY, 1 DECEMBER, 2015 ROOM S330C
EC-2 Are We There Yet?

1400
Military Vehicle Training with Augmented Reality
(15180)

1445
Modelling a Helicopter Training Continuum to Support System Transformation (15165)

Notes

MILITARY VEHICLE TRAINING WITH AUGMENTED REALITY
2015 I/ITSEC Paper No. 15180

Jonathan Brookshire, Taragay Oskiper, Vlad Branzoi,
Supun Samarasekera & Rakesh Kumar
SRI International
Princeton, NJ

Sean Cullen & Richard Schaffer
Lockheed Martin Mission Systems and Training
Burlington, MA

In order to be effective in the field, the military trains warfighters to operate its many ground vehicles. The goals of training are for the warfighter to learn vehicle and weapon operations and dynamics (e.g., how the vehicle and gun turret work and “feel”) in live tactical situations. Additionally, because many vehicles require multiple operators (e.g., a gunner and driver), team coordination is an important element of the tactical training.

The military employs both live and virtual reality training to achieve these goals. Live training, especially gunnery, requires significant facilities and range infrastructure and is also limited to specific sites due to safety restrictions. Such training events generally require travel/transportation to CTCs and ranges. Unfortunately, live training is expensive. In this paper, an augmented reality based vehicle training system is presented. The trainees are able to drive on physical terrain and engage virtual entities for tactical and gunnery training. By augmenting the real world using virtual entities and effects, along with existing training aids and devices, training anywhere and anytime is enabled.

The details of the vehicle-borne augmented reality system for augmenting both the driver’s periscope and the gunner’s remote weapon sight are presented. The system relies on inertial measurements, cameras, and GPS to provide jitter free, robust and real-time 6-DOF (degree of freedom) pose estimation. These poses are used to render synthetic targets (e.g., dismounts, technical, target) to the driver and gunner. An iPad style instructor interfaces controls the augmented engagement and provides student scores.

The system is evaluated on an Army Stryker vehicle operating in a real range. The consistency and quality of target insertions between the driver’s three augmented periscopes and the gunner’s augmented weapon sights are compared. The importance of each sensor is evaluated by removing its input and comparing.
MODELLING A HELICOPTER TRAINING CONTINUUM TO SUPPORT SYSTEM TRANSFORMATION

2015 I/ITSEC Paper No. 15165

Michael Johnstone, Vu Le, Burhan Khan, & Doug Creighton
Centre for Intelligent Systems Research
Geelong, Vic

Ana Novak, Vivian Nguyen, & Luke Tracey
Defence Science and Technology Organisation
Melbourne, Vic

This study investigates the role of system dynamics (SD) modeling to support strategic decision making for an aviation training continuum that is going through major change. The Australian helicopter training continuum (HTC) is currently undergoing transformation, with restructure and consolidation of training schools and training platforms across multiple services. In this research, we introduce a novel SD-based HTC simulation architecture to facilitate the discovery of relationships between student and instructor development and flow dynamics. The proposed simulation architecture employs hybrid push–pull flow control to quantify transience and estimate recovery time after a policy change or disturbance. This architecture allows for multiple student and instructor types, and their respective intake levels and pass rates. Here the instructor variables include availability, specialization and experience. Enos (2011) successfully explored the application of SD modeling to understand the behavior for combat aviation training in an individual school. This research employs a similar modeling philosophy, but takes a higher level view of the system by looking across multiple training schools, which introduces complexity due to pooling, latency and the amplification of affects across the system. The ability to identify causal relationships allowed stakeholders to develop a deeper understanding of the underlying systemic problems, such as delayed transitions between schools and instructor shortages, whilst the hybrid “push-pull” design allowed us to quantify the pooling of students between schools.

TUESDAY, 1 DECEMBER, 2015 ROOM S320C
EC-4 Pinging and the Brain

1600 Cognitive Two-Way Interactions In an Immersive Virtual Reality Environment (15332)
1630 Modeling and Integrating Cognitive Agents Within the Emerging Cyber Domain (15232)
1700 Tablet Computer Call for Fire Simulation Proof of Concept Study Results (15008)

Notes
TOWARD COGNITIVE TWO-WAY INTERACTIONS
IN AN IMMERSIVE VIRTUAL REALITY ENVIRONMENT

2015 IITSEC Paper No. 15332

Brennan D. Cox, Harvey M. Edwards, Katharine A. Service, Pinata H. Sessoms, Jose A. Dominguez, & Weimin Zheng
Naval Health Research Center
San Diego, CA
Seth A. Reini
Navy Experimental Diving Unit
Panama City Beach, FL

The use of Immersive Virtual Reality Environments (iVREs) for training and rehabilitation purposes is growing in popularity. An emerging topic in iVRE program development, particularly programs aimed at cognition enhancement, is implementing two-way interactions between the user’s cognitive state and the iVRE to achieve maximal effects. This process incurs several outstanding challenges. For example, although recent advances in electroencephalography (EEG) have revealed a number of neural correlates/signatures for a variety of operationally-relevant cognitive states (e.g., attentiveness, fatigue), most if not all of these neumarkers have not been validated in iVREs. The current paper addresses this gap by describing efforts to achieve high quality EEG signals in an iVRE with millisecond-time synchronization between the two systems. To achieve these goals, we evaluated several mobile EEG systems, incorporated off-the-shelf hardware, and developed custom software to effectively implement the EEG devices into the Physical and Cognitive Operational Research Environment (PhyCORE), an iVRE located at the Naval Health Research Center in San Diego, California. As a result, the PhyCORE can now provide cognitive information about human subjects through on-line monitoring of brain activity patterns. Equipped with this capability, the PhyCORE is ready for further development of individualized training and rehabilitation programs based on the subjects’ cognitive states as assessed in real-time and in a real-life environment. The technical challenges and solutions described herein can be easily generalized and adapted for other iVREs, and represent a critical step toward optimization of the human-machine interaction.

MODELING AND INTEGRATING COGNITIVE AGENTS WITHIN THE EMERGING CYBER DOMAIN

2015 IITSEC Paper No. 15232

Randolph M. Jones, Ryan O'Grady & Denise Nicholson
Soar Technology
Ann Arbor, MI
Robert Hoffman, Larry Bunch & Jeffrey Bradshaw
IHMC
Pensacola, FL
Ami Bolton
Office of Naval Research
Arlington, VA

One of the elements missing from virtual environments in the emerging cyber domain is an element of active opposition. For example, in a training simulation the instructor assigns the student a task or objective, and the student then practices within the environment (the “cyber range”) until they feel comfortable with the task or are able to demonstrate the requisite level of mastery. The environment may include some static defenses, such as access control or firewalls, or a fixed set of intrusion methods to defend against, but it typically lacks any active opposition that might adapt defensive or offensive actions (e.g., monitor logs, blocked connections, exploit switching or information gathering). This is akin to training fighter pilots against adversaries who know how to use their weapons, but do not have any tactical or strategic goals beyond that. This is unfortunate for two reasons: 1) it trains cyber operators to behave as though opponents do not have a tangible existence or do not have higher-level goals, and 2) it ignores an opportunity to tailor the student’s learning experience through adjustable adversary behavior. Cognitive agents have the potential to transform the cyber operations training experience. The application of cognitive agents to the roles of cyber offense and defense would provide a more complete cyber ecology for training purposes and thus a more realistic training experience for the student. There are two key challenges to creating such cyber agents: 1) modeling the complex, and continually evolving, processes of cyber operations within a cognitive architecture, and 2) defining the tools and data standards to enable cognitive agents to interoperate with networks in a portable way. This paper discusses novel models of cyber offensive and defensive behavior based on observation and elaboration of human expertise, as well as an approach to the creation of software adapters that translate from task-level actions to network-level events to support agent-network interoperability.
TABLET COMPUTER CALL FOR FIRE SIMULATION: PROOF OF CONCEPT STUDY RESULTS
2015 I/ITSEC Paper No. 15008

James Reynolds, USMC
Marine Corps Systems Command
MCB Quantico, VA

Craig Smith, USMC
II Marine Expeditionary Force
Camp Lejeune, NC

Call for fire (CFF), the coordination of indirect artillery and mortar fires by a ground observer, is an ideal mission set for virtual environment (VE) training. CFF is a United States Marine Corps (USMC) core competency and is a perishable skill that requires frequent reinforcement training. The requirement to expose Marines to initial and recurrent CFF training is hampered by the expensive and time-consuming nature of live indirect fire training. The USMC currently has a CFF simulation training capability, but access is limited by the fixed site nature of the simulations.

This paper presents the results of a proof-of-concept study that developed and tested a tablet-based CFF training simulation. The objective of this study was to investigate the comparative value of tablet-based CFF VE training. The research team designed and developed a tablet-based CFF prototype and then executed a user feedback experiment that compared the tablet solution to the USMC’s current personal computer (PC) based CFF simulation, ObserverSim. The comparison focused on end user opinions regarding the training value and effectiveness of the tablet’s multifunction interface relative to ObserverSim’s traditional mouse and keyboard interface.

End users with and without previous CFF experience registered an overwhelming preference for the CFF tablet prototype (p=0.002). While the tablet prototype was primitive and of much lower fidelity than ObserverSim, participants liked the tablet’s ability to mimic real world physical motion, its ease of use, and shallow learning curve. These study results offer the modeling and simulation community important lessons learned and a realistic example of how to exploit the tablet’s multifunction user interface to further training simulation development efforts.

TUESDAY, 1 DECEMBER, 2015 ROOM S330C
EC-4 Avatars Crossing

1600 Turn-Based Gaming for Convoy Commander Training
(15036)

1630 An Immersive Live / Virtual Bridge Approach with Ultra Wideband Tracking Technology: Phase II (15024)

1700 Virtualizing Humans for Game Ready Avatars (15023)

Notes
TURN-BASED GAMING FOR CONVOY COMMANDER TRAINING

2015 I/ITSEC Paper No. 15036

Rudy Boonekamp, Tijmen Muller
TNO
Soesterberg, The Netherlands

Jur de Vrijer
SIMCEN, Royal Netherlands Army
Amersfoort, The Netherlands

With the increasing complexity of current-day military operations, effective education and training of military commanders is of vital importance. Commanders need to perform within a broader range of conflicts; unpredictable threats and civil-military interaction place a great demand on their decision making skills. Because defense is transitioning towards a leaner organization, efficient and innovative tools are needed to provide better training value. The possibility to train frequently and learn from experience is indispensable.

The Royal Netherlands Army sees potential in the use of serious games to meet these demands. This paper presents the results of a research project that explores the use of ‘turn-based gaming’ for training convoy commanders. In a turn-based serious game, a scenario is played in rounds which have a distinct planning and execution phase, making it possible to control time compression and time pressure. The advantages of this concept are that 1) the trainee can gain experience controlling a large number of units; 2) less experienced trainees can focus on tactical decision making as the complicating real-time factor is removed; and 3) trainees can plan and reflect on tactical decisions while staying immersed in the game.

A prototype game was developed using VBS2, implementing the functionality and user interface for a turn-based convoy scenario. In a pilot session, seven logistics trainees played through three scenarios of increasing difficulty. The potential advantages of turn-based gaming were assessed using a questionnaire. The results indicate that the participants gain relevant experience, insight in effective communication and that turn-based gaming helps them learn by experience through fast loops of planning, execution and reflection. However, technical limitations and the limited scope of the experiment keep us from final judgment whether turn-based mechanics help trainees stay immersed in the game.

AN IMMERSIVE LIVE / VIRTUAL BRIDGE APPROACH WITH ULTRA WIDEBAND TRACKING TECHNOLOGY: PHASE II

2015 I/ITSEC Paper No. 15024

Jay Saffold, Tovar Shoaf & Jason Holutiak
Research Network, Inc
Kennesaw, GA

Pat Garrity & Timothy Roberts
U.S. Army Research Laboratory-Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC)
Orlando, FL

The U.S. Army Research Laboratory-Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC) performs research and development in the field of live/virtual and immersive technology with real-time Ultra-WideBand (UWB) tracking technology. This technical challenge has been thoroughly researched for many years and recently UWB technologies have become more mature. The basis of these studies is that live soldiers must be accurately located while virtual soldiers must stay immersed all within a common real environment. A novel integrated system approach previously developed has been updated to take better advantage of new UWB tracking systems, inertial measurement units, and global positioning system sensors. These redundant tracking sensors with uncorrelated error sources have been intelligently fused in real-time and combined with existing inverse kinematic technologies related to immersive systems developed by STTC, to provide a fast update rate tracking solution with full body articulation. The UWB component has also been optimized to allow for faster update rates and more intelligent responder choosing algorithms with transitioning between responder zones in the physical area; with the benefit of reducing the total UWB infrastructure requirements. This paper discusses extending these ongoing efforts to a more simplified system design and initial experimentation to demonstrate an improved soldier tracking and telemetry system which offers seamless indoor/outdoor tracking capabilities for live/virtual bridging with sufficient accuracy for high fidelity demonstration at the STTC facility, Military Operations for Urban Terrain, and other physical locations applicable for dismount training. The solution to real-time 3D location with high accuracy (< 1 ft) suitable for augmented reality over operational environments requires redundant systems with equivalent accuracy (when available), uncorrelated error sources to provide at least one tracking modality in denied conditions, and a high update rate for real-time systems.
VIRTUALIZING HUMANS FOR GAME READY AVATAR

2015 I/ITSEC Paper No. 15023

Jay Saffold, Tovar Shoaf & Jason Holutiak
Research Network, Inc
Kennesaw, GA

Timothy Roberts & Pat Garrity
U.S. Army Research Laboratory-Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC)
Orlando, FL

The U.S. Army Research Laboratory-Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL-HRED STTC) performs research and development in the field of creating realistic, individualized virtual avatars from live subjects that retain the physical characteristics and appearance of the subject including height, weight, skeletal dimensions, body morphology and facial/body appearance. While photogrammetric extraction technologies are maturing there are a number of additional steps which must be performed to “virtualize” live humans into game ready avatars. Game ready in this context means the mesh stretches properly with motion, there are sufficient level-of-detail options, and the number of polygons is optimized for computer rendering in real-time on commercial graphics adapters and central processing units. Photogrammetric algorithms which extract mesh information from 3D subjects also do not inherently include the underlying bone structure (rigging) required for avatars to move in virtual environments. A novel integrated system approach developed leverages low-cost data capture systems and targets automation of all the steps necessary to go from live human to a high-fidelity game-ready avatar. This paper discusses the different trade spaces associated with various photogrammetric techniques/algorithms, commercial software packages, data capture approaches, subject lighting, frame occupancy, motion during data collection impacts, and converting what is originally a very dense mesh through “retopologization” into optimized levels-of-detail which are properly weighted to a virtual bone system. Each step in the process is discussed along with approaches for automation and the associated trade spaces which affect the quality of the outcome.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320C

EC-5 Fidelity Matters

0830 Reliably Assessing the Effectiveness of a Plan with Models of Verying Fidelity and Under Time Constraints (15060)

0900 Requirements for Future SAFs: Beyond Tactical Realism (15193)

0930 Required Fidelity of simulated Wound at the Point of Injury (15351)

Notes
RELIABLY ASSESSING THE EFFECTIVENESS OF A PLAN USING MODELS OF VARYING FIDELITY AND UNDER TIME CONSTRAINTS
2015 IITSEC Paper No. 15060

Steven de Jong, Wouter Noordkamp, Nick van der Poel, Selmar Smit
TNO Defence, Safety & Security, The Netherlands

Assessing the effectiveness of a plan, given multiple potential scenarios, is a common problem for analysts, especially in the military domain. This problem can seriously impact the safety of the people that are involved in planned missions. More precisely, the availability of multiple models, with varying levels of fidelity, leads to the complex task of selecting the best model(s) to assess the effectiveness of a plan. Under time constraints, optimal model selection depends not only on the fidelity of the models at hand, but also on the nature of the possible scenarios the plan applies to, such as the potential presence of stochastic variables and the number of different scenarios that have to be evaluated in order to obtain a reliable estimate of the true effectiveness of the plan. In this paper, two algorithms are presented to maximize the reliability of the obtained plan effectiveness under time constraints. To this end, the algorithms select the best model(s) as well as the most appropriate scenarios. Both algorithms have been tested on synthetic data as well as on two Navy-related use cases. Results show that both algorithms reach a higher level of reliability within the given amount of time than conventional approaches. Thus, they allow analysts to better assess the effectiveness of their plans and therefore they increase the safety of everyone involved in planned missions.

REQUIREMENTS FOR FUTURE SAFS: BEYOND TACTICAL REALISM
2015 IITSEC Paper No. 15193

Robert E. Wray, PhD
Soar Technology, Inc. NAWC TSD
Ann Arbor, MI

Heather A. Priest, Melissa M. Walwanis, & Katherine Kaste
NAWC TSD
Orlando, FL

A key component of realistic and effective training in simulation is the behavior of semi-automated forces (SAFs). SAFs provide opponents, friendly forces, and other dynamic entities within the simulation. In most cases today, SAFs are designed and implemented to be tactically realistic; that is, they take actions that carry out good tactical decisions. As a result, SAFs are typically evaluated in terms of the realism or “fidelity” of their actions to the tactical situation and not with regard to training effectiveness. We contend SAF tactical realism is a necessary but incomplete requirement for cost-effective and training-effective deployment of SAFs for simulation-based training. SAF behavior should also be modulated by scenario/exercise goals and also by the learning needs of individual trainees. In practice, these additional requirements tend to surface during delivery of training, requiring human instructor/operator teams to intervene. Interventions both increase the cost of simulation-based training and potentially lower the aggregate effectiveness of that training: delivering an appropriate experience at an apt time to the trainee is contingent on the attention and action of the instructional team. Further, as SAFs are increasingly used in mixed live-virtual-constructive training situations, SAFs that consider only tactical decisions will further limit scalability and increase the operational cost of LVC training.

In response, we suggest that imbuing the training system with the capability to understand and support scenario goals and individual training needs can make SAFs more practical for everyday training. We present examples of adaptation and variation that may be important for training but that are not typically embedded in a tactical SAF. We discuss the implications of these missed requirements and outline suggestions for incorporating interpretations of learning context in future simulation systems based on experience researching and developing such a capability. Finally, we outline methods for verifying and validating SAFs designed to meet these additional requirements.

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
REQUIRED FIDELITY OF SIMULATED WOUNDS AT THE POINT OF INJURY
2015 IITSEC Paper No. 15351

M. Beth H. Pettitt
Army Research Laboratory
Human Research and Engineering Directorate
Simulation and Training Technology Center
Orlando, Florida

At the point of injury, critical medical tasks include finding and identifying the injury as well as applying the appropriate initial care. A considerable amount of research and development has already occurred to increase the fidelity of simulated wounds for training, primarily at the point of injury. As material and moulage techniques mature, and as more relevant data is collected on tissue properties, it is worth examining what fidelity is really required for training at the point of injury. This effort will explore the current state of wound simulation and propose a basic test methodology to assess what fidelity is adequate. Secondly, this effort will analyze the differences in technology effectiveness of two and three dimensional (2D and 3D) wound moulage. Other factors that will be examined including cost comparisons between the average 2D wound and silicon-based 3D wound, as well as the time to apply each type of moulage. Finally, conclusions will be discussed on the training effectiveness of the two types of moulage and recommendations will be made on the appropriate use of each in medical training.
VIRTUAL INTERVIEW TRAINING INCREASES JOB OFFERS FOR VETERANS AND OTHERS
2015 I/ITSEC Paper No. 15013

Dale E. Olsen, PhD & Laura B. Humm, BS
SIMmersion
Columbia, Maryland

Matthew J. Smith, PhD, LCSW,MPE;
Michael Fleming, MD, MPH & Neil Jorden, PhD
Northwestern University Feinberg School of Medicine
Chicago, Illinois

Morris D. Bell, Ph.D., ABPP
Yale School of Medicine,
Dept. of Psychiatry

It is difficult for Veterans with Post Traumatic Stress Disorder (PTSD) and others with disabilities to enter the workforce, resulting in a low employment rate. The job interview presents a critical barrier for obtaining employment. To improve job interview skills and the employment prospects of people with disabilities, we developed Molly, a virtual human resource manager. The simulation provides repeated job interview practice with extensive feedback and accommodates a variety of special needs. This paper will focus on the methodology and steps used to develop the simulation, and then report on four single-blind controlled studies and four field validations of the training solution.

During each virtual interview, Molly asks trainees questions about their skills and experiences. Using information provided on a job application, she randomly selects questions tailored to the trainee’s needs from a database of 1,200 options. The trainees practice until they master the skills at three difficulty levels.

The four studies included veterans with PTSD (n=33), people with mood disorders (n=37), people on the autism spectrum (n=26), and people with Schizophrenia (n=32). Those who used the simulation (treatment) demonstrated significantly greater improvement than the control group during live role-play interviews showing efficacy. They were also more confident in their interview abilities. Separate follow-up studies surveyed people from these study groups after six months. For each follow-up study, people from the PTSD and the Mood Disorder Cohorts were combined. The data analysis used logistic regression to adjust for known covariates and to estimate the odds of receiving a job offer. For each study group the estimated odds of receiving a job offer were about 8-9 times greater for the treatment group than the control group.

STEPPING STONES – AN AUGMENTED REALITY REHABILITATION GAME
2015 I/ITSEC Paper No. 15181

Stuart Armstrong
QinetiQ Inc.
Orlando, Florida

Gait disabilities are highly prevalent in veteran populations and include a wide range of symptoms, often caused by trauma or disease. Recent experimental techniques suggests that rapid advancement of Augmented Reality (AR) and hybrid virtual reality (VR) technologies have the potential for simulation of sensorimotor training in gait rehabilitation. This paper describes the development of a game based AR system to support the rehabilitation of lower limb amputees.

The AR system was built was designed to be a standalone wearable system that can be used outside of a clinical setting. Initial trials were held at the Providence Veteran Administration Medical Centers Gait and Motion Analysis Laboratory and the AR system was identified as a novel tool that can be used for gait rehabilitation in the clinic and the home.
THE VA VIRTUAL MEDICAL CENTER:
IMPLEMENTING A VISION FOR A VIRTUAL HEALTHCARE CAMPUS FOR OUR VETERANS
2015 I/ITSEC Paper No. 15358

Rosalyn P. Scott, Brian V. Burke, Cathy D. Graham & Terry L. Oroszi
Veterans Health Administration
Dayton, OH

Nancy Benton
Veterans Health Administration
Spokane, WA

Jennie Gallimore
Wright State University
Dayton, OH

Helga Carabello
Veterans Health Administration
Portland, OR

Mary E. Davidson
Veterans Health Administration
Cleveland, OH

Paul T. Ingrumson
Veterans Health Administration
Gainesville, FL

Sean C. McCoy
Veterans Health Administration
San Antonio, TX

Terry L. Oroszi
Veterans Health Administration
Dayton, OH

Jennie Gallimore
Wright State University
Dayton, OH

Nancy Benton
Veterans Health Administration
Spokane, WA

Helga Carabello
Veterans Health Administration
Portland, OR

Mary E. Davidson
Veterans Health Administration
Cleveland, OH

Paul T. Ingrumson
Veterans Health Administration
Gainesville, FL

Sean C. McCoy
Veterans Health Administration
San Antonio, TX

The Veterans Health Administration is the largest integrated health system in the world serving Veterans in both urban and rural environments. To enhance clinical outcomes and education, a VA Virtual Medical Center (VMC) has been launched as a collaborative care and learning environment. Resources can be accessed anytime and anywhere. Capabilities include virtual clinics with the integration of current telehealth technologies, cybraries for patients and healthcare team members with electronic resources and searchable medical content, serious medical games, e-learning platforms and conference venues. A full range of learning technologies, including virtual patient and standardized patient-based platforms are fully integrated into the environment. Our implementation strategy leverages ways in which the VMC can be synergistic with existing care models; decrease repetitive staff activities; increase dissemination of and participation in educational interventions; provide more effective education; capture productivity measures; and, be easy to navigate. Input from human factors engineers, clinicians, educators, and technology experts has been critical. Initial implementation includes five pilot projects characterized by the need for educational interventions for patients or/and healthcare team members as well as clinical interventions to optimize Veteran health outcomes in key clinical areas. The clinical areas include diabetes, sleep disturbances, congestive heart failure management, obesity, and palliative care. Interventions include staff training for new protocols, peer and professional coaching for patients with chronic diseases, shared medical appointments, training and resources for using at home equipment such as CPAP machines. Assessment strategies are comprised of a global assessment of the technologies in place and project specific ones tracking outcomes. Our newest generation of Veterans is very tech savvy and embraces virtual world technologies. The VMC will allow geographically separated staff and patients to interact in a rich avatar-based environment. In-world opportunities can provide important care resources and rich educational experiences for all learners.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320C
EC-7 Let’s Get Physiological

1030 Visualizing fMRI Data Using Volume Rendering in Virtual Reality (15253)

1100 Professional Soldier Assessment of a Rifle-Mounted Target Hand-Off System (15039)

1130 Empirical Support for Brain-Based Assessment in Simulation-Based Training (15300)

Notes
VISUALIZING FMRI DATA USING VOLUME RENDERING IN VIRTUAL REALITY
2015 I/ITSEC Paper No. 15253

Joseph Holub, Eliot Winer
Iowa State University
Ames, Iowa

Medical imaging technology has changed patient diagnosis since the first x-ray in 1895 (Rontgen, 1896). Powerful imaging technologies like Computed Tomography (CT), Ultrasound, and Magnetic Resonance Imaging (MRI) are now used daily. One study showed preoperative imaging for potential appendicitis reduced unnecessary surgeries by 87% (Raman et al., 2008). With the 2015 Defense Budget including $47.4 billion for the Military Health System (Overview United States Department of Defense Fiscal Year 2015 Budget Request Office of the Under Secretary of Defense (Comptroller)/ Chief Financial Officer, 2014), enhanced use of imaging for improved patient care and cost reduction is critical. More recently, functional MRI (fMRI) technology was developed to extend medical imaging beyond 3D static models to capture physiological changes over time. Currently, fMRI is used for applications from examining beating hearts to mapping brain activity in real-time. fMRI has the potential to dramatically change how illnesses are diagnosed, planned for, and treated. Methods created for visualizing fMRI data in the academic realm have rarely made their way into commercial software toolsets. For example, there are no software libraries available for researchers to create their own fMRI visualization tools. Another consideration needs to be the visual manner (i.e., 2D, 3D, or 3D stereo) in which these visual representations are created. Previous research on visualizing medical data has demonstrated improved understanding of spatial relationships when using stereoscopic 3D over traditional 2D representations. This indicates that virtual reality may be a superior medium for visualizing fMRIs. This paper presents research to: 1) make readily available fMRI software libraries and 2) use these libraries to visualize fMRI data in immersive VR. The method was tested on a desktop computer as well as a large multi-walled VR system running off a cluster of computers. Preliminary results have indicated that visualizing fMRI data in VR can be done in a computationally efficient manner. Multiple fMRI datasets were used for evaluation by measuring load times and frame rates.

PROFESSIONAL SOLDIER ASSESSMENT OF A RIFLE-MOUNTED TARGET HAND-OFF SYSTEM
2015 I/ITSEC Paper No. 15039

Jerome Levesque, Katherine Banko
Defence Research & Development Canada
Ottawa, Canada

Olaf Binsch
Netherlands Organization for Applied Scientific Research
Soesterberg, The Netherlands

The miniaturization of digital image acquisition and processing hardware, positional sensors, and batteries has enabled the creation of assisted targeting systems light enough to be integrated onto small firearms to increase the probability of soldiers detecting and hitting targets. As well, the technology allows soldiers to share target locations, thereby increasing tactical situational awareness and enabling target prioritization and target hand-off. We investigated how these new technologies might impact operational effectiveness by testing the concepts using human-in-the-loop simulation in a virtual environment. Two conditions examined the tool usage (no target hand-off vs. target hand-off). Within these conditions we added patrol and attack variants (no enemy, inaccurate enemy and accurate enemy). Each condition was repeated 8 times for a total of 64 randomized trials. Combat effectiveness measures quantifying blue casualties and the disruption of enemy activity were augmented with physiological indicators of stress and self-report measures of self-efficacy, performance and cognitive load. Null hypothesis significance testing applied to the combat effectiveness measures did not detect any statistically significant improvement in the combat effectiveness of the section as a result of using the target hand-off system. A Bayesian analysis was conducted to determine the probable size of an undetected effect. The human factor measures indicated differences between the simulated high and low threat conditions. Self-report measures combined with physiological measures did not reveal increases in stress when high and low levels of threat were compared. While participants evaluated the target hand-off system positively, the ability of the new technology to decrease cognitive load and therefore increase combat effectiveness measures remains unconfirmed. Simulations have limitations, particularly when exploring the benefits of target hand-off functionality (i.e. weapons effects and risks encountered in combat cannot be fully represented for safety and ethical reasons). And, combat stress is difficult to produce in an experimental setting. However, despite the small number of participants (n = 8), it was possible to estimate the probability distribution for the actual effect size.

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Individualized training solutions are increasingly important to military training programs. To effectively adapt training to each student requires valid and reliable measures of human performance. Historically, the military has relied on behavioral and subjective reporting methods to assess and evaluate human performance (e.g., speed, accuracy, reported workload); such measures are effective for simple, well-controlled tasks with a strong behavioral element, but they lack the diagnostic sensitivity required to measure meaningful differences in individuals’ performance on complex tasks that stress cognitive performance.

Brain-based measures of functional brain activity in naturalistic settings may lead to improved understanding of a trainee’s progress. Specifically, functional Near-Infrared Spectroscopy (fNIRS) is an optical brain imaging technology that can be used in the context of simulation-based training to measure changes in brain activity related to executive cognitive functions. Previous work describes how these changes could be used to measure the transition from novice to expert performance by accurately and reliably assessing the transition of cognitive skills out of working memory into automaticity.

In this paper, the authors describe how brain-based metrics derived from fNIRS and task performance data were developed for a realistic pilot flying task in a simulation environment. Results from this study demonstrate that fNIRS can be used to quantify meaningful differences as novice pilots learn to navigate a prescribed flight path. Behavioral performance data confirmed that navigational proficiency improved across trials, while the average oxygen concentrations declined in several areas of the prefrontal cortex, as hypothesized. Furthermore, there were statistically significant correlations between the neural and behavioral data. These results show that neurological data may provide a powerful complement to existing behavioral measures by allowing instructor pilots not only to observe trainee outward behavior, but also to gain a perspective of neurological changes occurring in the brain itself.
PUTTING LIVE FIRING RANGE DATA TO WORK USING THE XAPI
2015 I/ITSEC Paper No. 15019

Paula J. Durlach
Army Research Laboratory
Orlando, FL

Nick Washburn
Riptide Software, Inc.
Oviedo, FL

Damon Regan
The Tolliver Group, Inc.
Orlando, FL

The past decade has seen advances in instrumentation of live training ranges. For example, when combined, the Location of Hit and Miss (LOMAH) system and the Targetry Range Automated Control and Recording (TRACR) system send virtually immediate feedback on marksmanship performance to trainers, via a tablet computer. However, despite digital availability, the performance data are not used for individual feedback, analyzed, nor automatically shared with any other training management or readiness systems. A proof-of-principle prototype system was developed, which demonstrated how the use of the Experience Application Programming Interface (xAPI) could be used to collect valuable training data and support (1) individual feedback, (2) aggregated data views for trainers and range operations personnel, (3) flexible data views for training researchers, and (4) automated availability of qualification data to the Army Training Management System. The xAPI was developed to allow the collection of learner data from different types of learning experiences, and to make the data available to other applications. The LOMAH-TRACR data were converted to xAPI statements, which were sent via an encrypted wireless network to a Learning Record Store (LRS). Using a pin number, individual trainees could access a visualization of their own data on a mobile device, and be given a link to learning content, personalized by the software’s analysis of their individual shot group pattern; however, no actual Soldier testing occurred as part of the project. Trainers and range operations personnel could also view data, and filter it according to their needs. An unanticipated benefit was the ability of range personnel to identify operational defects in LOMAH targets. A third “researcher” dashboard was created to allow for analysts to select data and export for further analysis. A future benefit will be the ability to integrate data from simulation and live training, in order to determine the most efficient and cost-effective combination to achieve desired levels of performance.

ADAPTING GUNNERY TRAINING USING THE EXPERIENCE API
2015 I/ITSEC Paper No. 15179

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

Michael Hruska
Ashley Medford
Jennifer Murphy,
Carolyn Newton
Quantum Improvements Consulting
Orlando, FL

Tara Kilcullen,
Robert L. Harvey Jr
Raydon Corporation
Port Orange, FL

The Army’s Training and Doctrine Command (TRADOC) has described plans for modernizing Army training in documents such as the Army Learning Model (ALM, TRADOC PAM 525-8-2). The ALM calls for increasing the personalization of the soldier learning process so that training is tailored to the individual soldier throughout his/her career. To accomplish this goal, a persistent representation of soldier performance across a variety of technology-based training systems is required. Currently, performance data throughout the live, virtual, constructive, and gaming (LVCG) spectrum is not maintained, nor is it used to adapt future training for soldiers or their units. However, advances in data interoperability have recently made development of complex student models using this performance data a possibility. The Experience API (xAPI) is one such innovation. As part of our research, we have used the xAPI to capture interoperable performance data for unstabilized gunnery simulators. Using this performance data, we have developed an adaptive training curriculum in which crew training is adapted based on prior individual performance on a gunner simulator. This paper describes the development of interoperable performance data for unstabilized gunnery simulators using the xAPI specification as well as the findings of an experiment to demonstrate gains in learning and training efficiency. The results can be used to inform the Army in its training modernization goals, as well as the simulation-based training community as a whole.
OPENING LEGACY DATA SILOS: USING EXPERIENCE DATA FOR EDUCATIONAL IMPACT

2015 IITSEC Paper No. 15043

Jonathan Poltrack
ADL Initiative Contractor with Problem Solutions
Alexandria, VA

Tom Creighton
ADL Initiative Contractor with Aquate Corp
Alexandria, VA

The Sharable Content Object Reference Model (SCORM) afforded major benefits to the learning and training industry by creating an environment of interoperability for e-learning content and systems. However, the data that resulted from a learner experiencing SCORM content was often stored in proprietary data stores. As a result, potentially important data was locked away and unable to be used.

Recently, emerging trends in big data, predictive analytics and data visualization renewed interest in accessing massive amounts of learning experience data. Paradata and correlations can be evaluated to provide learner recommendations for relevant content, to present visualizations to teachers so they can see how their content is being used, and to view meaningful analytics that among other things, can be used to refine and improve learning content. But how can this be accomplished when the requisite data is locked in proprietary learning management systems?

This paper will discuss a novel method of intercepting SCORM communications and translating to standard Experience API (xAPI) ‘statements’. The xAPI is an emerging technology that allows tracking of experiential data and provides secure access to data once stored. After applying this solution, SCORM run-time data is stored in a learning record store (LRS) allowing secure access for analysis and visualization. It is possible to apply this solution in two distinct ways: content or server-side updates. Both of these are viable, and in some cases almost automatable solutions to exposing vast amounts of SCORM data.

This paper will explore both methods for removing legacy data silos, will discuss the pros and cons of both content and server side updates, will report on the feasibility of these methods by describing software proofs-of-concept, and will illustrate several use cases and examples of the value of leveraging SCORM e-learning data once it is available en masse.

THURSDAY, 3 DECEMBER, 2015 ROOM S320C

EC-9 3D Psycho

0830 Rapid 3D Geospatially Oriented Structure Extraction from Minimal Image Sets (15323)

0900 Extending Intelligent Tutoring Beyond the Desktop to the Psychomotor Domain (15029)

0930 Delivering 3D Virtual Maintenance Training Content: Examining the Deployment Options (15239)

Notes
**RAPID 3D GEOSPATIALLY ORIENTED STRUCTURE EXTRACTION FROM MINIMAL IMAGE**

2015 I/ITSEC Paper No. 15323

R. Scott Starsman, PhD
Avineon, Inc. Director, Defense Systems
McLean, VA

Traditional approaches to 3D scene reconstruction require very large image sets, are extremely processor intensive, and perform poorly when faced with surfaces with limited features. The work described in this paper builds upon an approach presented at I/ITSEC 2013 that greatly increases quality of 3D reconstruction, requires a minimal set of images, reduces model storage size, and is resilient in the face of low-feature surfaces. While the work presented in 2013 demonstrated the successful reconstruction of a 3D model from a small set of images, it suffered from several problems including long processing time, low success rate for arbitrary structures (meaning that it worked well on specific types of buildings/structures but not on the vast majority), sensitivity to misidentification of commonly present elements, such as logos and signs, and correspondence point noise. This paper details the methods used to address these deficiencies and achieve the full promise of rapid scene reconstruction in the face of a limited number of images. Two elements of the image processing pipeline were identified that led to the performance issues and replacement algorithms and processes were developed and integrated into the model. The replacement of those components dramatically improved performance and supported the generation of arbitrary structures from an image set. Key issues that have been resolved include: extremely long processing times, sensitivity to structures with few surface features, sensitivity to repeated features, and sensitivity to correspondence point noise. A description and derivation of these new approaches is discussed and as a final demonstration, the system is used to generate a 3D reconstruction of a city block with the results capable of being viewed in a tool such as Google Earth. This work is pertinent in the military, security, simulation, and disaster response scenarios.

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**EXTENDING INTELLIGENT TUTORING BEYOND THE DESKTOP TO THE PSYCHOMOTOR DOMAIN**

2015 I/ITSEC Paper No. 15029

Robert A. Sottilare, Ph.D.
US Army Research Laboratory
Orlando, Florida

Joseph LaViola, Ph.D
University of Central Florida
Orlando, Florida

Today, Intelligent Tutoring Systems (ITSs) are generally authored to support desktop training applications with the most common domains involving cognitive problem solving tasks (e.g., mathematics and physics). In recent years, implementations of game-based tutors based on the Generalized Intelligent Framework for Tutoring (GIFT), an open-source tutoring architecture, provided tailored, militarily-relevant training experiences in desktop applications (e.g., Virtual Battlespace and Virtual Medic). However, these game-based desktop tutors have been limited to adaptive training for cognitive tasks (e.g., problem solving and decision-making), whereas the military requires adaptive training to extend beyond the desktop to be compatible with the physical nature of many tasks performed by soldiers. This paper examines how commercial smart glass technologies could be adapted to support tailored, computer-guided instruction in the psychomotor domain for military training in-the-wild, locations where no formal training infrastructure is present. We evaluated the usability and system features of 10 commercial smart glasses including Atheer One, CastAR, Epson Moverio BT-200, GlassUp, Google Glass, LaForge Icis, Laster See-Through, Meta Space Glasses, Optinvent ORA-S, and Vuzix M-100. Smart glasses were selected as the focus of this study over handheld mobile devices to promote a hands-free experience during a training task where the hands are needed to accomplish the task (e.g., climbing and maneuvering over uneven terrain). Each set of smart glasses was evaluated not with respect to each other, but with respect to their capabilities to support adaptive instruction in-the-wild and at the learner’s point-of-need. We examined a wide range of smart glass features and capabilities, and evaluated their compatibility with a representative military task, land navigation, to answer the question: what system design features (e.g., usability and interaction) are needed to support adaptive training for this individual psychomotor task beyond desktop applications so it can be taught anywhere (in-the-wild)?
DELIVERING 3D VIRTUAL MAINTENANCE TRAINING CONTENT: EXAMINING THE DEPLOYMENT OPTIONS
2015 I/ITSEC Paper No. 15239

Christopher Van Duyne, Scott Ariotti
The DiSTI Corporation
Orlando, FL

Over the past several years, the U.S. Armed Forces have been significantly expanding their adoption of virtualized solutions for use in maintenance training applications. This growing adoption is coupled with a growing interest in expanding the ways in which these training materials are consumed. Unlike traditional operational trainers that teach students on fixed hardware, the virtualized training material for maintainers lends itself well to providing innovative training beyond typical brick and mortar schoolhouses; so long as the content can be effectively delivered. These graphically intense 3D virtual environments often levy hefty requirements on the type of computer capable of delivering an immersive interactive 3D experience. This paper focuses on the latest options available for delivering these virtual environments to the training consumer along with the pros and cons of each option and key lessons learned for two different types of training consumers; Classroom users and External users.

The deployment options in this paper compare and contrast traditional desktop use with technologies that incorporate mobile client applications, fixed server rendering solutions, and newly emerging cloud-based application rendering services. The review includes relative cost comparisons, barriers to entry, the consumer access experience, application development considerations, and necessary hardware utilizing real-world examples that encompass both military aircraft and commercial automotive training devices. The paper also introduces discussion topics on information assurance and security considerations for each deployment option.
GAMERS TODAY, SURGEONS TOMORROW?
2015 I/ITSEC Paper No. 15235

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

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

Faced with an age of reliance on technology and innovative advances, surgeons are using cutting-edge robotic systems to perform complex procedures and virtual reality simulators for specialized skill training. The virtual environment and controllers in surgical simulators are reminiscent of those in videogames. So, can playing video games develop skills similar to those used in robotic surgery?

This paper compares the performance of video gamers, medical students, and “lay people” to expert robotic surgeons on a robotic surgery simulator. Participants recruited from the UCF College of Medicine, UCF FIEA, and Florida Hospital completed a demographic questionnaire. The subjects then performed three computer-based perceptual tests and participated in two warm-up tasks on the Mimic dV-Trainer to familiarize themselves with the system. The experiment then measured their performance over eight trials of two core simulated exercises. After completing these trials, participants completed a post-questionnaire about their experience.

Analysis of the data did not verify differences between the groups for the perceptual tests except for the time to complete scores in the Flanker and subsidizing tasks, in which expert surgeons took significantly longer than other groups. Significant differences were found between the groups for the first and eighth trials of the simulated exercises, with surgeons performing better than other groups. All groups improved significantly from trial one to trial eight, with surgeons performing better than all groups. Gaming console type positively correlated with Overall Score in the Ring & Rail exercise, as well as Time and Economy of Motion in the suturing exercise. No other correlations were found.

The results are in contrast with prior literature on video game experience in laparoscopic surgery, suggesting that gaming abilities do not translate to all surgical modalities. Future research is necessary to further examine the impact alternative skillsets may have on surgical skills.

RELATIONSHIPS BETWEEN LEARNER AND ENVIRONMENT:
LEARNER TRAITS IN SERIOUS GAMES
2015 I/ITSEC Paper No. 15092

Marvin G. Fuller, Ph.D.
Oglethorpe Charter School
Savannah, Georgia

Dennis Beck, Ph.D.
University of Arkansas
Fayetteville, Arkansas

When investigating learning, it is commonly discussed that there is a strong relationship between learning and the interactions between the learner, environment, and content. It is important to understand these relationships regarding serious games because they may provide many learning and training advantages, including maximizing the efficiency of achievement of learning targets. Despite the recognized potential of serious games, few researchers have explored the relationships between specific patterns of behaviors and types of game-based learning environments.

This paper presents a practical underlying theory that relates how patterns of learner characteristics and behavior can be used to improve serious game design and promote learning effectiveness. It also presents research results showing relationships between the learner and engagement in serious game environments. The case study used for this research involved high school and college-level math students using a commercial 3D adventure-quest math game. The data and statistically significant results of the study show the relationship between gamer behavior, gender, and age-band, to time-on-task and learning performance. Important conclusions presented at the end of this paper include a range of principles useful for serious game designers, developers, and educators. Recommendations for future research provided at the end of the paper will provoke interest in furthering basic principles for learner engagement across a broad range of serious game applications.
LEARNING STORIES: DESIGN CONSIDERATIONS FOR NARRATIVE ELEMENTS IN SERIOUS GAMES
2015 I/ITSEC Paper No. 15303

Michael W. Freeman, EdD
MW Freeman Solutions
Fayetteville, NC

Mark Friedman
Adayana Inc
Suffolk, VA

Serious games are powerful tools for providing direct experience and concrete contexts in military training environments. They depend on stories, or narratives, to provide the basis for effective, engaging learning experiences. However, there are few research-based guidelines to support design of learning narratives or account for why they include specific characters, environments, or activities. While the fundamentals of good instructional design and learning are enduring, narratives for serious games require careful design to leverage the great promise and inherent power of the serious game.

This paper proposes an inclusive model for understanding and designing serious game narrative. The paper starts with a working definition of serious game narrative and continues with a distillation of a review of the literature to propose the components that make up an effective narrative for serious games. The paper continues by proposing specific design considerations based on a review of learning theories and best practices for each of these components. This is intended to recommend to serious game designers and developers a common lexicon of terms to describe narrative and to enable a purposeful process for designing the game narrative and experience. The paper concludes with recommendations for implementation and future study.

THURSDAY, 3 DECEMBER, 2015 ROOM S320A
EC-11 Droning On

1330 Procedural Reconstruction of Simulation Terrain Using Drones (15041)
1415 Assessment of Unmanned Aircraft Platform Performance Using Modeling and Simulation (15006)

Notes

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
PROCEDURAL RECONSTRUCTION OF SIMULATION TERRAIN USING DRONES
2015 I/ITSEC Paper No. 15041

Ryan McAlinden, Evan Suma, Timofey Grechkin
USC Institute for Creative Technologies
Los Angeles California

Michael Enloe
National Simulation Center
Ft. Leavenworth, Kansas

Photogrammetric techniques for constructing 3D virtual environments have previously been plagued by expensive equipment, imprecise and visually unappealing results. However, with the introduction of low-cost, off-the-shelf (OTS) unmanned aerial systems (UAS), lighter and capable cameras, and more efficient software techniques for reconstruction, the modeling and simulation (M&S) community now has available to it new types of virtual assets that are suited for modern-day games and simulations. This paper presents an approach for fully autonomously collecting, processing, storing and rendering highly-detailed geo-specific terrain data using these OTS techniques and methods. We detail the types of equipment used, the flight parameters, the processing and reconstruction pipeline, and finally the results of using the dataset in a game/simulation engine. A key objective of the research is procedurally segmenting the terrain into usable features that the engine can interpret – i.e. distinguishing between roads, buildings, vegetation, etc. This allows the simulation core to assign attributes related to physics, lighting, collision cylinders and navigation meshes that not only support basic rendering of the model but introduce interaction with it. The results of this research are framed in the context of a new paradigm for geospatial collection, analysis and simulation. Specifically, the next generation of M&S systems will need to integrate environmental representations that have higher detail and richer metadata while ensuring a balance between performance and usability.

ASSESSMENT OF UNMANNED AIRCRAFT PLATFORM PERFORMANCE USING MODELING AND SIMULATION
2015 I/ITSEC Paper No. 15006

Brent Terwilliger, Dennis Vincenzi, David Ison, and Todd Smith
Embry-Riddle Aeronautical University, Worldwide Campus

Unmanned aircraft systems (UAS) can provide significant enhancement to capability, when used in a manner best aligning inherent design characteristics to requirements of a given application. However, wide variability in designs, configurations, and operational attributes requires the performance of thorough investigation to appropriately identify suitable platforms. Failure to perform sufficient examination can lead to expensive cost overruns, diminished capability, and degraded safety. Assessing the capabilities and performance associated with categorized UAS platforms through experimentation and analysis can produce valuable insight regarding propriety for application. The use of modeling and simulation (M&S) provides the means to identify limitations, benefits, and considerations necessary to aptly employ UAS. Understanding how to best select, configure, and apply this rapidly advancing technology is anticipated to support increased innovation, safety, efficiency, and effectiveness; elements essential to achieving successful integration into the National Airspace System (NAS) for use across government, industry, and academia. This paper contains a description of continued work from an experimental research project featuring use of M&S to identify, observe, and investigate critical factors of UAS platform application in an efficient and expedient manner. Operational design attributes (i.e., published and derived metrics) of 282 commercially-off-the-shelf (COTS) platform configurations were identified, classified, and analyzed to create category representative UAS performance models. These models were employed in 30 experimental trials and subsequent statistical analysis. The results led to the development of a theory of operation, selection requirements for use of UAS in aircraft rescue and fire fighting (ARFF), and an expanded series of UAS category performance models. Future anticipated research, including improvement of performance models, expanded simulation trials, and further refinements will also be discussed.

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One of the challenges facing the Army today is the ability to explore innovative concepts and capabilities in a resource constrained environment to develop materiel, doctrinal, and organizational solutions for the future force. Early Synthetic Prototyping (ESP) is a process and a set of tools that will enable Soldiers and technologists to rapidly assess how technologies might be employed within a game environment. ESP is envisioned to be a persistent game network that allows Soldiers to play scenarios and provide experiential feedback to concept and capability developers. An operational test has been conducted that leveraged VBS3 to explore four future concepts: Virtual Pointer, Counter Unmanned Aerial System, Aerial Resupply, and the Next Generation Close Combat Vehicle. A total of 76 Soldiers participated in the test. The test allowed the prototyping of ESP tools and processes, along with answering three primary questions: (1) What games do Soldiers play in their off-duty time and what devices do they use? (2) What would motivate Soldiers to participate in ESP on their own time? (3) How valuable is their qualitative feedback and game data to concept and capability developers? The results of this test were encouraging and overwhelmingly positive. More than 85% of Soldiers play military-themed games in their off-duty hours; more than half of the Soldiers play more than 10 hours of military-themed games each week. Most Soldiers stated they would participate in ESP on their off duty hours and their biggest motivation to participate is knowing they are helping shape the future of their Army. The qualitative feedback indicates Soldiers are able to provide insightful feedback about materiel, organizational, and doctrinal solutions. The results of this study show there is strong potential that ESP will not only be a great way for concept and capability developers to gain meaningful feedback from end users but is also an environment Soldiers relate with and can innovate solutions. This paper describes the test procedure, analysis of the results, lessons learned, and recommendations for future development. Insights are generalizable to understand how to engage service members in their off-duty hours through gaming solutions. The results of this test gained the attention and support of senior leaders in ARCIC and TARDEC. Continued research needs to refine the ESP method and to determine the best way to extract and visualize both qualitative and quantitative data from the composite data collected from thousands of Soldiers.
IMPLEMENTATION OF AGILE METHODS WITHIN INSTRUCTIONAL SYSTEMS DESIGN: A CASE STUDY
2015 I/ITSEC Paper No. 15094
Lisa Cooney & Anne Little, PhD
Addx Corporation
Alexandria, VA

Today’s economic environment of shrinking budgets demands training that aligns with the needs of the workforce by improving specific employee behaviors. When organizations identify a workforce deficiency there often are critical implications for their operations, so they typically respond with training solutions to correct the deficiency.

During the fall of 2014, the authors were tasked with a course design and development effort for a two-week instructor-led program management course. The traditional instructional design methods used for previous versions of this course relied on a locked-down front-end design, classic linear processes, and evaluation methods that provided feedback late in the development cycle. The previous version of the course was heavily based on another Federal agency’s models and did not meet the needs of the students. Additionally, policies needed for inclusion in the class were in flux. The time available for development was tight; two full-time instructional designers and three part-time subject matter experts needed to create a 10-day instructor-led course in time to deliver a class offering in less than seven months.

To create the new course, the development team incorporated the principles of Agile software development. This paper will review Agile software development, the ADDIE (Analysis, Design, Development, Implementation, Evaluation) instructional design method, and explain how the team applied the principles of Agile development to instructional systems design. We will discuss the implementation process, organizational tools, team dynamics, and customer involvement. Finally, we will illustrate the potential cost savings of this method by comparing a summary of the resources utilized to industry training development metrics.

DEVELOPMENT AND EVALUATION OF A VENIPUNCTURE AND PHLEBOTOMY TRAINING SYSTEM
2015 I/ITSEC Paper No. 15084
Teresita M. Sotomayor, Ph.D.
U.S. Army Research Laboratory HRED-STTC
Orlando, Florida
Angela M. Alban
SIMETRI, Inc.
Winter Park, Florida

The U.S. Army has invested significantly in manikin technology to train procedural skills associated with military medical training in diverse simulated environments. Training equipment needs to be rugged and reliable to endure austere conditions but refined enough to provide training solutions with appropriate fidelity. A manikin or Part-Task Trainer (PTT) possessing those qualities that accurately trains venipuncture and injection procedures has historically been a challenge. The goal of the U.S. Army Medical Simulation Training Centers (MSTCs) is to provide Army personnel with more effective technology, tools, and techniques for training Army personnel. As a result, the U.S. Army Research Laboratory Human Research and Engineering Directorate (ARL-HRED) Simulation and Training Technology Center (STTC) was sponsored by the U.S. Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI) to develop a next-generation venipuncture and injection PTT, that is more realistic, durable, and cost effective to teach these lifesaving skills. The primary objective is to develop a proof of concept device that demonstrates the viability of the materials, the electrical/mechanical design, and the technical approach. 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 first responders 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 training system and 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.
PILOTING A GROUNDBREAKING VIRTUAL CONTINUING COMPETENCY PLATFORM: 
RESULTS AND RECOMMENDATIONS
2015 I/ITSEC Paper No. 15325

Jennifer McNamara
BreakAway Games
Hunt Valley, MD

Paul Grace and Margaret Bent, Ph.D. OTR
National Board for Certification in Occupational Therapy Inc
Gaithersburg, MD

The National Board for Certification in Occupational Therapy (NBCOT®), the national certification body for occupational therapy professionals in the United States, embarked upon a novel project to employ a virtual continuing competency platform. The genesis for the innovative virtual product was the result of a practice analysis study - the goal of which was to gain evidence-based direction for individualized programs of continuing professional development. The study identified six key areas for focus: providing client-centered care, working in interprofessional teams, employing evidence-based practice, applying quality improvement, utilizing informatics, and promoting professional responsibility. The virtual platform targets certificants’ needs related to maintaining knowledge for current practice as well as supporting career enhancement and growth. With neither an existing platform nor content to meet its needs, NBCOT took on the task of designing, developing, pilot testing, and delivering the virtual platform and all of its supporting content from initial concept through deployment. The live system includes a web-based assessment delivery engine, certificant dashboard, and interfaces that support self-reflective assessments, multiple-choice practice knowledge assessments called mini practice quizzes, animated case simulations, and games as educational experiences. Prior to the full implementation of the new virtual continuing competency platform, a pilot test including 512 unique testers accessing 6,561 assessment tools was conducted. This paper will introduce the program at a high level and discuss the design process to frame discussion and then share the descriptive results of the user pilot study. While this specific program targets occupational therapy certificants, the virtual platform, focus areas, and lessons learned regarding use of a large scale virtual assessment program apply to other domains. The team will share generalized recommendations for future design and development of advanced technology-enabled assessment, certification, and educational experiences based upon our findings.
Pressure ulcers are a significant cause of morbidity and mortality among hospitalized, institutionalized, and mobility-compromised Veterans, and the prevalence of pressure ulcers has been an ongoing challenge for the U.S. Department of Veterans Affairs (VA). With the VA currently serving World War II- through Post-911-era Veterans with Service-, age-, and illness-related physical and cognitive limitations, the VA sought an innovative solution to educate and support the full spectrum of Veterans at risk of developing pressure ulcers. They selected the VA Pressure Ulcer Resource (VAPUR) project to design a hybrid Mobile Application (App) providing this “just-in-time” education and performance support for Veterans and their Caregivers.

In addition to educational content structured as frequently asked questions with graphics and videos, the App allows Veterans to securely self-report wound data to the VA using a simply worded form. This reporting capability enhances the VA’s ability to monitor Veterans who live too far from specialized wound care facilities to get regular pressure ulcer care. The App supports Veterans with cognitive limitations by automating functions like setting reminders for daily tasks, dialing help and locating resources, and communicating with medical providers. The VA Human Factors Team tested the App with Veterans to ensure usability heuristics and industry-wide standards were focal points in the design. The VA Section 508 Accessibility Team also tested the App to ensure it optimizes the accessibility features in current operating systems and fully complies with all Section 508 requirements.

Because standard App interfaces and traditional educational approaches were insufficient for the diverse target audience, this paper discusses the unique human-computer interface design considerations made for users with physical and cognitive limitations. It also discusses how the resulting design can be reused for other Apps, particularly for conditions like COPD, heart disease, and diabetes. VAPUR will be deployed in August 2015.
WORK DOMAIN ANALYSIS FOR ECOLOGICAL INTERFACE DESIGN OF TANGIBLE INTERFACES

2015 I/ITSEC Paper No. 15130

Michael W. Boyce, Robert A. Sottilare, Benjamin Goldberg & Charles R. Amburn
Army Research Laboratory
Human Research and Engineering Directorate Simulation and Training Technology Center
Orlando, FL

This research developed a Work Domain Analysis (WDA) to help in guiding the design of a user interface for the Augmented REality Sandtable (ARES). ARES combines the traditional military sandtable used in sandtable exercises with projected topography. It leverages commercial off the shelf software in an effort to provide affordable simulation technology. In order to create an interface that is usable, valid, representative of the environment, and free from unnecessary elements, there is a need to perform a top to bottom domain analysis that can be validated by experts. This assists in deciding interface grouping, visual mapping, and ease of learning in the operational environment. WDA takes the relationships that exist between interface components and translates those into tangible interface design specifications. WDA, a foundation for ecological interface design (EID), will be leveraged in future usability experiments as well as the incorporation of a tutor to ARES. The WDA uncovered common functionality and unexpected relationships between the interface components to better support the tasks of land navigation, and military tactics training to support mission needs. Detailed breakdown of these domains can help to serve as guidance for other projects looking for a structured basis for interface design.
ADAPTIVE TESTING: ADAPT AND OVERCOME THE SHORTFALLS OF TRADITIONAL PROFICIENCY ASSESSMENTS
2015 I/ITSEC Paper No. 15196

Robert “Mac” McLaughlin, Dr. Stephen Gunter
Camber Corporation
Orlando, FL

Jeff Pearson
Veterans Benefits Administration
Orlando, FL

Most military tests direct outcomes to a simple pass or fail; a Go/No Go model in which the individual must meet specific standards of performance. Another testing approach can assess critical job competencies and current proficiency levels across a continuum, which ranges from entry level to mastery. When implemented for occupational specialties and skill areas for which it is suited, such a model offers significant long-term advantages in maximizing training budgets, and developing skill mastery throughout a warfighter’s career. Specific proficiency levels may be designated as minimum standards for different pay-grades, or for testing similar jobs sharing common competencies at different required levels of proficiency. Unlike a binary pass/fail approach, this identifies specific areas and the degree of remedial training required to meet standards. It also identifies gradual skill decay and offers targeted remediation before it reaches the point of certification failure. Over the long term, this can reduce training expenses by identifying specific training requirements. Standard remedial training approaches are often very broad, with participants sitting through hours of training on standards, which they may actually meet, waiting for the specific training content in which they are deficient. It may also allow for faster advancement to skill mastery, as targeted remediation means additional training hours are available for skill advancement beyond minimum certification standards. Identifying areas of skill decay provides for a just-in-time training approach that can reduce future test failures and the impact of individuals taken away from their primary job for corrective training. Adaptive test engines, which use a branching logic to adjust test question difficulty at multiple points during the test, offer an effective means to achieve this outcome. This paper presents an overview of the benefits of a diagnostic testing model, steps required for its implementation, and experiences designing such a test.

COGNITIVE LOAD ASSESSMENT FOR INTELLIGENCE ANALYSTS THROUGH FMV (FMV) ANALYTICS
2015 I/ITSEC Paper No. 15142

Elizabeth Wilson
Chenega Technical Innovations, LLC
Dumfries, VA

Upesh Patel
US Army Intelligence and Information Warfare Directorate
Aberdeen Proving Ground, MD

The U.S. military has made a significant investment in fielding a wide variety of airborne and ground Full-motion Video (FMV) electro-optical and infrared sensors to provide superior situational awareness and persistent surveillance of the battlefield. These sensors collect an increasingly unmanageable amount of data, up to terabytes per hour from a single wide area motion imagery sensor. Even with conventional FMV sensors, the data being produced far exceed the number of intelligence analysts available to manually exploit the data. Together, the U.S. Army Communications-Electronics Research, Development and Engineering Center, U.S. Army Intelligence and Information Warfare Directorate (I2WD), and the Joint Improvised Explosive Device Defeat Organization (JIEDDO) are working to address this operational need. The project to provide an initial material capability to meet these requirements is named Advanced Video Activity Analytics (AVAA). The AVAA is maturing a video processing exploitation framework (VPEF), a video data model (VDM), a video annotation web service (VAWS), and integrating computer vision analytic algorithms as plug-ins. The framework provides standardization, integration, and parallelization of computer vision algorithms (CVAs), making them interoperable and testable. The system processes large-scale data and manages the results using a video data model. This paper describes the formulation for testing and evaluation conducted at the Army Intelligence Center of Excellence at Fort Huachuca, AZ, to measure AVAA’s ability to improve video data processing and to reduce the cognitive load on analysts while providing the building blocks for improved knowledge discovery across Intelligence domains. The techniques can be applied to understand and refine cognitive load on training. Quickly processed full-motion imagery data can also facilitate population of simulation data for an experimentation or training event.

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WEDNESDAY, 2 DECEMBER, 2015 ROOM S320E
H-3 Do You Understand?

0830 Multi-measure Assessment of Internal Distractions on Driver Performance (15017)
0900 Measuring Trust of Autonomous Vehicles: A Development and Validation Study (15049)
0930 Building Trust in a Human-Robot Team with Automatically Generated Explanations (15315)

Notes

MULTI-MEASURE ASSESSMENT OF INTERNAL DISTRACTIONS ON DRIVER PERFORMANCE
2015 IITSEC Paper No. 15012

Kevin F. Hulme
Center for Engineering Design and Applied Simulation (CEDAS)
Buffalo, NY

Karen L. Morris
The Center for Children and Families (CCF)
Buffalo, NY

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

Mark G. Frank
Department of Communications
Buffalo, NY

Rebecca J. Houston
Research Institute on Addictions
Buffalo, NY

Panos Ch. Anastasopoulos
Department of Civil, Structural, and Environmental Engineering
Buffalo, NY

The primary objective of this effort is to employ a high fidelity simulator for a small pilot study to assess the impact of internal distractions on traffic safety. While all vehicle distractions have the potential to endanger driver, passenger, and bystander safety, distractions internal to the driver (i.e., mindlessness, being lost-in-thought, mind wandering) can be defined as “the decoupling of attention from the task at hand coincident with a shift in focus to internal thought processes.” Recent studies estimate that internally distracted driving is the least understood and most deadly form of distracted driving: 62% of all driving fatality cases involving distractions are “internal.” By contrast, the second deadliest source of distraction, cell phone usage, accounts for 12% of fatalities. Internal Distraction is often unintentional, and can last from a split second to numerous minutes, and while driving, has been shown to occur most frequently during low-stimulus drives. Regardless of content, length, or intensity, whenever perception and attention are decoupled, the risk of “looking but not seeing” increases, along with the likelihood of driver error.

Previous research in this area has documented impairments in driver performance while internally distracted, however the reliability with which internal distraction was “induced” in simulation remains a point of contention. Most simulator-based research that has analyzed the topic employs a “straight road, car following” model to induce mind wandering. In this study, we employ a Route Familiarity scenario coupled with an Unusual Uses Task (UUT) to induce a state of internal distraction while driving. Our novel multi-measure assessment includes: self-report, evaluator observation, and simulator performance measurement (e.g., lane position, speed, following distance). Physiological metrics (e.g., facial expression, eye pupil dilation) with on-board cameras are captured for future analysis. Ultimately, the outcomes of this investigation could lead to countermeasures (e.g., vehicle technologies, improved practices in road geometry, signage, targeted training) that mitigate negative driving outcomes resulting from internal distraction.

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HOW HUMANS TRUST AUTONOMOUS VEHICLES: A STUDY IN MEASUREMENT DEVELOPMENT AND PERSONALITY DIFFERENCES  
2015 I/ITSEC Paper No. 15049

David R. Garcia, Christine Kreutzer, and Karla A. Badillo-Urquiola  
University of Central Florida, Psychology Department  
Orlando, Florida

Recent advances in technology have improved the ability of vehicles to act autonomously, thereby enabling the implementation of these systems into the lives of the everyday consumers. For example, in the past three years several major vehicle manufacturers, suppliers, and technology companies have announced projects involving autonomous vehicles (AVs). While the notion of AVs has been popular within the military, the urgency to make them commonplace has gathered pace as companies outside the auto industry have illustrated the feasibility and benefits that AVs offer. However, in order to predict user adoption of these autonomous features, attitudes towards them must be understood. Thus, the purpose of the present work is to develop and validate a scale to quantify trust towards autonomous vehicles. The data was subjected to a factor analysis with Promax rotation, yielding two factors. A number of correlations between trust towards autonomous features and personality were also identified. Finally, differences in trust between autonomous levels were identified.

BUILDING TRUST IN A HUMAN-ROBOT TEAM WITH AUTOMATICALLY GENERATED EXPLANATIONS  
2015 I/ITSEC Paper No. 15315

Ning Wang, David V. Pynadath  
University of Southern California  
Los Angeles, CA

Susan G. Hill  
U.S. Army Research Laboratory  
Aberdeen Proving Ground, MD

Technological advances offer the promise of robotic systems that work with people to form human-robot teams that are more capable than their individual members. Unfortunately, the increasing capability of such autonomous systems has often failed to increase the capability of the human-robot team. Studies have identified many causes underlying these failures, but one critical aspect of a successful human-machine interaction is trust. When robots are more suited than humans for a certain task, we want the humans to trust the robots to perform that task. When the robots are less suited, we want the humans to appropriately gauge the robots’ ability and have people perform the task manually. Failure to do so results in disuse of robots in the former case and misuse in the latter. Real-world case studies and laboratory experiments show that failures in both cases are common. Researchers have theorized that people will more accurately trust an autonomous system, such as a robot, if they have a more accurate understanding of its decision-making process. Studies show that explanations offered by an automated system can help maintain trust with the humans in case the system makes an error, indicating that the robot’s communication transparency can be an important factor in earning an appropriate level of trust. To study how robots can communicate their decision making process to humans, we have designed an agent-based online test-bed that supports virtual simulation of domain-independent human-robot interaction. In the simulation, humans work together with virtual robots as a team. The test-bed allows researchers to conduct online human-subject studies and gain better understanding of how robot communication can improve human-robot team performance by fostering better trust relationships between humans and their robot teammates. In this paper, we describe the details of our design, and illustrate its operation with an example human-robot team reconnaissance task.

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Cyber threats have become ubiquitous as criminals extend their reach and cyber becomes a front in conflicts between different peoples and a major source of revenue for criminal organizations. Personnel responsible for cyber defense are becoming increasing critical. However, there is a shortfall between the number of individuals training to enter cyber security and the projected demand for these skills. Consequently, methods and technologies are needed to enhance and accelerate the training of cyber security personnel.

Previous research has demonstrated the benefits of automated performance assessments as a means to target training to the specific needs of individual students. The current paper describes an extension of these capabilities to cyber security training exercises. In these exercises, students are placed in teams and must work together, using appropriate software tools and online resources, to conduct forensic analysis for cyber crimes. Individual and team performance is assessed on the basis of successfully solving individual challenges and applying information from individual challenges to correctly ascertain an overall picture of the who, what and why of the crimes.

The current paper describes a framework for conducting cyber security training exercises with an emphasis on instrumentation to enable automated performance assessment. Instrumentation captures students’ computer-based transactions in a log that is time-synched with the game-server used to deliver challenges and register student responses. Analyses were conducted to better understand the factors that distinguish more or less effective student performance and techniques developed to automatically parse logs of student activities into meaningful blocks of task-oriented activity. These capabilities are a prerequisite for the development of real-time automated assessment of student performance within the context of cyber security exercises.
COMMAND SHIFT: EXPLORING MODERN GAMING TECHNOLOGIES TO CREATE NEXT-GENERATION OCO INTERFACES

2015 I/ITSEC Paper No. 15091

Chad Caison
KEYW Corporation
Hanover, MD

Jennifer McNamara
BreakAway Games
Hunt Valley, MD

Offensive Cyber Operations (OCO) are complex tasks involving abstract and logical concepts that are difficult for end users to synthesize and engage with. Typical user engagement involves using a keyboard and mouse, and working with Command Line or Graphical User Interfaces (CLIs and GUIs). While these tools let users command tools, they do not provide robust situational awareness and they require extensive training and experience to achieve competence. This paper describes the analysis, design, and development of a new cyber interface that uses input and visualization methods borrowed from the game industry to fully immerse the operator more naturally in the cyber battlespace. This type of tool has never been used in the OCO space and has neither been openly welcomed nor understood within the community. Until now, stakeholders have not seen a prototype to demonstrate the potential of this more natural type of interface, which gives the operator a better understanding of the abstract environment to facilitate better decision making and reduce human mistakes. To create this new user interface, two organizations collaborated: one representing current OCO training and state-of-the-art OCO tools, and the other representing game design. Together, these organizations designed a new cyber interface focused on three primary goals: to reduce complexity and training time, to improve situational awareness, and to reduce human error. This paper discusses the standard OCO work environment and its challenges for end users, the results of our user analysis that drove the design process, the game-based hardware and software considerations used by the team, and the prototype interface itself, along with informal playtest reactions from end users.

EMBEDDING CYBER-PHYSICAL SYSTEMS FOR ASSESSING PERFORMANCE IN TRAINING SIMULATIONS

2015 I/ITSEC Paper No. 15263

P. Shane Gallagher
ADL
Alexandria, VA

Brenda Bannan & Bridgette Lewis
GMU
Fairfax, VA

Shelly Blake-Plock
Yet Analytics
Baltimore, MD

As a result of next-generation networking and the Internet of Things (IoT) technologies, big data analysis is possible and has been shown to have a positive impact on areas of national significance yet requires new tools to deal with the variety and quantity of data multiplying at an exponential rate. Concurrently, IoT technologies are rapidly becoming a mainstream data source. Training simulations have historically been limited either to computer-based simulations or live human-observable field-based simulations; however, IoT technologies can open up innovative, hybrid digital-physical opportunities both for delivering and for understanding the outcomes of training in a much more dynamic and comprehensive way. The feasibility of IoT technologies in training has historically been limited by interoperability and scale. However, Advanced Distributed Learning’s Experience Application Programming Interface (xAPI) allows interoperability and scale in next-generation training environments and provides a way to standardize the formative data of human experience captured through digital context. It also provides a way to capture information and formalize human experience from multiple and varied networked devices into standardized, human-readable statements. These can inform both human and machine learning through leveraging big data analysis and interoperability of the IoT technologies. By leveraging the xAPI and IoT technologies as a cyber-physical system embedded in virtual and live training scenarios, it is possible to capture and measure real-time team performance for immediate analysis and remediation or for post hoc analysis in after action reviews. This paper discusses the application of learning analytics and design for an IoT context through describing the implementation of 1) a live action medical simulation as part of the Global Smart Cities Challenge (sponsored by the NIST and the OSTP) and 2) the proposed capture and analysis of communication performance data and measures within specific coalition training scenarios supporting the 2015 Bold Quest Assessment sponsored by the Joint Fires Division of the Joint Staff.
HUMAN PERFORMANCE IN CONTENT DESIGN FOR INTERACTIVE AUGMENTED REALITY SYSTEMS

2015 I/ITSEC Paper No. 15156

Louise Yarnall, Sara Vasquez, Anna Werner, Rakesh (Teddy) Kumar, Supun Samarasekera, Girish Acharya, Glenn Murray, Michael Wolverton, Zhiwei Zhu, Vlad Branzoi, Nicholas Vitovitch, & Jim Carpenter
SRI International
Menlo Park, CA and Princeton, NJ

The military is exploring the use of new technologies to improve the training of a large pool of personnel to maintain and repair a variety of complex equipment. Achieving technology integration in maintenance training requires developers to clear three human performance hurdles: physical usability, learning content efficacy, and a path to integration with existing learning methods. Augmented reality technologies smoothly project explanatory visuals (e.g., text, directional arrows, videos, and 2D and 3D animations) over the workspace. Interactive technologies verbally dictate steps to the user and respond to users’ spoken commands (e.g., “Computer, repeat step.”). In developing AR-Mentor, an innovative maintenance training technology that combines augmented reality and interactive dialogue technologies, a team of engineers and education researchers encountered and responded to each of the human performance hurdles.

In this paper, we show how these human performance hurdles were addressed and how they informed the refinement of the AR-Mentor in two rounds of system development and testing. The AR-Mentor system provides a Heads-up and Hands-free experience to permit a user to train with real equipment. The AR-Mentor system consists of a compact computer, head worn cameras, microphone, ear-buds, and augmented reality eyewear.

The learning content addressed in the two rounds of testing focused on both basic training in maintenance procedures and more advanced training in troubleshooting. The performance evaluation measured usability, time to learn, and the relative learning achievement in procedural knowledge and troubleshooting reasoning between business-as-usual instruction and technology-assisted learning conditions. The paper concludes by presenting key human performance concepts for trainers and vendors of complex equipment systems to consider when designing technological content for presentation with newer automated instructional technologies such as AR-Mentor.
USING MICRO AND MACRO STUDIES OF TABLETS TO IMPROVE MAINTENANCE
2015 I/ITSEC Paper No. 15279

Robert Pokorny, Ph.D., Jacqueline Haynes, Ph.D. & Lisa Holt, Ph.D.
Intelligent Automation, Inc.
Rockville, Maryland

Michael diPilla
Naval Surface Warfare Center, Carderock Division
Philadelphia, Pennsylvania

Navy maintenance is becoming increasingly difficult with more complicated systems, reduced staffing, and efforts to reduce expensive training time. To improve maintenance readiness, the Navy is testing tablets by which technicians receive performance aids and directly connect with the larger Navy maintenance enterprise system. Technicians’ performance can be improved by (1) micro controlled experiments which investigate interface details of accessing and presenting content via tablets and (2) macro field tests that illustrate the effect of technological tools in their deployed state. A comprehensive approach to improve productivity and decrease cost through tools is best informed by both micro and macro studies, and to integrate the results of both to create and promote Navy goals.

The micro element of our approach is the study of how a tablet-based presentation of procedures can be structured to provide technicians the support needed to maximize performance. We will report results from one such study, identifying difficulties introduced by tablets and how they can be overcome, and the capabilities now possible with interactive tablets.

The macro element of our comprehensive approach is the study of how the Navy maintenance technicians can benefit when connected to enterprise resources. Technician benefits include an ability to order components when technicians are in the field, access updated technical documentation, and automatically collect work performance data which reduces redundant paperwork and enables big-data analytics to identify interesting trends of previously unknown efficiencies and performance difficulties. We will report results from a recent field test that includes lessons learned from connecting technicians to the enterprise system.

Micro studies provide scientific verification of principles used to develop the solution, and macro studies reveal how well the solution improves work flow and productivity in the Navy context.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320E

H-6 Flight Life

1600 Helicopter Pilot’s Modeling Including the Stress Factor (15168)
1630 Human-in-the-Loop Flight Simulation Study of Virtual Constructive Representation on Live Avionics Displays (15197)
1700 Practical Recommendations for Validating Survey Apparatus in Coalition Training Environments (15299)

Notes
HELICOPTER PILOT’S MODELING INCLUDING THE STRESS FACTOR
2015 I/ITSEC Paper No. 15168

Antoni Kopyt
Warsaw University of Technology
Warsaw, Poland

In the modeling and simulation domain the human is often considered as an inherent system element. In most studies his/her model remains unchanged due to the external factors. Concerning the wide studies on human performance, workload impact, psychological aspects of human behavior, such an assumption might be too far of a simplification. The present study proves, that a relationship between the mental stress and human dynamics cannot be neglected. The dynamic characteristics of the operator’s model, change in the function of external stimuli i.e. mental stress must be considered. The aim of this study was to present identification of a mathematical human model and measurement methodology of the mental stress level during various work conditions. 20 pilots form Polish Air force Academy were involved. Pilots performed a slalom maneuver task on a SW-4 helicopter flight simulator. Subjects had to repeat slalom maneuver three times, each time, the work conditions were different. The simulator software allowed the registration of flight parameters during the experiment. The analysis of collected data were used to assess the flight efficiency of each task. Pilot’s mental stress level was measured with NASA Task Load Index survey. Additionally, to determine the level of pilot’s response to external stimuli, the electrocardiography (ECG) and skin impedance methods were applied. Finally, base on registered data, the typical dynamic models of each pilot have been identified. Consequently the models obtained from various flight conditions were compared with the stress level respectively. The comparison of model parameters and detailed analysis identified some tendencies in models. The presented paper proves that human susceptibility to external factors directly transfers into dynamic models. The study shows that using more complex models that includes stress factors is much closer to the real human behavior.

HUMAN-IN-THE-LOOP FLIGHT SIMULATION STUDY OF VIRTUAL CONSTRUCTIVE REPRESENTATION ON LIVE AVIONICS DISPLAYS
2015 I/ITSEC Paper No. 15197

Dr. Tom “Mach” Schnell
Operator Performance Lab
University of Iowa
Iowa City, IA

Dr. Angus “Mac” McLean, Mr. Scott Rediger
Advanced Technology Center (ATC)
Rockwell Collins
Cedar Rapids, IA

The integration of virtual and constructive elements into live training not only opens new training avenues, but also raises concerns about flight safety as live aircraft trainees need to be able to differentiate between live and virtual entities and threats. Current fourth-generation fighter aircraft lack an integrated avionics methodology to provide this Live Virtual Constructive (LVC) specific situation awareness (SA). A flight simulation study was performed to assess fighter pilot behaviors in an air-to-air context involving virtual (V) and constructive (C) red force representations. LVC enabled avionics systems were used involving a networked federation comprised of two fast jet flight simulators, a fighter trainer jet aircraft configured as an aircraft-in-the-loop (AIL) simulator, a Ground Control Intercept (GCI) station, and a Next Generation Threat System (NGTS) semi-automated forces (SAF) generator. Participants were non-active duty fighter pilots. The objective of the study was to attempt to detect and quantify specific, important attributes of aircrew condition and performance and to show the relationship to VC-enabled training situations. The results indicate that that red air entity count significantly drove fighter pilot workload and engagement. We also found a statistically non-significant trend that V red air entities tended to generate a higher workload than C red air.
PRACTICAL RECOMMENDATIONS FOR VALIDATING SURVEY APPARATUS IN COALITION TRAINING ENVIRONMENTS

2015 IITSEC Paper No.15299

Emilie Reitz
Alion S&T
Norfolk, VA

If a training event happens and no one builds a record of its gains and outcomes, does it matter? How do you know that the gains and outcomes you recorded, or the tools you used to make that record, are even valid and generalizable to other situations? Are you really improving human performance, or just inferring that you improved it? It’s a challenge faced by all communities of research (Teijlingen & Hundley, 2002), whether attempting to solicit survey data in support of human factors assessments or training effectiveness analyses. This challenge is increased in multinational events, where results contribute to a shared end state for the coalition. To create a valid new measurement apparatus, reliability and validity must be established, and correlations should be built between subscales. Nonetheless, that takes time, results measured from a comparable apparatus or repeated tests, and access to audiences that many researchers lack. During Bold Quest 15.1, two apparatuses were run for precisely this testing and validation purpose and presented to the multinational training audience under one of two circumstances: uncommented testing of the apparatuses or careful explanation of the validation and verification purpose. Two-hundred and seven participants provided over 1600 free text responses which were taken as indicators of their engagement with each apparatus, compared against a non-pilot-tested survey. The pilot-tested apparatuses that were actively administered, elicited significantly more productive responses from the participants than the passive administration groups. Recommendations focus on optimizing apparatuses that cannot be translated into a native language due to constraints, and provide suggestions to bolster both pilot tested and non-pilot tested apparatuses.

THURSDAY, 3 DECEMBER, 2015 ROOM S320E

H-7 Is That Your Final Decision?

0830 Stealth Assessment of Problem-Solving Skills from Gameplay (15212)

0900 “Fixing” the Military Decision-Making Process (15220)

0930 The Small Unit Decision Making Assessment Battery: Development and Psychometric Analysis (15143)

Notes
STEALTH ASSESSMENT OF PROBLEM-SOLVING SKILLS FROM GAMEPLAY

2015 I/ITSEC Paper No. 15212

Weinan Zhao, Valerie Shute, Lubin Wang
Florida State University
Tallahassee, FL

Stealth assessment represents a promising way to address the needs of validly measuring and supporting important 21st century competencies (e.g., creativity, problem solving) within interactive digital environments (e.g., video games). The assessment is woven into the environment such that it becomes invisible to students, which is conducive to eliciting targeted competencies (Shute, 2011). Stealth assessment also runs dynamically, enabling real-time support. We use ECD (Evidence-Centered Design, Almond, & Lukas, 2003) as our assessment design framework for creating stealth assessments that capture far more information related to multiple competencies compared to traditional forms of assessment, which typically report a single summative score, and/or judgments of right or wrong. To date, we have developed a number of stealth assessments for use in different games to examine various competencies. For example, we have designed three stealth assessments to measure various cognitive and noncognitive variables in a game called Physics Playground (Shute & Ventura, 2013). The focal competencies included persistence (Ventura, Shute, & Small, 2014), qualitative physics knowledge (Shute, Ventura, & Kim, 2013), and creativity (Kim & Shute, in press). From these design and development efforts, we have learned a number of useful lessons about developing and applying stealth assessment. This will comprise the focus of our paper—lessons learned and best practices related to the design process of stealth assessment. We will demonstrate the process of designing stealth assessment using a research project that assesses problem solving skill in the popular game Plants vs. Zombies 2. Results from our evaluation study show that our game-based assessment is promising, correlating with the external measures of problem solving: Raven’s progressive matrices (r = .40, p < .01) and MicroDYN (r = .48, p < .01). However a larger sample size is needed to establish definite claims about its validity.

“FIXING” THE MILITARY DECISION MAKING PROCESS (MDMP)

2015 I/ITSEC Paper No. 15220

Michael J. Smith, Ronald B. Sprinkle
Leidos, Inc.
Orlando, FL

LTC(P) Johnny Powers
PEO STRI
Orlando, FL

James Xu
Adayana
Falls Church, VA

Michael Knapp
Aptima, Inc.
Orlando, FL

The U.S. Army Military Decision Making Process (MDMP), used for planning operations, is a deliberate, time intensive, manual process. Critics state that MDMP Course of Action (COA) Analyses take too long to arrive at a single plan. COA analysis and Running Estimate (real time comparison of a running operation against the plan) require data to measure and compare combat actions. Many assert that the only viable way to automate and measure proposed COAs is to use data produced by simulation. Historically, simulations have been difficult to setup, require specially trained personnel and separate computing hardware to operate, making their application impractical in a tactical environment.

To address these problems, we developed a concept prototype and architecture to make practical use of simulation to support the MDMP. We believe that “fixing” the MDMP means increasing its speed through rapid automated decision support. During development of the prototype, we explored the technical barriers and military planning process updates that would help automate the MDMP with simulation support.

U.S. Army simulations require several major modifications to be practical in a Mission Command Information System (MCIS) environment. First, technical support requirements must be eliminated. Second, an interface that supports the input of plans and operations by Warfighting planners is needed. Third, Warfighters must be able to specify measurement of COAs, plans, and operations. In addition, recognizing the human/machine boundaries in the decision-making process, we must be mindful that simulation systems cannot present conclusions that can only be fully developed by experienced warfighters. This paper shows how these things can be done and addresses primary MDMP criticisms.
THE SMALL UNIT DECISION MAKING ASSESSMENT BATTERY: DEVELOPMENT AND PSYCHOMETRIC ANALYSIS
2015 IITSEC Paper No. 15143

Karol G. Ross, Jennifer K. Phillips
Cognitive Performance Group
Orlando, Florida

Kenneth A. Knarr
II Corps Consultants, Inc.
Quantico, Virginia

The U.S. Marine Corps Training and Education Command is developing a requirement for a set of measures to assess cognitive abilities in support of small unit decision-making challenges. Prior assessment efforts in this area of research have failed to address several key issues, including the multidimensionality of decision making and the ability to predict decision performance across a range of operational settings. This paper reports on the development of a Small Unit Decision Making Assessment Battery that treats decision performance as a multidimensional construct supported by competencies, such as problem solving and attentional control, and cognitive and relational skills, such as perspective taking and resilience. Candidate battery instruments were selected or developed based on their face validity and existing psychometric properties as measures of 15 constructs hypothesized to enable small unit decision making. The instruments were subjected to comprehensive testing with a large population from The Basic School to assess their psychometric properties and to finalize each instrument. Analyses were performed at item, battery, and relationship levels to identify the most meaningful items and improve internal consistency reliability, examine the factor structure of each instrument, and identify the constructs most predictive of decision-making proficiency. Results indicate the predictive ability of the battery and the ability of the battery to distinguish levels of performance by correctly, significantly classifying participants into different performance levels. This research furthers the community’s understanding of decision making as a multidimensional construct. Plans for future research and application are discussed.

THURSDAY, 3 DECEMBER, 2015 ROOM S320E
H-8 From the Halls of Montezuma

1030
MarineNet User Engagement Exercise (15011)

1100
Supporting Unit Training Management Through Mobile Performance Assessment Tools (15034)

1130
Marine Corps Instructor Master Model: A Foundation for Marine Faculty Professional Development (15146)

Notes
MARINENET USER ENGAGEMENT EXERCISE
2015 I/ITSEC Paper No. 15011

Major Michael A. Gavin, USMC
College of Distance Education & Training
Quantico, VA

The Marine Corps Distance Learning Network (MarineNet) is the United States Marine Corps’ enterprise level Learning Management System. MarineNet is employed to increase operational readiness by improving training quality and accessibility for individual Marines. The Marine Corps University’s (MCU) College of Distance Education and Training (CDET) is the entity responsible for managing MarineNet. Like many technology heavy organizations, CDET has encountered several challenges in adapting and aligning organizational practices with emerging technologies and evolving user needs. This paper details CDET’s efforts to mitigate these challenges through the conduct of the MarineNet User Engagement Exercise (MUE2).
The MUE2 was executed as an instructor led discussion and survey. Participants were drawn from the I, II, and III Marine Expeditionary Forces, Marine Forces Reserve, and MCU’s Professional Military Education resident schoolhouses. The problem the MUE2 research addressed focused on the development of a procedural method to tap into the range and depth of knowledge available within the MarineNet end user community. Based on the principles of human-centered design, the MUE2 is a requirements elicitation project that directly engaged the MarineNet end user community as an exploitable systems design asset. The objective of the MUE2 was to give voice to the MarineNet end user population and to provide CDET with a contextually based understanding of the concerns held by the end user community. The purpose of the MUE2 was to provide CDET with a data-driven decision support methodology on which the architecture changes designed to improve MarineNet’s capabilities could be validated and appropriately prioritized.

SUPPORTING UNIT TRAINING MANAGEMENT THROUGH MOBILE PERFORMANCE ASSESSMENT TOOLS
2015 I/ITSEC Paper No. 15034

Courtney Dean
Aptima, Inc.
Woburn, MA

Matthew Puglisi, Jared Freeman, Ph.D.
Aptima, Inc.
Washington, D.C.

The Marine Corps Training Information Management System (MCTIMS) warehouses performance information regarding all mission essential tasks Marine Corps units must perform in order to execute across the full range of military operations. MCTIMS currently has a requirement for a mobile application. This application enables Marine leaders to collect unit performance data digitally in the field and quickly upload those data into MCTIMS, avoiding laborious manual input of each result. The application’s concept of operations is as follows: 1) download performance evaluation criteria from MCTIMS; 2) provide leaders with inputs to capture performance ratings; 3) display results immediately following an exercise to enable After Action Reviews (AARs) and; 4) upload results to MCTIMS to support tracking of trends across the force. A prototype application, MCTIMS Mobile, was developed for testing and feasibility assessment. The application was tested in two live-fire exercises where usability and utility metrics were captured. The goals of the field tests were to informally evaluate, with Subject Matter Experts (SMEs) and proposed users, the ability of the MCTIMS Mobile tool to support productive trainee assessment and efficient data collection and measurement. The field study demonstrated support for the tool, with clear directions for improvements. The results show that the tool works as expected, but certain features can be made more intuitive and easier to use. The quantitative results were interpreted very strictly and users provided substantial constructive feedback. Consideration of the feedback received from the users led to redesign and modification of the mobile tool. MCTIMS Mobile is intended to capture more data concerning Marine performance, better data (because it is captured in real time), and data that persist in MCTIMS to improve assessments of Marines and the training the Marine Corps provides.
MARINE CORPS INSTRUCTOR MASTERY MODEL:
A FOUNDATION FOR MARINE FACULTY PROFESSIONAL DEVELOPMENT
2015 I/ITSEC Paper No. 15146

Jennifer J. Vogel-Walcott, Jennifer K. Phillips, Karol G. Ross
Cognitive Performance Group
Orlando, Florida

Kenneth A. Knarr
II Corps Consultants, Inc.
Quantico, Virginia

This paper reports on the creation of a USMC Instructor Mastery Model and its utilization for setting performance standards and assessing instructor performance. The Mastery Model is derived from the Dreyfus and Dreyfus model of cognitive skill acquisition. It makes the path to mastery explicit by specifying how individuals progressively develop into high performers and what indicators can be observed and assessed during each of five stages of development. To customize the model for Marine instructors, reviews of the literature and other services’ instructor development approaches were conducted. Semi-structured interviews were conducted with 93 highly skilled instructors at 15 USMC learning institutions. Thematic analysis and card sorts were employed to understand what a skilled Marine instructor does and define 10 Key Performance Areas (KPAs). A second analysis examined how an instructor performs at the five stages of development and yielded performance indicators for each KPA at each stage. Outcomes were examined against teacher competencies from the literature to compare military and civilian instruction. The final set of KPAs has been adopted by TECOM and included in the Train the Trainer Training and Readiness (T&R) Manual in the form of five T&R events and five appended learning outcomes. The next step is to produce an Instructor Assessment Battery and observation rubric to enable assessment of individuals’ progressive skill development as well as program- and policy-level impact assessments.

THURSDAY, 3 DECEMBER, 2015 ROOM S320E
H-9 Experience Counts

1330
Realism and Effectiveness of Robotic Moving Targets
(15118)

1400
Soldier Physiological Changes of Shooting Performance in the Tank Simulator (15192)

1430
Novice and Experience Police Officer Simulation Experience: Guiding the Future (15370)

Notes
For the vast majority of U.S. Army Soldiers, the first opportunity to engage a realistic moving target with small arms is in combat. Even Infantry Soldiers and special-skill Soldiers (e.g., Snipers) have very limited opportunities to train realistic moving-target engagements. Current capabilities are limited to targets fixed to rail systems or silhouette targets mounted on pickets that can be walked by Soldiers in a firing-range target pit. Without the opportunity to practice engaging realistic moving targets, the Soldier is not able to develop the correct perceptual and motor tuning to adequately engage live moving targets. One solution for the lack of moving target training capabilities is the use of robotic human-type targets (RHTTs). RHTTs can present a realistic three-dimensional human-sized target that can freely move with semi-autonomous control. Furthermore, RHTTs can be programmed to react to events (e.g., flee after another RHTT is hit) and to move in groups in order to provide more complex training scenarios. Even though RHTTs provide a significant increase in training capability, the realism of the RHTTs will ultimately determine the training effectiveness of the capability. In a sense, the training effectiveness question is a matter of human-robot interaction. RHTTs are designed to emulate human beings moving over terrain, moving in a defined area, and reacting to scenario events. If the RHTTs are perceived as freely moving and acting humans, then training can be optimized. Perceptions of realism, shooting performance metrics, and training capabilities inventories were collected from Soldiers training with one type of RHTT to determine the level of target realism. Overall, the RHTT was determined to provide a realistic representation of human targets. However, several factors detracted from realism in certain scenarios. Both the factors that contributed to and the factors that detracted from realism provide insights for developing more effective RHTTs.

Soldiers executing military missions, especially shooting tasks that involving visual attention are high level cognitive processes, which is highly correlated to the soldiers' survival and fighting abilities in military operations. Current shooting simulation training in the military mainly focuses on the performance of target shooting and does not consider the soldier's mental states to evaluate their performance. Therefore, this study intends to explore soldier’s mental states of visual attention corresponding to EEG oscillations when performing the simulated tank-shooter task. Soldiers are required to finish (5-times target shooting practice) with time constraint in the realistic tank-inspired cabin simulator. Physiological signals including 32-channel EEG signals and lead-II ECG signals are simultaneously recorded while performing shooting tasks. Using shooting scores and physiological measurements, we can further investigate the cross correlation with each other and figure out when will be the better time period to execute military mission. According to the preliminary study, in time-frequency domain, this study observed the correlation between task performance and the difference of frequency bands activities in each brain regions from junior and senior shooters. In terms of frequency domain, the study found that novices and skilled subjects have differences in pre-frontal lobe, motor areas and occipital lobe. Based on these results, we constructed biomedical-signals models with attention, decision. A comprehensive analysis of shooting performance and physiological signals will be applied to construct a prediction model of the better-shooting state. The constructed model can effectively reflect the soldier’s mental states and could be considered as one of the evaluation indicators for target training performance in the future.
NOVICE AND EXPERIENCED POLICE OFFICER SIMULATION EXPERIENCE – GUIDING THE FUTURE
2015 I/ITSEC Paper No. 15370

Dr Amanda Davies
Charles Sturt University
Goulburn, NSW, Australia

In the education and simulation design communities the deliberations continue which are centered on how much fidelity is enough or too much. This paper presents findings from a research project which explored the way in which fidelity influences the sense of immersion and presence and the subsequent perceived benefit to the transfer of learning to the field of application in police training for high-risk high-stakes decision-making. The unique feature of the study is the inclusion of two case studies, one of which utilizes low physical fidelity and high psychological fidelity with participants who are seasoned field based police operatives. The second simulation based learning exercise environment and scenario embraced high levels of physical and psychological fidelity with participants who have nil or limited operational experience in the real world of policing. The common criterion for the two simulation exercises is a pivotal catalyst which requires decision-making in providing a police response to a high risk incident. The findings suggest that a key design feature in the development and application of simulation-based learning environments and exercises is the level of prior real world experience the learner has with the simulated environment. This case study offers insight into the value learners place on the simulation characteristics in representing the real world environment and how this influences the application of knowledge and skills in their real world of policing the streets. Understanding the influence on field based application of simulated learning environments offers a valuable contribution to the instructional design endeavours for creating authentic situated learner experiences.
THE LIVE-SYNTHETIC TRAINING, TEST AND EVALUATION ENTERPRISE ARCHITECTURE
2015 IITSEC Paper No. 15076

Paul Dumanoir  Jeff Bergenthal, David Drake
PEO STRI The Johns Hopkins University Applied Physics Laboratory
Orlando, FL Laurel, MD

Cross community and interservice Live-Synthetic (Virtual-Constructive-Gaming) initiatives often fail due to the lack of formalized governance, as stated by Frank DiGiovanni, Director, Force Readiness and Training in the Office of the Deputy Assistant Secretary of Defense (Readiness), during the 2014 Interservice/Industry Training, Simulation and Education Conference (I/ITSEC). In March 2014, the US Army initiated a cross community Research and Development (R&D) initiative to investigate the feasibility of establishing a common Live-Synthetic approach for the Training and Test & Evaluation (T&E) communities, called the Live-Synthetic Training and Test & Evaluation Enterprise Architecture (LS TTE EA).

This paper reports on the progress of this initiative in establishing the objective framework for the enterprise architecture (EA) that includes: (1) the initial governance approach, (2) the business architecture, and (3) the reference architecture. The governance approach provides agreed-upon practices and interactions for the formalized collaboration between organizations to build and deploy services that are useful and sustainable for the EA. The framework for the development and evolution of the governance approach for the LS TTE EA is outlined, including how the governance approach is being applied to current prototyping activities. The business architecture provides a common understanding to align Army strategic objectives and tactical Training and T&E demands. Business architecture artifacts and the results of a quick-look cost benefit analysis are discussed. The reference architecture is the authoritative source of information that guides the implementation of EA solutions. The reference architecture layers and initial documentation in Department of Defense Architecture Framework (DoDAF) viewpoints are shown. Finally, the paper discusses the way forward for application of the EA objective framework to the Army’s Integrated Training Environment (ITE), Integrated Live-Virtual-Constructive Test Environment (ILTE), and Synthetic Training Environment (STE), and applicability to the Defense Training Environment (DTE).

EARLY ADOPTION OF COMMON OPERATING ENVIRONMENT (COE) STANDARDS AND GUIDELINES
2015 IITSEC Paper No. 15098

Robert Wittman, PhD  Amit Kapadia  Burt Grippin, Sean Barie,  Paul Dumanoir
McLean, VA Orlando, FL Orlando, FL Orlando, FL

This paper presents the driving requirements, results, and user-oriented use cases behind the Enterprise After Action Review (EAAR) prototype. The activity, funded in FY14 by Program Manager Integrated Training Environment (PM ITE), focused on producing a reusable AAR architecture with transferrable technologies and lessons learned for early adoption of the Common Operational Environment (COE) across PM ITE and PEO STRI. At project initiation it was clear the successful execution of a prototype depended on collaboration between the PM ITE team and engineers supporting the Command Post Computing Environment (CP CE) within PM Mission Command (MC). This paper starts by introducing earlier efforts that provided critical insight and software that led to the feasibility of the EAAR prototype investigation using COE constructs. It continues by highlighting common AAR requirements across the training and operational MC community. This sheds light on the potential for AAR system lifecycle cost-savings through shared AAR component development and use across the two communities. The paper then explores the specific COE design constructs and technologies employed as part of the EAAR prototype effort. Finally, the paper concludes with a section on technology transfer progress and a listing of the COE and other standards-based technologies employed and their training or operational MC source.
P-2 Design, Build, Track and Train – Here and Abroad

1600
Sejong the Great Class DDGs: How ROK Navy Trained and Embraced Them (15032)

1645
A System-Model-Centric Collaborative Environment for the Acquisition Lifecycle (15093)

Notes

THE SEJONG THE GREAT CLASS DDGS: HOW ROK NAVY EMBRACED AND TRAINED THEM

2015 I/ITSEC Paper No. 15032

LCDR Junho Eum, ROKN
Ajou University
Suwon, Republic of Korea

CAPT Minsoo Yang, ROKN
Republic of Korea Navy
Busan, Republic of Korea

Sangyoon Oh
Ajou University
Suwon, Republic of Korea

The Aegis combat system has been widely considered as one of the most powerful weapon systems for surface ships due to its high level of war-fighting capability. In 2009, Republic of Korea (ROK) Navy became the fifth country in the world that operates Aegis combat system-equipped ships through the KDX-III program, and a total of three Sejong the Great class DDGs (Destroyers with Guided missile) are currently in fleet operations. These ships have performed an excellent level of war-fighting capabilities such as successful tracking missions for the missile provocations by North Korea and ROKS Sejong the Great’s top-gun award-winning at the firing competition during multi-national exercise. These are empirical supports showing outperformance of ROK Navy’s DDGs in spite of its relatively short period of operations as less than six years when compared to other countries operating similar Aegis equipped ships. In this paper, we introduce ROK Navy’s strategy, plan and efforts to realize these accomplishments in the KDX-III program, mainly focusing on how ROK Navy accomplished and settled a high level of war-fighting readiness in such a short period from the ship’s training and familiarization perspectives. Primarily, ship crew’s individual capability and team work as an entire ship force were considered as the fundamental for proper operation and maintenance, which precede the state-of-the-art hardware such as system and weapons.

We introduce ROK Navy’s systematic approach applied to training and familiarization as a core factor to maximize ship’s performance and readiness in this paper. From the beginning of the KDX-III program, a phased approach for ship crew was applied to develop skills from the basic to advance. Based on the programmatic foundation, we present plans and achievements by ROK Navy Headquarters and fleet operations, which provided various opportunities including on-board familiarization and utilization of the Aegis Operation and Maintenance Center (AOMTC) – ROK Navy’s own education and training facility for DDGs. At the end, we conclude with lessons learned and proposals to utilize these efforts for force improvements in the future.
Since the mid-1990s, the U.S. Department of Defense has sought ways to improve the acquisition process by applying modeling and simulation (M&S) tools and data in a collaborative fashion involving government customers and industry providers. Originally known as (Distributed) Simulation Based Acquisition, over the past decade, these concepts have evolved under various monikers, including Model Based Systems Engineering, originated by the International Council on Systems Engineering, and Model Based Engineering, a term that has been used by the Office of the Secretary of Defense (OSD) and the National Defense Industrial Association (NDIA). OSD has recently introduced a concept for a (Digital) System Model that evolves throughout the acquisition lifecycle, and the U.S. Air Force has coined the terms Digital Thread and Digital Twin that complement the OSD concept.

As these concepts have evolved, the M&S Committee of NDIA’s Systems Engineering Division has performed two technical studies that help to describe the application of M&S tools/data during the acquisition lifecycle. This paper provides a summary of the results of these two studies. The first study, the identification of M&S capabilities across all acquisition lifecycle phases, resulted in the development of a multi-spreadsheet workbook that links activities in each lifecycle phase with M&S capabilities that support performing those activities, along with example tools that can be used to implement those M&S capabilities. The second study, the identification of essential elements of the system model, instantiates the high-level system model concept by defining the data/information needed for its implementation, linked to the acquisition activities and M&S capabilities identified during the first study.

Finally, the paper presents a potential way ahead for integrating these concepts and studies to formulate a high-level approach for an overarching collaborative M&S environment centered on the system model concept.
IMPROVING EDUCATION, TRAINING AND CAREER ADVANCEMENT THROUGH COMPETENCY PORTABILITY

2015 I/ITSEC Paper No. 15117

Robby Robson
Eduworks Corporation
Corvallis, Oregon

“Competencies” – which in this paper include skills, knowledge, abilities, learning objectives, and outcomes – play a fundamental role in education, training and career advancement. This is reflected in the many standardized lists of competencies ranging from occupational standards (MOS and O*Net) and task lists (UJTL) to educational standards (Common Core Standards) and industry standards (NIMS, OPITO, etc.). It is also reflected in the emergence of organizations such as the Competency-Based Education Network (CBEN), and in initiatives sponsored by federal agencies such as the Departments of Labor, Defense, and Education, and the White House.

Nonetheless, competencies are still not managed or exchanged in a standardized or interoperable way. Training systems cannot access lists of competencies through an Application Programming Interface (API), training packages define their own tasks and outcomes rather than use existing ones, and competency-based records of achievement are rarely transportable across military-civilian barriers. The consequences are severe: Jobs go unfilled by qualified unemployed workers (especially veterans) and billions of dollars are wasted because of unnecessary or ineffective training.

Multiple efforts aim to change this. These include standardization efforts, technology development sponsored by the government and by private industry, and government initiatives. This paper provides an overview of competencies, reports on competency-related efforts, and discusses the implications for the training community.

STEMULATING: AN INTEGRATED APPROACH TO CULTIVATING OUR FUTURE

2015 I/ITSEC Paper No. 15270

Elizabeth Biddle, Ph.D., CMSP
CFSEC
Orlando, FL

Carol Ann Dykes
UCF Business Incubator
Orlando, FL

Shawn Harrs, Ph.D.
Universal Orlando Resort
Orlando, FL

Robert Seltzer
NAWCTSD
Orlando, FL

Abdul Siddiqui
PEO STRI
Orlando, FL

For over 50 years, the need to increase the number of students who pursue STEM (science, technology, engineering, and math) has been acknowledged. Yet the US continues to fall behind in student performance in STEM fields and pursuit of STEM degrees (US Bureau of Labor Statistics, 2009; Galloway, 2008; Rothwell, 2014; National Research Council Committee on Science, Engineering Education Reform, 2006). The STEM talent pool impacts not only the industries that drive the US economy but also those that comprise the US defense industrial base. Now more than ever, STEM underpins the Department of Defense’s (DoD’s) ability to defend the Nation. While there are many factors that impact STEM education, a key element of increasing the STEM workforce is stronger local and regional partnerships among industry, academia, government, and nonprofits (Achieve, 2010). The Central Florida STEM Education Council (CFSEC) is a model of such a regional partnership with a long term objective of encouraging and preparing pre-college students to enter STEM fields of study and to pursue employment in the Central Florida workforce. The CFSEC targets primarily three audiences—parents, students and teachers—through communications and events. The CFSEC’s goals are to 1) advocate for and raise awareness of the importance of STEM, 2) connect individuals and organizations with resources and each other, and 3) coordinate activities and partnerships that increase the awareness and availability of STEM education opportunities. This paper will provide an overview of the future outlook for the STEM workforce that highlights the compelling need for STEM initiatives to address the projected shortages (Bayer Corporation, 2014; Morones, 2013). The paper will describe the vision and governing model of the CFSEC and how it can serve as a model that other regions and states can adopt and tailor to implement a collaborative STEM community. Finally, the paper will conclude with the challenges encountered in establishing a CFSEC-like organization as well as best practices and lessons learned.
The development and appropriate use of modeling and simulation (M&S) technology relies on professionals with a skill sets that run the gamut from computational science, software engineering, and analysis to domain knowledge found in instructional design, physics, engineering, health sciences, military sciences and more. To support the needs for developing the skilled workforce required to grow the M&S industry, which provides well-paying jobs and bolsters the economy, universities have developed curricula, certificate, and degree programs to meet this niche. However, fulfilling these M&S skill sets is not the exclusive domain of M&S programs. Furthermore, time constraints may require specialization among the many M&S-related topics for a Certified Modeling and Simulation Professional (CMSP). It may not be possible for a new graduate to develop proficiency sufficient to meet workforce demands. This paper builds upon earlier work surveying Domains, Skills, Knowledge, and Applications of the M&S Professional. Assuming the stated restrictions exist, we survey professionals, program managers, and academics and examine areas of emphasis in the various M&S programs available. We evaluate the degree to which M&S specific programs are able to meet industry demands and assess whether those demands are being met by M&S graduates or graduates with other specialties. We end with observations about the M&S workforce with recommendations for the M&S Community at large.
CALCULATING SIMULATION-BASED TRAINING VALUE: COST AVOIDANCE AND PROFICIENCY
2015 I/ITSEC Paper No. 15199

Dr. Tim Cooley
DynamX Consulting
Castle Rock, CO

Mr. Greg Seavers, Mr John Roth &
Mr. Jose Rodriguez
USMC/PM-TRASYS
Orlando, FL

Dr. Steven Gordon
Georgia Tech Research Institute
Orlando, FL

For over a decade, leaders in the Department of Defense (DoD) have asked “What is the value of simulation based training?” or “Why should I spend one more dollar on simulation?”. The easiest answer may be the qualitative benefits of simulation that pertain to areas like safety, availability, flexibility in scenarios, and protection of operational plans. But leaders want quantitative measures such as Return on Investment (ROI), and ROI for simulation has two major facets: cost and benefit (often called results). The authors’ research has focused on answering the DoD questions with cost avoidance computations because cost avoidance is a key component of ROI calculations, and with proficiency improvement evaluations to determine if use of simulation has a quantitative benefit. The authors will present their methods of calculating cost avoidance over the last four years for many simulation-based training systems managed by the United States Marine Corps Program Manager for Training Systems (PM-TRASYS). The research has shown cost avoidance of over $2B across the PM-TRASYS systems analyzed, but the authors are also developing methods to refine these measures of cost avoidance. These more realistic measures are linked to live training requirements allowed to be conducted in simulation and/or to proficiency increases due to use of simulation. These same cost avoidance methods are now being applied to large scale exercises to show the value of using a mix of live-virtual-constructive systems in these scenarios. This paper will also discuss the management data that is gathered and depicted as part of the cost avoidance studies. This data captures use statistics by system and site, and includes data such as the number of Marines trained and munitions used. As will be shown in the paper, this study provides quantitative measures of simulation cost avoidance and results.

LARGE SCALE ADOPTION OF TRAINING SIMULATIONS: ARE WE THERE YET?
2015 I/ITSEC Paper No. 15256

Dr. Amela Sadagic
Naval Postgraduate School
Monterey, CA

Maj Floy A. Yates Jr.
MAGTFTC Battle Simulation Center, USMC
Twentynine Palms, CA

Computer-supported training simulations have been recognized for the potential and the benefits they have in supplementing the training needs of the military, yet we still do not see evidence of large-scale deployment and adoption of these systems by users in this domain. The current challenging budgetary situation suggests that the Return on Investment (ROI) will be more scrutinized than ever before, forcing communities to abandon underutilized and underperformed Modeling and Simulation (M&S) solutions. Such developments are also likely to affect global decisions related to future investments in these types of technologies. This paper presents the design and results of a study that included collection of comprehensive data on the adoption and use of training simulations in the military domain. The analysis of this data set suggests that the reasons for low use of simulations had little to do with the overall quality of hardware and software (although they were mentioned as factors), and that a myriad of other factors were found to influence the outcome to a greater extent. The understandings collected in this and other studies all attest that military training is a complex, multilayered domain that is only partially defined by the type and technical characteristics of systems being used to achieve that goal. Our work and experience in this domain give us a firm basis to hypothesize that a well selected set of strategic approaches could bring much greater results in this domain, even with a modest investment made to support that change. The findings and recommendations are highly applicable to all DoD services and other communities that plan to use these types or solutions in their training and learning practices. The study also offers a contribution towards a better understanding of general diffusion and adoption of other technical innovations in the military domain.
AUTOMATED SURVEYS: LOWERING THE RESPONDENT’S BURDEN
2015 IITSEC Paper No. 15080

Richard Kist MSc., Igor Franken MSc.
National Aerospace Laboratory (NLR)
Amsterdam, The Netherlands

Measuring effectiveness and the operational utility of new techniques, technologies and training through feedback of the Warfighter is critical. Paper questionnaires and interviews have merits. However, offering a relevant, compact questionnaire after each mission to test and exercise participants with different roles and backgrounds can be made more efficient with an automated survey. This paper discusses the challenges faced in survey data collection in an operationally realistic environment, and lessons learned during years of survey data collection. During the Bold Quest cycle, a survey effort was set up using such an automated tool (Questionnaire for Utility Evaluation and Survey Tool, QUEST). The concept of employment for automated surveys described here addresses many of the concerns associated with web-based surveying techniques (Sills & Song, 2002). Use of clear and concise questions and other measures lowering the burden for the respondents yield the best results from a survey effort. An automated tool ideally should work locally on any laptop or handheld device, as well as in networked conditions. It should be tailored to military environments, offering questionnaires for all phases (pre/post exercise, daily post mission). By tooling the questions to reduce burden, analyzing the language used, and taking steps to assure the relevance of the questions to each participants, more efficient data collection can occur – the kind of data collection which provides 100,000s of survey responses helping to determine the effectiveness of new military developments.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320F


1600 Risk Management Framework (RMF) Transition Impacts in Training Simulation Systems (15009)
1630 Cybersecurity Controls: Then and Now (15010)
1700 Cybersecurity Challenges and Resolutions for Simulator & Training Systems (15063)

NOTES
RISK MANAGEMENT FRAMEWORK (RMF) TRANSITION IMPACTS IN TRAINING SIMULATION SYSTEMS
2015 I/ITSEC Paper No. 15009

Graham Fleener & Marco Mayor
U.S. Army PEO STRI
Orlando, FL

Dr. Cliff Zou
University of Central Florida
Orlando, FL

The Department of Defense (DOD) Information Assurance Certification and Accreditation Process (DIACAP) is undergoing its first transition and update since 2007. The new process is titled Risk Management Framework (RMF) and there are significant changes in the new guidance. Given the transition there are a number of implications for the training and simulation community for ensuring training systems maintain both their certification and their information security posture. Guidance for the transition has been evolving slowly with each the agencies initiating RMF implementation individually. The Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) follows Army guidance for the transition. This paper will define the formal requirements, new terminology, and discuss how the RMF risk assessment is determined. Additionally, we will capture the transition and migration of how PEO STRI will implement the Risk Management Framework. This paper will describe the tools that support the RMF implementation, such as the Knowledge Service (KS) and the Enterprise Mission Assurance Support Service (eMASS). We will describe the transition impacts for PEO STRI stakeholders such as contractors doing business with PEO STRI, system users, and Project Managers (PM). Each of the stakeholders will have unique concerns, impacts, and questions during the transition. There will be a number of challenges associated with transitioning to a new process that will be discussed. To conclude, we’ll provide guidelines to help the training and simulation community make the transition to RMF.

CYBERSECURITY CONTROLS: THEN AND NOW
2015 I/ITSEC Paper No. 15010

Marco Mayor
U.S. Army PEO STRI
Orlando, FL

The phase out of the Department of Defense (DOD) Information Assurance Certification and Accreditation Process (DIACAP) is leading to a new process called Risk Management Framework (RMF). This new process was mandated by DOD Instruction 8500.01, which also mandated the adoption of the term “cybersecurity” to be used throughout DOD instead of the term “information assurance (IA).” RMF will follow a set of security controls inherited from the National Institute of Standards and Technology (NIST). These controls are specifically located in the Special Publication (SP) 800-53. The NIST SP 800-53 controls will replace the existing DOD Instruction (DODI) 8500.2 controls and have been updated to reflect the evolving technologies while addressing new cybersecurity threats. Given the transition, there are a number of implications for the training and simulation community for ensuring training systems comply with these new controls and maintain their information security posture. Guidance for the transition has been developing gradually and each of the DOD agencies are handling it individually at the implementation level. The Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) is following DOD and specifically Army guidance to ensure the NIST control implementation gets executed in the most efficient manner possible.

This paper will first provide some background on the legacy DOD 8500.2 controls and an overview of the transition to the NIST SP 800-53 controls. It will then discuss the formal requirements, new terminology, implementation and guidance driving this transition. This paper will analyze the framework of the NIST SP 800-53 RMF controls and how they compare to DIACAP controls. It will discuss the security control overlays, and the assessment procedures. To conclude, this paper will describe the transition impacts for PEO STRI stakeholders, which include DOD contractors, system users, and Project Managers (PM). This paper will layout the fundamental ideas and challenges PEO STRI faced on a particular use case, while handling the transition from the DODI 8500.2 DIACAP controls to the NIST SP 800-53 RMF controls.
CYBERSECURITY CHALLENGES AND RESOLUTIONS FOR SIMULATOR & TRAINING SYSTEMS
2015 I/ITSEC Paper No. 15063

Douglas E. Wedel
Defense Security Service, IOFND
Beavercreek, OH

Dr. Ilya Lipkin
USAF AFMC AFLCMC/WING
Wright-Patterson AFB, OH

Lt. Luis Cintron
USAF AFMC AFLCMC/WNSEB
Wright-Patterson AFB, OH

Cybersecurity (CS) requirements and considerations have increasingly been impacting special-purpose systems with embedded Information Technology (IT) such as simulator and training systems in recent years. This is primarily driven by increased insider threats, proliferation of network interconnections, and the rise of mobile computing (smartphones/tablets) as well as increased capabilities of nation states, organized crime, and political activists to gather and exploit information about current capabilities. In the past CS measures have been applied through either Risk Avoidance “shutting down a capability until the risk is eliminated” or Risk Ignorance, “operating a system without regard to the risk because of a perceived functional or operational need”. However, through the use of Risk Management, CS can balance these two areas by assuring the mission and protecting the systems, networks and information by properly categorizing the system and the information through a risk based assessment process. To avoid mission impact previous policy was compliance based and risk was typically avoided or waived rather than mitigated. The DoD Risk Management Framework (RMF) (DoDI 8500.01, 2014) seeks to address the shortfalls that compliance management imposed on systems. However, a clear understanding of how to apply risk is needed to provide a balanced approach to CS. To support CS requirements this paper will present an approach for assessing risk to simulator and training systems and outline the steps necessary to overcome and mitigate said issues through a process that focuses on applicability, compliance, mitigation, and reduction of impact. This paper is not a description of the DoD RMF, but seeks to provide a process to assess CS requirements by addressing the “Spirit and Intent” of the CS requirement, its applicability, probability, and impact of applying or not applying that requirement, and identifying solutions that resolve the finding or reduces the impact to an acceptable level for authorization. This paper will strive to provide a practical approach to assessing system risk by providing initial framework examples that will demonstrate its applicability to manage new technology insertions, network connectivity, existing program limitations and mobile computing impacts to existing simulator and training systems.

TUESDAY, 1 DECEMBER, 2015 ROOM S320B
S-1 Cutting Edge Training

1400 Mobile Augmented Reality for Force-on-Force Training (15223)
1430 Emergency Medical Card Augmented Reality: Training Evaluation (15266)
1500 Real-Time Cutting of Organs with Scissors (15333)

Notes

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
MOBILE AUGMENTED REALITY FOR FORCE-ON-FORCE TRAINING
2015 I/ITSEC Paper No. 15223

Richard Schaffer, Sean Cullen, Laura Cerretelli
Lockheed Martin
Burlington, Massachusetts

Rakesh Kumar, Supun Samarasekera, Mikhail Sizintsev, Taragay Oskiper, Vlad Branzoi
SRI International
Princeton, NJ

Live field training against a thinking human opposing force – force-on-force training – is highly valued by commanders. However, a limitation of current force-on-force training is the lack of battlefield effects, such as mortar or artillery detonations. This prevents fully employing indirect fires as part of combined arms operations in these exercises. In particular, forward observers have no means to adjust fire if they cannot observe impacts. We describe the development of a prototype system that provides mobile forward observers the visual feedback they need to conduct these operations.

The key emerging innovative technology that enables this training is precision mobile augmented reality. Augmented reality inserts virtual elements into views of real environments. In this application, a forward observer’s position and look direction must be precisely tracked in real-time in order for battlefield effects to appear stably in the correct location. This precision must be maintained as the observer moves between positions. In addition, the effects must be rendered realistically, so they appear to be part of the environment and reflect local conditions, including wind and obscuration by terrain. Forward observers routinely use binoculars to locate targets and adjust fire. Consequently, augmented reality capable binoculars are also required for this task. As an additional challenge, the tracking and rendering for both naked eye and binocular views must be performed on a small, lightweight, body-worn computer compatible with field use. Finally, the system must integrate with an existing LT2 force-on-force training system.

This paper describes the key advances needed to produce the prototype system. We focus in particular on the challenges of extending an earlier prototype designed for use only from fixed positions and not connected to any live training system. The results of initial demonstrations at MCB Quantico are also presented.

USING AUGMENTED REALITY TO TRAIN COMBAT MEDICS: AN EVALUATION
2015 I/ITSEC Paper No. 15266

University of Central Florida, IST
Orlando, FL

Christine Allen, Mark Mazzeo
ARL-HRED STTC
Orlando, FL

This study aims to evaluate the training effectiveness of the augmented reality enabled version of the Combat Medic cards and to assist the Army in determining future development and implementation plans for augmented reality (AR) training in conjunction with the Emergency Medical Care cards or other similar training products. The University of Central Florida’s Institute for Simulation and Training (UCF IST) has previously developed emergency medical training cards in an effort to design effective simulation for Army medics. Additionally, two digital supplementary versions of the cards were developed: an online Flash version and an iOS mobile eversion supporting flash card study and self-assessment with integration of study scheduling to assist with scheduling of material for transfer into long-term memory. Moreover, an augmented reality solution for the Combat Medic card deck, which will launch videos of procedures after the user scans the card was developed, with an existing third-party augmented reality toolkit that uses image recognition as a trigger. The evaluation compares learning, speed of learning, usability, perceived utility, level of engagement, and perceived speed of access to information between the augmented reality enabled Combat Medic cards and the Combat Medic app. The evaluation should provide a validated methodology for integrating AR into existing training print and/or digital training materials which can: 1) serve to expand the toolkit for Army instructional designers and trainers and 2) facilitate and continue to improve an active learning process already under development which has been well received and has already demonstrated training utility on a small scale.
REAL-TIME CUTTING OF ORGANS WITH SCISSORS
2015 I/ITSEC Paper No. 15333

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

Steve McIlwain, Bradley Willson
Raleigh, NC

The ability to perform random cuts to organs in real-time is crucial in a virtual reality based surgical simulator. Nowadays, organs are commonly simulated using the Finite Element Method (FEM) on tetrahedral meshes. In many cases, cuts can be approximated as singular sections. Thus, the method presented in this paper was designed to perform subdivisions of tetrahedrons accurately along the path of the blades following a set of pre-computed patterns. To ensure the resulting meshes remain suitable for simulation, the subdivisions are performed in such a way that adjacent tetrahedrons will weld and not overlap. Care is taken to minimize the subdivision of tetrahedrons in the instances where blades traverse the mesh along the boundaries of elements, in which case application of the basic patterns would have generated degenerated tetrahedrons. This paper also describes the way in which the surface mesh is extracted from the tetrahedral mesh after the cut is performed, in order to update the data for collision management and visualization.

TUESDAY, 1 DECEMBER, 2015 ROOM S320B
S-2 Getting to the Right Scenarios & Data

1600 Virtual Battlespace Scenario Encoding for Reuse (15027)
1630 Multi-Federate Scenario Development and Testing: “A Good Plan, Violently Executed” (15249)
1700 The Expected Results Method for Data Verification (15020)

Notes
SIMULATION SCENARIO ENCODING FOR REUSE
2015 IITSEC Paper No. 15027

Captain Michael J. Eady, USMC
Marine Corps Training and Education Command
Quantico, Virginia

Lieutenant Colonel David W. Parkes, USA
Joint Staff J7
Suffolk, Virginia

The United States Army and United States Marine Corps employ the Virtual Battlespace 3 (VBS3) commercial game for first-person small-unit training and have invested significantly in training scenarios constructed using proprietary tools and data formats. Open standards data structures need to be utilized in order to move toward improved interoperability, address the statutory intent for open competition and affordability, and protect investments made in models, terrain, and other elements of scenarios that are separate and distinct from the game engine source coding. Expanding capabilities for open scenario interchange will improve scenario reuse while creating greater opportunities for simulation data interchange and open competition for future virtual training capabilities. This paper describes and demonstrates initial application of Extensible Markup Language (XML) technologies to represent and interchange simulation scenario data. Design of XML data structures to capture a subset of a VBS2 scenario’s data content is successfully demonstrated, and the capability to transform content from the XML model back to the VBS2 scenario data formats utilizing an Extensible Stylesheet Language Transformation (XSLT) document is discussed. Proposed extensions to existing and developing simulation standards are made in order to accommodate the set of data used in VBS2 scenarios. The research provides a foundation for future efforts to determine the feasibility of creating an open XML schema that addresses all critical aspects of a simulation scenario, which will enable open competition for the first-person “games for training” requirement while preserving investments in proprietary data structures.

MULTI-FEDERATE SCENARIO DEVELOPMENT AND TESTING:
“A GOOD PLAN, VIOLENTLY EXECUTED”
2015 IITSEC Paper No. 15249

Donald C. Meinshausen
ARCIC / JAMSD / Lockheed Martin
Ft Eustis, VA

Mitchell Faircloth
MCoE / MBL / EEB / SAIC
Ft Benning, GA

The Battle Lab Collaborative Simulation Environment (BLCSE) annually hosts a variety of multi-federate, entity based, advanced concepts and systems simulation experiments. Technical challenges, evolving scenarios, changing requirements and even good ideas, often create moving targets for scenario developers preparing for the events. Challenges and opportunities include: structural division, replication and distribution; automation, referential integrity, nomenclature, command and control, assignment, attrition and lay down, composition/behavioral impact analysis, configuration management, semantic mapping, operator/player usability and division of labor.

As collaborating members within the BLCSE Community of Practice, the Maneuver Battle Lab (MBL) and the Joint and Army Models and Simulations Division (JAMSD) are forging methods and employing a variety of tools, including the BLCSE ForceBuilder, to accelerate the development, quality and testing of a variety of formats for scenario and supporting deliverables. This paper describes the rapid construction, adaptation and testing of futuristic task organizations from the basic Table of Organization and Equipment (TO&E) to the networked, human-in-loop, real-time, 60,000-entity war game. Lessons learned and innovations, including a new ten stage ORBAT development process and our initial utilization of tools such as the Web-based Military Scenario Development Environment (WebMSDE), in preparation for BLCSE simulation exercises for 2014 and 2015, will be covered in detail.
THE EXPECTED RESULTS METHOD FOR DATA VERIFICATION

2015 IITSEC Paper No. 15020

Paul Monday
Lockheed Martin
Radcliff, KY

The credibility of US Army analytical experiments using distributed simulation depends on the quality of the simulation, the pedigree of the input data, and the appropriateness of the simulation system to the problem. The second of these factors is best met by using classified performance data from the Army Materiel Systems Analysis Activity (AMSAA) for essential battlefield behaviors, like sensors, weapon fire, and damage assessment.

Until recently, using classified data has been a time-consuming and expensive endeavor: it requires significant technical expertise to load, and it is difficult to verify that it works correctly. Fortunately, new capabilities, tools, and processes are available that greatly reduce these costs. This paper will discuss these developments, a new method to verify that all of the components are configured and operate properly, and the application to recent Army Capabilities Integration Center (ARCIC) experiments.

Three recent developments have focused improving the process to load the data. OneSAF has redesigned their input data file formats and structures so that they correspond exactly with the Standard File Format (SFF) defined by AMSAA, ARCIC developed a library of supporting configurations that correlate directly to the AMSAA nomenclature, and the Entity Validation Tool was designed to quickly execute the essential models with a test-jig approach to identify problems with the loaded data.

The missing part of the process is provided by the new Expected Results Method. Instead of the usual subjective assessment of quality, e.g., “It looks about right to me”, this new approach compares the performance of a combat model with authoritative expectations to quickly verify that the model, data, and simulation are all working correctly.

Integrated together, these developments now make it possible to use AMSAA classified performance data with minimal time and maximum assurance that the experiment's analytical results will be of the highest quality possible.
POLYGONE LVC: THE NEW PARADIGM FOR EW TRAINING

Lt Col Scott Case
United States Air Force
Warrior Preparation Center Detachment 3 Germany
Orlando, FL

Ryan McLaughlin
Northrop Grumman
Orlando, FL

By the end of 2015, the Multinational Aircrew Electronic Warfare Tactics Facility (MAEWTF) known as Polygone range, based on a tri-national agreement between France, Germany, and the United States will establish itself as a world-class Live-Virtual-Constructive (LVC) training range. Through working together with German Air Force Command, French Air Force Command, United States Air Forces in Europe-Air Forces Africa (USAFE-AFAFRICA), and several LVC industry leaders, Polygone will offer a first-of-kind capability that promises to usher a new paradigm of Electronic Warfare (EW) training. The initial operational capability reuses or repurposes existing Polygone range infrastructure while leveraging innovations made by other ranges, particularly the Joint Pacific Alaska Range Complex (JPARC). By avoiding a ‘home grown’ approach, Polygone managed to save approximately $300 million in acquisition costs and yield a similar training capability.

The baseline of the Polygone LVC project, also known as Multinational Aviation LVC Training System (MALTS), provides a mobile LVC range capable of bringing advanced EW training to major exercises worldwide. The initial phase included developing innovative virtual surface-to-air missiles (SAMs) leveraging the expertise of professional German Air Force live SAM operators, improving training capabilities for future Special Operations Forces (SOF) and Joint Terminal Attack Controller (JTAC) mission readiness training, and establishing the framework required for a worldwide distributed training audience. The lack of modern advanced SAM training assets, increasingly prohibitive live training restrictions, and alarming increases in potential adversary air defense capabilities have led to the Polygone's development of virtual SAMs. These virtual SAM operator stations enable trained threat operators to utilize modern and advanced SAM techniques at virtual single and double digit SAM stations providing affects to live aircraft flying training missions at Polygone. This paper will discuss the MALTS LVC project, development of virtual SAMs for EW training, and how Polygone leveraged JPARC LVC innovations to advance Coalition training in Europe.

LIVE SYNTHETIC TRAINING AND TEST & EVALUATION INFRASTRUCTURE ARCHITECTURE (LS TTE IA) PROTOTYPE

Paul Dumanoir, Mike Willoughby
U.S. Army PEO STRI
Orlando, FL

Burt Grippin, Richard Crutchfield, Rob Wittman & Sean Barie
MITRE Corporation
Orlando, FL

This paper describes the Live Synthetic Training and Test & Evaluation Infrastructure Architecture (LS TTE IA) prototype. The LS TTE IA was funded by PEO STRI and AMSO in FY14 with the intent of providing a technology insertion into LVC-IA, replacing the existing infrastructure with a cloud-enabled service-oriented architecture (SOA). This SOA infrastructure is being developed with the expressed goal of supporting both the Training domain and the Test & Evaluation community. It will be compliant with the Common Operating Environment (COE) and suitable for hosting within the COE Data Center/Cloud Computing Environment. The prototype architecture was developed in collaboration with Johns Hopkins University’s LS TTE Enterprise Architecture (LS TTE EA) research which explored the business case and governance strategy for managing a SOA environment. The LS TTE EA is described, as well as the relationship of the LS TTE IA to the reference architecture of the LS TTE EA.

This paper explains the SOA prototype layered architecture, and the initial services developed in FY14. Two concurrent projects under development in FY14 developed services that operate on the LS TTE IA infrastructure. This paper will briefly discuss those projects and their successful use of the infrastructure. Finally, the paper will discuss the planned FY15 infrastructure improvements and the forward looking implementation strategy.
MEASURING REALISM IN SIMULATIONS FOR TRAINING AND TESTING
2015 I/ITSEC Paper No. 15206

Jerrit Askvig, Phil Hallenbeck
The MITRE Corporation
McLean, Virginia

Many publications and presentations on training or testing mention the need for “realism,” or the responsibility of trainers or developers to provide a “realistic training environment” or “a realistic simulation.” Yet, none appear to define realism or describe how it might be judged such that choices could be made among competing investments, or the realism of a given simulation environment improved.

We present here a doctrine-based model to rigorously and repeatably assess the realism of a simulation environment. It provides a framework to reason about, assess, and communicate realism for tasks and systems spanning all the Army’s Warfighting Functions; and a software application to repeatably yet quickly and easily assess the specific components of realism as they impact specific tasks or systems.

The model is based on the Army’s Mission Variables of METT-TC (Mission, Enemy, Terrain, Troops, Time, and Civil considerations), plus the Immersive environment (the visual, aural, and other factors that lead a participant to believe that he or she is in a “real” environment and should behave accordingly). Framing the assessment in terms of Army risk management doctrine (where both the likelihood and the severity of hazards are considered) leads to the straightforward concept of assessing risks to realism in terms of “METT-TC+I.”

The model decomposes the Enemy (E) and Troops (T) variables into fine-grained capabilities suitable for assessment; and each of the other variables (mission, terrain, and so forth) into factors (such as weapon lethality, or visual indications of weapons fire) that may impact capability achievement and therefore event outcome. Each capability’s and factor’s risk to realism is calculated based on its probable impact, and the likelihood it would be inadequately simulated. Users of the software application may easily modify these calculations or their results to reflect risk mitigation steps, or the expert judgment of the user.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320B
S-4 From Reality to Simulation

1030 Network Bandwidth’s Effect on Virtual World Simulator Performance Optimization (15360)
1100 3D Immersive Environment Using X-Plane for Depth Perception Research (15261)
1130 Battle Damage Computation Server (15051)

Notes
The United States Department of Defense (DoD) employs virtual and game-based training simulators to train its servicemembers on both individual and collective cognitive and psychomotor tasks. The current employment of these training simulators is typically conducted in a stand-alone manner, with distributed simulation remaining the exception due to interoperability challenges. The OpenSimulator (OpenSim) is a popular open-sourced virtual world simulator that currently provides a persistent three-dimensional social community for its users. Under the Army Research Laboratory's (ARL) Military OpenSimulator Enterprise Strategy (MOSES) research program, OpenSim is being developed to serve as a prototypical distributed military virtual training environment for tactical operations.

Virtual worlds for military training is an emerging domain. As such, detailed analysis of critical architecture parameters is required in order to optimize the performance of both the simulator's servers as well as the multitude of client connections. Unfortunately, due to a lack of extensive virtual world performance analysis, OpenSim server administrators often make arbitrary resource allocations to support their environments and training scenarios. Negative consequences to this approach are that typically too few resources are allocated to an overwhelmed server, resulting in an unresponsive environment, while too many resources are allocated to an underutilized server, when those resources could be more effectively applied elsewhere. In this paper, we analyze network bandwidth's effect on virtual world simulator performance so as to support the future creation of a predictive model that will determine the optimal amount of resources required to support a target number of concurrent users in the virtual world. This analysis, and the future development of our predictive model, will provide the OpenSim developer community with the knowledge required to best allocate resources to support expected server load.

Game-based flight simulation software has been shown to provide a reliable, low-cost, virtual environment able to facilitate a wide range of training and research objectives. In this work, which is part of the U.S. Air Force School of Aerospace Medicine Operational Based Vision Assessment program, game-based simulation software was used to render an immersive three-dimensional constructive environment within a helmet mounted display (HMD) for weapons platform specific vision research and to quantify the impact of aircrew vision on selected operational tasks. In this work, an operationally relevant MH landing task was simulated to provide data relevant to the applicability of U.S. Air Force Flying Class III landing task, including discussion of its applicability to simulated tasks requiring precise depth discrimination. This work will provide an example simulation framework for future stereoscopic virtual immersive environments applicable to both research and training.
BATTLE DAMAGE COMPUTATION SERVER
2015 IITSEC Paper No. 15051

Hung Tran
Tactical Systems, CAE USA
Tampa, FL

This paper will present a new approach for handling the battle lethality computation in the context of a Distributed Interactive Simulation (DIS) network training scenario where participants in an exercise are required to broadcast their current damage status. Usually, each simulation handles the computation and the assessment of damage differently, resulting in an “unfair fight” between the participants. Rather than having each simulation perform this computation, an alternate approach would be to delegate the lethality computation to a common processing task implemented on a server. The design of the battle damage server will be described and discussed in this paper.

The advantage of the battle damage computation approach described in this paper is twofold: participants within the network would use a common mathematical model, and simulations being freed from the burden to compute the battle lethality. This approach will help to eliminate the interoperability variances in lethality results and achieve a “fair fight” weapon effect.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320B
S-5 Innovation in Environmental Modeling

1400 High Fidelity Wind Model Software for Real-Time Simulation Platforms (15362)
1430 Automated Runtime Terrain Database Correlation Assessment (15218)
1500 Automated Modelization in Terrain Database Production (15290)

Notes
HIGH FIDELITY WIND MODEL SOFTWARE FOR REAL-TIME SIMULATION PLATFORMS
2015 I/ITSEC Paper No. 15362

Jaime Sanchez, Dr. Juan Pelaez
SimSpace Ingenieria S.L.
Madrid, Spain

Atmospheric conditions can be a threat to flight safety. Specifically, wind conditions can be particularly critical in ground-proximity, low altitude operations or flying near aerodynamic wakes. Since flight simulation is intended to train pilots in the most difficult flight situations under the most extreme conditions it is necessary to include a detail wind model as part of the flight simulator, allowing pilots to train safely in complex operation procedures in a cost-effective manner.

This paper presents a methodology for modeling detail physics based winds in real-time. The method is designed to be flexible and can simulate wind conditions in different types of environments such as large mountainous landscapes, urban areas, offshore oil rigs or aerodynamic wakes of moving ships and airplanes.

The methodology presented consists of three steps. First, given a particular environment and after its geometry is defined, the winds are computed using a mesh-free Computational Fluid Dynamics (CFD) solver, very adequate for complex geometries and quick turnaround times, which models turbulence using Large Eddie Simulation (LES), very appropriate for highly separated flows. In each environment multiple CFD computations are required for different wind conditions (i.e. wind directions and speeds) in order to characterize the real-time operating conditions. Second, the resulting CFD solutions are compressed and optimized. Third, the post process optimized databases are used by a software module which generates steady and turbulent wind vectors in real-time.

The method’s flexibility to simulate wind conditions in different environments will be presented through different case studies: aerodynamic winds due to a simplified building structure, low level wind shear and turbulent effects in Gibraltar airport, aerodynamic wakes of moving a transport airplane and a ship frigate. Finally, the effect of the detail wind model in a helicopter pilot’s workload operating near a ship will be presented.

AUTOMATED RUNTIME TERRAIN DATABASE CORRELATION ASSESSMENT
2015 I/ITSEC Paper No. 15218

Jeremy P. Joseph, MS, CMSP, Andrew Tosh, MBA
GameSim Inc
Orlando, FL

Benito Graniela, PhD
Naval Air Warfare Center Training Systems Division (NAWCTSD), Orlando, FL

As the US Navy and US Marine Corps move toward integrating existing flight simulators into common training environments, the importance of having a correlated, correct environmental representation is vital for achieving a fair fight and a high training value to the warfighter. Many of these simulators are operating off different versions of source data and using different image generator (IG) vendors, which can result in interoperability problems. Although correlation between visual terrain databases and simulation terrain databases have been investigated in the past, there is a lack of research on correlation between large synthetic environments using runtime visual and sensor databases in Navy and Marine Corps flight simulators. Many current practices involve manual inspection and limited area of interest (AOI) testing to determine correlation, resulting in ineffective correlation assessments, which may cause negative training.

In an effort to address this gap, preliminary research has been conducted to develop a tool that can perform automated correlation and integrity assessments on runtime formats, including visual and sensor databases, using standard interfaces such as the Common IG Interface (CIGI) within a distributed simulation environment. Utilizing these standard interfaces along with standard data formats, such as the U.S. Navy Naval Air Systems Command (NAVAIR) Portable Source Initiative (NPSI), the research framework facilitates tests to identify integrity and correlation conditions that may negatively affect training. The details of the investigation, its outcomes, and future research are reported.
AUTOMATED MODELIZATION IN TERRAIN DATABASE PRODUCTION
2015 IITSEC Paper No. 15290

Stephen Eckman
GameSim
Orlando, FL

Ronald Moore
Leidos
Orlando, FL

Mark Johnson
U.S Army PEOSTRI
Orlando, FL

Jaeson Munro
PAI
Orlando, FL

The feature content requirements for terrain databases used in the Modeling and Simulation industry continue to grow. The requested database geographic extents are expanding. Database feature densities and complexities are increasing. New simulation systems are leveraging game engines, enabling this growth in database content requirements. Unfortunately, the cost of producing 3D cultural models, that reflect these increased complexities, using traditional commercial 3D modeling tools, by hand, is quickly becoming unsustainable, and maintaining and updating 3D cultural models libraries are becoming unaffordable. The process of assigning 3D model references to vector features in a geospatial database, identified as modelization, has been automated by the SE Core program to significantly reduce database production costs, improve database quality and consistency and increase run-time database performance. This paper describes the processes and tools used in the Automated Modelization Process in the production of the Synthetic Environment Core (SE Core) terrain databases. When applied, these tools and processes results in a cost effective approach to automatically generate 3D cultural models that are designed for the specified run-time requirements, saving considerable development time when compared to using commercial 3D modeling tools and manual processes.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320C
S-6 Human Interface to Artificial Intelligence

1400 Modeling CGF Behavior with Machine Learning Techniques: Requirements and Future Directions (15128)

1430 Automatic Speech Recognition in Training Systems: Misconceptions, Challenges and Paths Forward (15205)

1500 On the Peripheral Application of Head Mounted Display (HMD) Devices in Infantry Simulation (15186)

Notes
MODELING CGF BEHAVIOR WITH MACHINE LEARNING TECHNIQUES: REQUIREMENTS AND FUTURE DIRECTIONS
2015 I/ITSEC Paper No. 15128

Armon Toubman, Gerald Poppinga, Ming Hou, Linus Luotsinen
Jan Joris Roessingh, Defense Research and Swedish Defence Research Agency
National Aerospace Laboratory NLR, Development Canada FOI
Amsterdam, Netherlands Toronto, Canada Stockholm, Sweden

Rikke Amilde Løvlid, Christophe Meyer, Roel Rijken, Michal Turčaník
Norwegian Defence Research Thales Dutch Ministry of Armed Forces Academy
Establishment (FFI) Palaiseau, France Defence Utrecht, Netherlands Liptovský Mikuláš, Kjeller, Norway Stockholm, Sweden Slovakia

Commercial/Military-Off-The-Shelf (COTS/MOTS) Computer Generated Forces (CGF) packages are widely used in modelling and simulation for training purposes. Conventional CGF packages often include artificial intelligence (AI) interfaces, with which the end user defines CGF behaviors. We believe Machine Learning (ML) techniques can be beneficial to the behavior modelling process, yet such techniques seem to be underused and perhaps underappreciated. This paper aims at bridging the gap between users in academia and the military/industry at a high level when it comes to ML and AI. Also, specific user requirements and how they can be addressed by ML techniques are highlighted with the focus on the added ML value to CGF packages. The paper is based on the work of the NATO Research Task Group IST-121 RTG-060 ‘Machine Learning Techniques for Autonomous Computer Generated Entities’.

AUTOMATIC SPEECH RECOGNITION IN TRAINING SYSTEMS: MISCONCEPTIONS, CHALLENGES AND PATHS FORWARD
2015 I/ITSEC Paper No. 15205

Brian Stensrud, Charles Newton, Beth Atkinson, John Killilea
Soar Technology, Inc. NAWCTSD
Orlando, FL Orlando, FL

Over the past decade, we have seen moderate demand for simulation-based training systems to include automatic speech recognition (ASR). Like commercially available services such as Apple's Siri and Google Now, ASR gives training systems the capability to interpret human speech and react to that speech with appropriate actions (e.g. executing a spoken command) and responses (e.g. replying to a human with confirmation or requests for clarification). Introduction of this capability is designed to address instructor-manning limitations and improve the fidelity of the training experience. However, ASR successes within simulation-based training systems have been modest, historically. We contend that this lack of widespread usage and success stems primarily from a fundamental misunderstanding of (and thus lack of investment in) the components necessary to achieve more effective ASR. In this paper, we describe the essential functions of ASR: (1) Recognition is when the audio of the spoken utterance is translated into text. (2) Understanding attempts to glean meaning from the text – whether they denote, for example, a new directive, a response to a previous query, or a request for new information. (3) Behavior refers to the functions the system is responsible for after receiving a recognized speech utterance. (4) Some training systems also employ dialogue when continuous interaction with humans is required. Finally, we outline current ASR research and development, discuss typical implementations, and introduce potential strategies to improve specific ASR functions and the capability as a whole to provide better support for future training systems.
ON THE PERIPHERAL APPLICATION OF HMD DEVICES IN INFANTRY SIMULATION
2015 IITSEC Paper No. 15186

Tomer J. Michael  
IDF GFC Battle-Lab  
Tel-Aviv, Israel

Yaniv Minkov  
IDF GFC COR  
Tel-Aviv, Israel

The purpose of this paper is to present the results of an attempt carried out at the IDF Ground Forces Command Battle-Lab to integrate a Head Mounted Display (HMD) device as part of a peripheral-equipment simulator for infantry. The Battle-Lab is a research oriented simulation environment, where combat scenarios with many multiple human participants can be run to examine the effects novel concepts or technologies could have on scenario outcomes.

Previously (Michael et. Al, 2014) an attempt was made at the Lab to evaluate an HMD’s effectiveness as an exclusive display for infantry simulation. At that time, while the device tested was found to have had a positive impact on a participant’s motivation and spatial awareness, it was found lacking in the field of visual fidelity, as well as responsible for an increased incidence of simulation sickness among its wearers.

As a result of the previous evaluation it was decided to proceed with the integration of the device, but only in supplementary peripheral simulators. These included a pair of binoculars made available to an infantry soldier for use concurrently with a standard flat-screen first-person infantry simulation.

However, given the device’s reputation for causing simulation sickness, and our previous experience with the phenomena, it was decided to monitor the participants’ experience closely. This task was accomplished through simple after-action self-review supplemented by a more detailed daily debriefing with the Simulation Sickness Questionnaire.

In this paper are presented the results of this monitoring throughout a series of scenarios carried out at the Battle-Lab in 2014, conclusions from the gathered data, as well as lessons learned from the process of both building and studying simulation sickness in the use of peripheral simulators with HMD integration.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320B
S-7 Next Gen LVC

1600  
M&S Training Transformation: Bridging the Next Generation Joint LVC (15167)

1630  
Leveraging Cloud Computing Technology for LVC Training (15101)

1700  
Osseus, An Experiment in What’s Next in LVC M&S Architecture (15085)

Notes

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M&S TRAINING TRANSFORMATION: BRIDGING THE NEXT GENERATION JOINT LVC
2015 I/ITSEC Paper No. 15167

Mr. Bruce Uphoff Mr. Michael Koscielniak Mr. Brian Gregg Mr. Karl Hines Mr. John Mizelle Mr. Daniel Leigeber
Army, Program Executive Office for Simulation, Training and Instrumentation, Project Manager, Integrated Training Environment, Leavenworth, KS Los Alamos National Laboratory Joint Staff J7 Suffolk, VA Intelligent Decision Systems, Inc. Huntsville, AL

To enable training of U.S. Forces, Korea (USFK) to “Fight Tonight” (deter/defeat aggression), their Korea Battle Simulation Center (KBSC) has evolved to the Joint Training Transformation Initiative (JTTI) and Korean Simulation System (KSIMS) (JTTI+K) federation of models. This federation is a “one off” solution within DoD, especially with regard to the Joint Staff J7 simulation federation (Joint LVC). Why is this important? Aside from the obvious that in a day of diminishing resources it is difficult to justify and maintain “one-off” approaches, there is the fact that as USFK transforms to US Korea Command (KORCOM) it will fall under the J7 for training capability support.

The JLVC and JTTI+K federations are divergent. To support the command structure change and resulting training capability gap, the SECDEF directed an enterprise DoD M&S architecture. It was determined that the JS J7 would provide a software bridge between the JLVC and JTTI+K federations to achieve the SECDEF directive. Los Alamos National Laboratory is working development of the KORCOM Bridge, linking the JLVC and JTTI+K, as part of the next generation JLVC 2020 v0.6 development cycle and faces several challenges. The JTTI+K federation is aggregate based, time managed, connected, reliable delivery and uses the HLA 1.3 NG Pro RTI. JLVC is essentially entity-based, non-time managed, non-connected, best effort delivery, and not previously integrated with KSIMS. The KORCOM Bridge has addressed these challenges and is delivering an initial (production level) capability in FY15. The J7 has conducted a series of KORCOM Bridge integration tests with the JTTI+K at the Joint Digital Integration Facility (JDIF) in Orlando, FL, and with the JTTI+K at the KBSC. This paper captures results of design and integration testing through the initial FY15 delivery of JLVC 2020 v0.6 and how the KORCOM Bridge helps forge future Joint/Coalition M&S capabilities.

LEVERAGING CLOUD COMPUTING TECHNOLOGY FOR LVC TRAINING
2015 I/ITSEC Paper No. 15101

Paul Dumanoir Army, Program Executive Office for Simulation, Training and Instrumentation, Project Manager, Integrated Training Environment, Orlando, FL
Henry Marshall Army Research Laboratory Human Research and Engineering Directorate Simulation and Training Technology Center Orlando, FL
Robert Wells Dynamic Systems Orlando, FL
Jeff Truong Effective Corporation Orlando, FL

Over the past years the Department of Defense and the Army have been working to accelerate toward wide-scale adoption of cloud computing for the potential cost saving and enhanced mission capabilities that it brings. The Live, Virtual, Constructive – Integrating Architecture (LVC-IA) is a Program of Record (POR), under the Army Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) Project Manager for Integrated Training Environment (PM ITE), which provides a net-centric linkage for existing Training Aids, Devices, Simulations, and Simulators in an ITE. To date the LVC-IA architecture utilizes a series of servers which are physically located in one or more fielding sites. Each instance of an LVC-IA system has to be individually installed and maintained at each site. Building and running these on site systems is complex and expensive. With each instantiation of LVC-IA for the new training sites, the capital and operating expenditures would simply multiply. A research effort was sponsored by PM ITE to evaluate the feasibility of leveraging cloud computing for LVC-IA. This paper summarizes the analysis conducted, architecture design, and prototype implemented from this research effort. The paper dives into the Information Assurance issues encountered and touches on processes from other Army programs as they relate to the Common Operating Environment (COE) Data Center/Cloud (DC/C) Computing Environment (CE). The paper also reports the comparative analysis results between an ITE with co-located LVC-IA versus an ITE with LVC-IA in the cloud. Finally the paper reports the challenges uncovered, lessons learned, and recommended way forward.
OSSEUS, AN EXPERIMENT IN NEXT GENERATION LVC M&S ARCHITECTURE
2015 I/ITSEC Paper No. 15085

Mark Riecken
Trideum
Orlando, Florida

Derrick Franceschini
StackFrame, LLC
Sanford, Florida

Scott Gallant
Effective Applications
Orlando, Florida

John Rutledge
Trideum
Huntsville, Alabama

Walter Barge
Director, Joint Assessment and Enabling Capability (JAEC)
OSD Force Readiness and Training (FRT)
Alexandria, Virginia

Live, Virtual, and Constructive (LVC) technologies provide a powerful range of capabilities that the distributed training community enjoys in support of its broad spectrum of training needs. The fundamentals of this LVC capability were built over two decades ago at a time when the modeling and simulation (M&S) community was arguably ahead of commercial information systems, especially in terms of distributed computing and networking. With the advent of many web-based technologies the LVC community now finds itself attempting to integrate new technologies with legacy architectures. Due to the flexibility of the new technologies as well as the inventiveness of the LVC community, this approach has had some success, but these approaches continue to require specialized skillsets and can be costly to establish and maintain. The Defense M&S Coordination Office (DMSCO) has sponsored an effort to describe and prototype selected features of a next generation architecture that leverages recent and emerging technology more directly. This paper describes a framework called Osseus to accomplish these goals. Osseus incorporates desired next generation characteristics such as 1) more open and flexible interoperability between disparate systems; 2) the ability for relatively untrained users to fill in functionality gaps between available systems by dynamically injecting behavioral changes into the LVC environment; 3) the ability to connect services with granularity smaller than an application to increase the capability of the environment; 4) a more accessible means of composing distributed training capabilities for an educated, but non-specialist trainer; 5) data filtering to optimize or reduce data transmission over the network; and 6) centralized data management to facilitate tools such as visualization, data collection, and analysis. This paper discusses architectural aspects of Osseus and selected prototype results which include the integration of OneSAF with an example virtual system.

THURSDAY, 3 DECEMBER, 2015 ROOM S320B
S-8 Simulation Supported Training

0830 Embarking on a Home Station Training Revolution (15176)
0900 Implementation of Role-Based Command Hierarchy Model for Actor Cooperation (15166)
0930 Innovative Division/Brigade Level CO Training Solution for Influence Operations (15107)

Notes
EMBARKING ON A HOME STATION TRAINING REVOLUTION
2015 I/ITSEC Paper No. 15176

Anthony J. Cerri
TRADOC, G27 OE TSC
Newport News, Virginia

Alan J. Knox & Mathew N. McMillan
CGI Federal
Newport News, Virginia

As the US Army has been at war for over a decade, the art of developing and conducting Home Station Training (HST) has not been a focal point for our next generation of leaders. Units have become accustomed to having their training provided to them by others prior to overseas deployment. This diminished capability has made it difficult to develop and execute effective HST when that training includes live, virtual and constructive (LVC) environmental considerations. To fully understand the scope of the problem, this paper articulates the processes in which HST is currently designed and developed, and how that training could be supported by Mission Training Centers (MTCs). The process, while not the same for all units, demonstrates the genesis of how training is developed at home station. To help overcome the challenges, the Training Brain Repository-Exercise Design Tool (TBR-EDT), a collaborative, web-based repository and exercise design tool has been created. It enables commanders and staffs to reuse storylines, events, and other exercise related items from within the repository. It allows units to work closely with MTCs to automate and modernize HST lifecycles. The TBR-EDT revolutionizes the current mainstream exercise design process; reducing the time required to develop an exercise and its associated training support package (TSP), due to the enhanced collaborative opportunities between the training unit and the supporting MTC. The TBR-EDT currently supports simulations with start of the exercise (STARTTEX) data, provided in multiple machine readable order of battle service, extensible markup language (OBS XML) versions for import into simulation systems. In the future, more robust STARTTEX conditions such as terrain, C2, and parametric data will further enhance the simulations environment, and better replicate the operational environment. Finally, the paper will present the TBR-EDT as a game changer for Army and Joint trainers; significantly shortening the design process for realistic and economical HST exercises.

IMPLEMENTATION OF ROLE-BASED COMMAND HIERARCHY MODEL FOR ACTOR COOPERATION
2015 I/ITSEC Paper No. 15166

Jungyoon Kim, Hee-Soo Kim, Jihyun Jang
REALTIMEVISUAL
Seoul, Republic of Korea

Sangjin Lee, Samjoon Park
Agency for Defense Development
Daejeon, Republic of Korea

Many approaches to agent collaboration have been introduced in military war-games, and those approaches address methods for actor (agent-) collaboration within a team to achieve given goals, where the team’s abstract mission is translated into concrete tasks for each actor. To meet fast-changing battlefield situations, an actor must be 1) loosely coupled with their tasks and be 2) able to take over the role of other actors if necessary to reflect role handovers occurring in real combat. Achieving these requirements allows the transfer of tasks assigned one actor to another actor in circumstances when that actor cannot execute its assigned role, such as when destroyed in action. Tight coupling between an actor and its tasks can prevent role handover in fast-changing situations. Unfortunately, existing approaches and war-game software strictly assign tasks to actors during design, therefore they prevent the loose coupling needed for successful role handover. To overcome these shortcomings, we have defined Role-based Command Hierarchy (ROCH) model that dynamically assigns roles to actors based on their situation at runtime. In the model we devise “Role” to separate actors from their tasks. Described in this paper, we implement the ROCH model as a component that uses a publish-subscribe pattern to handle the link between an actor and the roles of its subordinates (other actors in the team). Therefore, an actor can indirectly send a message (order or report) to another actor without knowing which actor is recipient. The sender actor is only required to know the relevant roles. The model has been implemented and tested in a military project, and we briefly show the outcomes in this paper.
INNOVATIVE DIVISION/BRIGADE LEVEL COMMANDING OFFICER TRAINING SOLUTION FOR INFLUENCE OPERATIONS
2015 I/ITSEC Paper No. 15107

Ariane Bitoun & Romain Bosa
MASA Group
Paris, France

Tahar Hannachi
Université Pierre et Marie Curie
(Paris VI)
Paris, France

Lionel Khimeche
DGA/DS/CATOD
Arcueil, France

Asymmetric conflicts, involving populations that support armed groups, represent an increasingly significant proportion of all armed conflicts. Influence Operations, which deal directly with this type of warfare, is therefore a sector for which Commanding Officers (COs) at division- or brigade-level must now train. Influence Operations training tools, mostly based on virtual simulations, are today mainly focused on individual skills improvement and increased cultural awareness. Therefore they are not suited to train COs who need high-level information for the planning and successful running of operations. The main challenges regarding these objectives involve i) modeling, simulation and visualization of the abstract concepts of Influence Operations, ii) the definition of operational training scenarios.

This paper introduces a solution that departs from classic Influence Operations training solutions, by rising to the challenge of training division- or brigade-level COs and offering a high-level simulation. This solution consists of an innovative platform that integrates an existing constructive simulation, already used to train division- or brigade-level COs, with a new simulation component capable of representing Influence Operations. Indeed simulation-based training platforms, built on constructive simulations, are an efficient and proven means to train at the level we are targeting in traditional military combat. The resulting platform addresses the operational expectations for the training of Influence Operations COs with vital components (preparation, gaming, supervision and analysis) and includes high-level models to simulate the abstract concepts required to represent Psychological Operations (PSYOP), Key Leader Engagement (KLE) and Civil-Military Cooperation (CIMIC) operations (life-cycle of messages, dynamics of acceptance amongst populations, Target Audiences).

Finally, the paper presents an implementation of this solution using an existing aggregated constructive simulation integrated with a dedicated Influence Operations simulation component. This platform is validated using operational training scenarios that highlight Influence Operation challenges.

THURSDAY, 3 DECEMBER, 2015 ROOM S320F
S-9 UAS Engineering Design Simulation

0830 Reducing Operational Risk through Better Performance Testing (15138)
0900 Design of an Educational Tool for Unmanned Air Vehicle Design and Analysis (15086)
0930 Using Simulation to Test Manned-Unmanned Teaming (15112)

Notes

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REDUCING OPERATIONAL RISK THROUGH BETTER PERFORMANCE TESTING

Tom Wilson
Lockheed Martin
Orlando, Florida

One of the more difficult simulations to implement is an accurate load test. In order for a load test to mimic reality, it must reflect the system's activities in function, data, and timing; properly representing the data component is often the most challenging. Nonetheless, load testing must be more than a realistic simulation. It must provide robustness so it can give accurate insight into the system's behavior when other workloads are encountered.

This paper describes several methods to improve the robustness of load testing so that it not only gives insight into performance of a system in current operations, but also gives insight into the performance behaviors of the system for workloads yet to be encountered. Key features of the testing include: operationally-representative scenarios, easy-to-change workloads, scalable workloads, scalable data, random parameter generation, and repeatable tests. Since these features are provided independently of the tool used to implement the load test, the methods are easily applied to the load testing of any system. Once applied, a basic requirements verification exercise is transformed into a sophisticated operational risk-reduction strategy.

DESIGN OF AN EDUCATIONAL TOOL FOR UNMANNED AIR Vehicle DESIGN AND ANALYSIS

Brian Sanders, Brent Terwilliger, Ken Witcher & Mark Leary
Embry-Ride Aeronautical University
Daytona Beach, Florida

James Ohlman, Christina Tucker
Pinnacle Solutions
Huntsville, Alabama

Offering laboratories and team projects present significant challenges for delivering Science, Technology, Engineering, and Mathematics (STEM) courses in the online (asynchronous) modality. These interactive workspaces are important attributes since they provide forums for students to more deeply explore fundamental principles, exercise teamwork and planning to jointly overcome problems, and gain critical experience. The employment of online environments and interactive activities hold the potential to change how fundamental student outcomes measured by accreditation organizations are incorporated and treated in curricula, potentially improving the quality of the overall educational experience. To address this need Embry-Riddle Aeronautical University has teamed with Pinnacle Solutions to develop a realistic unmanned aircraft system (UAS) development, application, and evaluation simulation that educators can integrate into program curriculum. The research contained in this paper addresses simulation development and application starting with identification of basic educational objectives driving the need and how the simulation tool is envisioned to satisfy learning objectives. This will be followed by a description and examples of a multi-environment simulation framework designed to meet those needs. The first is a component test environment where students can investigate basic technical principles of operation and key performance metrics of standalone UAS components such as sensors, communications, and propulsion elements. The second is an integration facility, where students are provided the capability to apply knowledge gained in the previous laboratory to select and combine appropriate elements into a unified subsystem to meet prescribed mission parameters. The third is a flight test environment, where students experiment with development and execution of simulated flight profiles over common terrain environments (i.e., mountainous) to measure operational performance attributes of the completed UAS. The design is anticipated to provide the flexibility to implement each environment sequentially, as described above, or independently; ensuring a solution applicable to a broad range of courses, objectives, outcomes, and student capabilities.
USING SIMULATION TO TEST MANNED-UNMANNED TEAMING
2015 I/ITSEC Paper No. 15112

Michael J. O'Connor
Trideum Corporation
Huntsville, AL

Kenneth LeSueur, Mark Ebert, Sean Millich
Redstone Test Center
Huntsville, AL

Fred Ventrone
CTSi
Lexington Park, MD

Tom Punihaole
Scalable Network Technologies
Huntsville, AL

Manned-Unmanned Teaming (MUM-T) allows helicopter pilots to link with Unmanned Aircraft Systems (UAS) and receive video feeds, control payloads, and direct UAS movements. Robust communications protocols are used for this process, however, communications loss does occur due to signal strength, terrain, weather, and jamming. Using live testing to create all of these conditions is difficult and has potential safety and cost issues. To address the need for repeatable testing of these issues, a simulation environment was created to replicate the conditions using live aircraft on the ground.

The Joint Unmanned Aircraft Systems Mission Environment (JUAS-ME) is a Central Test and Evaluation Investment Program (CTEIP) for creating test environments for UAS testing. The Army’s portion of the program is focused on MUM-T testing.

Two key technologies were developed to support this testing. Hardware-In-the-Loop (HWIL) tactical network simulation and MIL-STD-1553 bus extension. A real-time network simulation that emulates the Standard Common Data Link (SCDL) was built to perturb the data links between the helicopter and UAS. The communications effects server can operate in a physics based mode, fault inject mode, and a hybrid mode. A key test requirement was to exercise the use of the UAS’s onboard lasers that receive commands over a MIL-STD-1553 bus. These non-eye safe lasers could not be fired in the UAS HWIL facility, resulting in the need to move the UAS sensor to another test lab. This extension necessitated the development of a MIL-STD-1553 bus extender to link the test facilities that are 4 miles apart.

This paper describes the issues encountered in creating a tactical network simulation with HWIL interfaces and the MIL-STD-1553 bus extender. In particular, several approaches were tried with the network simulation before a workable solution was found. The techniques describe in this paper can be applied to other programs with similar requirements.
DESIGN AND DEVELOPMENT OF A GENERAL VIRTUAL MAINTENANCE TRAINING PLATFORM

2015 IITSEC Paper No. 15312

Xingxin Li, Jianping Hao, Fei Ye
Shijiazhuang Mechanical Engineering College
Shijiazhuang, Hebei, P.R.China

Xu Yang
The University of Tennessee
Knoxville, TN

Since the 1990s, Chinese researchers have initiated a series of virtual maintenance training technology studies and system development projects sponsored either by government or industry. Most of them employed similar methodology and developed a training system for the selected equipment and system. In fact, rare of these software achievements were used and improved continuously. In 2006, a proposal for a general desktop virtual maintenance training platform suitable for diverse user entities and varied training requirements was approved and sponsored by government and enterprise. The resultant software system was put into use in 2009 and with continuous improvements, so far as 2012, the research work was generally recognized and concluded that initial expectations have been met. Further research and development work was sponsored again. The paper describes this general virtual maintenance-training platform (GVMTP) from several aspects. The introduction part addresses the background and a brief description of the research. The design part puts emphasis on the problem identification, potential requirements, goal definition, and relatively detailed platform framework design. The development part mainly describes the platform components, and the realization of three key elements. The application part provides a general applications summary and the effects analysis result. The paper finally presents lessons learned and the further work. GVMTP provides a normalized and systematic process to facilitate and manage all activities throughout the lifecycle of virtual maintenance training product, and also makes the data share and reuse easier during this process. GVMTP is not only a set of training tools, but also a training product generation studio.

VIRTUAL ENVIRONMENT COMPUTER-BASED TRAINING FOR BRIDGE AND TUNNEL INSPECTIONS

2015 IITSEC Paper No. 15276

Steve Ianni
Engility Corporation
Virginia Beach, Virginia

Mary P. Rosick, P.E.
Michael Baker International
Pittsburgh, Pennsylvania

While physical field trips to bridge and tunnel sites are a critical learning component to the Federal Highway Administration (FHWA) National Highway Institute’s (NHI) training courses, they are difficult to arrange due to many factors such as safety, time constraints, weather, and costly logistics. In response for an alternative to a physical inspection field trip, bridge engineers at Michael Baker Jr., Inc., a Michael Baker International company, and technical developers at Engility Corporation worked together with FHWA/NHI to create three-dimensional (3D) Virtual Inspection Computer Based Training (CBT). This paper explains several key design, development and implementation elements of the 3D Virtual Inspection. It details the process used to create a comprehensive 3D CBT structured for a blended learning environment. The paper examines the elements used to create approximately 40 interactive checkpoints across three virtual environments that respond to the inspector’s standard toolset. It explains how the CBT incorporates reference documentation and instructor “teachable moments”. This paper also highlights how experts from multiple disciplines (engineering, classroom instruction, 3D modeling, computer programming, etc.) came together to create a unique and successful training tool for the modern classroom. Since its pilot in 2012, NHI successfully delivered the award winning CBT 55 times to approximately 1400 participants. After using the 3D Virtual Inspection CBT as an alternative to the field trip, the virtual environment is now the primary training tool for the safety inspection of in-service bridges and tunnels courses.
DEVELOPING AUTHORING TOOLS FOR SKILL MODELS THAT ENABLE ADAPTIVE GAME-BASED MAINTENANCE TRAINING
2015 IITSEC Paper No. 15129

Sean Guarino, Peter Weyhrauch & James Niehaus
Charles River Analytics Inc.
Cambridge, MA

While game-based maintenance training provides a powerful, personalized approach to address individual training needs, it can be costly to update immersive game engines to address new training objectives. Challenges lie not only in the incorporation of new technology that must be trained, but also in the construction of surrounding training materials—curriculums, performance metrics, and optimal training methods—to address procedures for the new technology. In ongoing work with the Air Force Research Laboratories (AFRL), the authors are developing a modeling framework and editing tools for subject matter experts to translate new technology and Technical Orders (TOs) into training objectives, scenarios, and content for existing virtual game-based trainers. The Methodology for Annotated Skill Trees (MAST) provides a formalism that organizes training goals and associated performance metrics, skill decay models, scaffolding models, and effective training methods. This paper discusses the application of this modeling framework to maintenance training for the F-15E aircraft, and the associated development of editing tools to adapt content both in MAST and in the immersive game engine. This paper also describes an approach to improving training by adapting training objectives to support focused repetition of maintenance procedures and review with instructors. Finally, this paper summarizes initial feedback from active duty instructors, and next steps for improving these tools.
TOWARD ACQUIRING A HUMAN BEHAVIOR MODEL OF COMPETITION VS. COOPERATION
2015 I/ITSEC Paper No. 15316

David V. Pynadath, Ning Wang, and Chirag Merchant
Institute for Creative Technologies
University of Southern California
Los Angeles, CA

One of the challenges in modeling human behavior is accurately capturing the conditions under which people will behave selfishly or selflessly. Researchers have been unable to craft purely cooperative (or competitive) scenarios without significant numbers of subjects displaying unintended selfish (or selfless) behavior (e.g., Rapoport & Chammah, 1965). In this work, rather than try to further isolate competitive vs. cooperative behavior, we instead construct an experimental setting that deliberately includes both, in a way that fits within an operational simulation model. Using PsychSim, a multiagent social simulation framework with both Theory of Mind and decision theory, we have implemented an online resource allocation game called “Team of Rivals”, where four players seek to defeat a common enemy. The players have individual pools of resources which they can allocate toward that common goal. In addition to their progress toward this common goal, the players also receive individual feedback, in terms of the number of resources they own and have won from the enemy. By giving the players both an explicit cooperative goal and implicit feedback on potential competitive goals, we give them room to behave anywhere on the spectrum between these two extremes. Furthermore, by moving away from the more common two-player laboratory settings (e.g., Prisoner’s Dilemma), we can observe differential behavior across the richer space of possible interpersonal relationships. We discuss the design of the game that allows us to observe and analyze these relationships from human behavior data acquired through this game. We then describe decision-theoretic agents that can simulate hypothesized variations on human behavior. Finally, we present results of a preliminary playtest of the testbed and discuss the gathered data.

EMBEDDED SIMULATION TO PREVENT TACTICAL SURPRISE AND IMPROVE SOLDIER PERFORMANCE
2015 I/ITSEC Paper No. 15054

Dr. Jonathan Stevens
University of Central Florida (UCF)
Orlando, FL

Ms. Latika Eifert
Army Research Laboratory (ARL)
Orlando, FL

Timothy Baldwin
EOIR Technologies
Aberdeen Proving Grounds, MD

Oleg Umanskiy
Dr. Boris Stilman
STILMAN Advanced Strategies
University of Colorado Denver
Denver, CO

The U.S. Army Science and Technology (S&T) Advisory Group created the Technology Enabled Capability Demonstration (TECD) concept in order to demonstrate and measure progress towards meeting the Army's top ten science and technology challenges. One of the designated challenges is the prevention of tactical surprise at the small unit level. Operating under the premise that soldiers at the squad level lack sufficient situational awareness to prevent tactical surprise, the TECD 3 effort was created to increase small unit situational awareness through the fusion of various planning and intelligence systems into a small unit framework. The Linguistic Geometry Real-time Adversarial Intelligence & Decision-making (LG-RAID) simulation is a lightweight course of action (COA) planning tool that employs innovative algorithms to predict enemy activity in a highly reliable and efficient manner. As such, LG-RAID was selected as a participating application in the TECD 3 federation and was embedded on both individual soldiers and tactical vehicles in a lightweight mission command system. In this paper, we discuss how the LG-RAID simulation improved soldier effectiveness, situational awareness and facilitated the prevention of tactical surprise during the execution of four tactical situational training exercises (STXs) held at Fort Dix, NJ and executed by the Army's Experiment Force (EXFOR). Furthermore, we discuss the integration of LG-RAID into the TECD 3 framework and technical challenges that were overcome. Results of this integration and exercise, presented in this paper, highlight the potential value of embedded simulation at the tactical level.
DISTRIBUTED SOLDIER REPRESENTATION: IMPROVING M&S REPRESENTATION OF THE SOLDIER

2015 IITSEC Paper No. 15123

Manuel Diego, Clayton W. Burford
US Army RDECOM Army Research Laboratory
Orlando, Florida

Joseph S. McDonnell, Ph.D., Bert Davis, Gary Smith
Dynamic Animation Systems, Inc.
Fairfax, Virginia

Derrick Franceschini
StackFrame, LLC
Sanford, Florida

The Army has developed a breadth of Modeling and Simulation (M&S) capabilities representing platforms such as fixed and rotary-winged aircraft, tracked and wheeled vehicles, and weapons systems for various uses and of various fidelities. The Army has represented humans – soldiers, civilians, and threats – in its M&S as well. These representations provide physical model characteristics for mobility, delivery accuracy, lethality, and sensing, as well as behavioral representation to support tactical movement, clearing a building, obtaining Human Intelligence (HUMINT), and treating simulated wounded. These models rarely represent the soldier as a complex system, representing factors such as stress, human physiology, leadership, unit cohesion, and morale, to name a few. Instead, the actions of the simulated soldier are often based on a deterministic model of human behavior. When nondeterministic representations are used, they are often stochastic where random numbers provide variability across iterations, but the variability comes from the random number seed, not from the model. This provides unsatisfactory simulation results for those stakeholders interested in analyzing the effects of the soldier representation, as the simulated soldiers appear robotic or even superhuman. This paper describes the Distributed Soldier Representation (DSR) research and development effort that has been underway at the Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL HRED STTC) for the past two years. In this paper, we describe our research that has identified eleven areas of interest for improving soldier representation. We further describe the development of an innovative Service Oriented Architecture (SOA) that provides a modern web services-based approach to integrate disparate models to address these identified representation gaps. We describe the challenges and benefits achieved by taking a web-services approach, as well as the lessons learned from the web-services integration of the Effects of Stress with One Semi-Automated Forces (OneSAF). Finally, we discuss ongoing development work.
A MBSE APPROACH IN MODELING SYSTEMS USING HYBRID SIMULATION TECHNIQUES
2015 IITSEC Paper No. 15368
Asli Soyler Akbas
Modeling and Simulation
University of Central Florida
Orlando, Florida
Waldemar Karwowski
Industrial Engineering and Management Systems
University of Central Florida
Orlando, Florida

Modern simulation efforts, vastly improved with recent computing and visual power advancements, provide solutions to various fields such as engineering, defense management and training. The current body of knowledge on simulation from different domains displays this field’s wideness as well as the amount of variation and interaction among its components. Such intricacy and scale drives the need to adapt a holistic and robust approach aiming to support modelers with three core challenges. First, the increasing complexity of modeled problems complicates the ground-up approach. Second, the involvement of stakeholders from various fields and backgrounds introduce additional needs and expectations varying from one to another, each facing unavoidable changes due to shifts in environmental conditions affecting the modeling efforts as well as the model, itself. Finally, the need to maintain the coherency and efficiency of validated models through structural change requests that arise from emerging variables, constraints or states.

This paper proposes a methodology for modeling and maintaining hybrid platforms using Model-Based Systems Engineering (MBSE) approach. The approach is demonstrated by building the architectural model of a hybrid simulation platform using Systems Modeling Language (SysML). The finalized architecture, which consists of an agent-based and systems dynamics parts, is then built and simulated in a C++ based environment. Finally the findings are analyzed to evaluate the benefits and shortfalls of the approach in aiding developers to overcome the challenges through their modeling efforts.

SIMULATOR ARCHITECTURE UPGRADE UTILIZING VIRTUAL MACHINES (VMS)
2015 IITSEC Paper No. 15219
Thomas Bridgman
National Technologies Associates
Wright Patterson AFB, Ohio
Elizabeth Gaugler
AFLCMC/WNSE
Wright Patterson AFB, Ohio

The Simulators Division of the Air Force Life Cycle Management Center (AFLCMC) located at Wright-Patterson Air Force Base (WPAFB) Ohio is responsible for many Air Force simulator assets. Currently, the state of some of the simulators consists of multiple legacy computer system architectures with non-supported hardware and operating systems (OS). For example, some of the OSs includes MSDOS 6.22, Windows NT, Windows XP, IBM AIX, and multiple versions of Linux. Furthermore, the simulators consist of several racks of Personal Computer (PC) hardware running a single instance of an OS with single software application. In addition, many of these PC systems are not fully utilizing their resources including CPU, memory, storage, input/output, network, etc. A majority of a simulator’s PCs are internally networked and synchronized together over an internal and external network via multiple switches and routers. With the current system configurations usually consisting of outdated equipment, unsupported hardware, software and OSs, an alternative architecture of Virtual Machines (VMs) may assist the technical obstacles that arise with the inefficiencies of legacy simulator systems. Upgrading legacy simulators with a single or a combination of bare-metal and native hypervisor architectures could provide the means to maintain the legacy OS and software load while simultaneously storing the current OS and application in multiple VMs within the same server. Along with hosting a simulators legacy OS, VMs may also contribute to reduced system administration functions, lower physical system footprint, operational redundancy, reduced power consumption and costs, and provide a more effective security boundary. This paper will investigate some alternatives to simulator hardware, software, and security upgrades with VMs.
One of the biggest obstacles facing research organizations is how to effectively develop innovative technologies that transition into Programs of Records (PoRs). On the other hand, Project Managers (PMs) are interested in technology developments efforts that mitigate the technology risks of their PoRs with minimal risks to their existing Engineering, Manufacturing, & Development or Production acquisition phases. Solving this technology transition “valley of death” has long been elusive as technologies have been developed that are not transitioned, and PoRs continue to have their technology gaps that are not addressed. To attempt to solve the quagmire created by this mismatch, the Army Research Laboratory, Human Research and Engineering Directorate, Simulation and Training Technology Center (ARL HRED STTC) partnered with the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI) Project Manager for Constructive Simulation (PM ConSim) to develop a new process to bridge the technology transition chasm. The effort created a program called the Risk Reduction Test Bed (RRTB) with a defined process for risk mitigation and streamlined the technology insertion from Research and Development (R&D) programs. This program has quickly become a model for technology maturation and transition between these two organizations. The initial phase of the process requires a capability and technology gap analysis that extends into the project’s users and long-term life cycle. A concurrent activity within this phase includes building representative test beds to develop and test the technologies. The process involves a gap analysis that determines which are feasible and provides the greatest return on investment to the PoRs. The process then develops projects that look at possible solutions. This paper details examples of how this process moves from gaps to solutions to transition to the PoRs providing a model example for any organization seeking to improve their processes in this area.
MEASURING TRAINING EFFECTIVENESS OF LIGHTWEIGHT GAME-BASED CONSTRUCTIVE SIMULATION
2015 IITSEC Paper No. 15007

Dr. Jonathan Stevens
Ms. Latika Eifert
Dr. Boris Stilman
Dr. Oleg Umanskiy
Dr. Stephen R. Serge
Army Research Laboratory (ARL)
University of Colorado
STILMAN Advanced Strategies
Mr. Dean Reed
Orlando, FL
Denver, CO
Denver, CO

The U.S. Army continues to employ constructive and game-based simulation for training. While both classes of simulation have been found to lower the cost of training, it is still unknown whether or not these classes are actually effective training mechanisms. The Linguistic Geometry Real-time Adversarial Intelligence and Decision-making (LG-RAID) simulation is a lightweight, game-based, constructive simulation that exploits novel game theory to create intelligent, predictive and tactically-correct Courses of Action (COAs) for exercise participants at the company echelon and below. The primary goal of this study was to examine the training effectiveness and usability of the U.S. Army's LG-RAID simulation in an operationally relevant environment. A secondary objective of this study was to assess both the usability and functionality of the simulation in order to improve the technology through future design recommendations. Qualified Soldiers were randomly assigned to one of two training treatments (LG-RAID or a traditional planning method) and tasked to develop, plan and brief a tactically sound operational mission in order to empirically assess the training effectiveness of LG-RAID. The independent variable was training treatment. Dependent variables included performance and individual survey responses. Experimentation was conducted at Fort Benning, GA and performance was evaluated by accredited Army instructors. Results of this study indicate that LG-RAID shows promise as an effective training simulation tool when compared to the baseline condition.

VALIDATING SCENARIO-BASED TRAINING SEQUENCING: THE SCENARIO COMPLEXITY TOOL
2015 IITSEC Paper No. 15102

Robb Dunne, PhD
Stephen A. Sivo, PhD
Nathan Jones
Innovative Reasoning LLC
University of Central Florida
MCSC PM TRASYS
Orlando, FL
Orlando, FL
Orlando, FL

Effective and efficient Scenario-Based Training (SBT) is sequenced using well-grounded instructional strategies and learning theory. The primary instructional strategy employed by the Military requires that SBT is sequenced in a “crawl-walk-run” trajectory. For software to sequence scenarios effectively and efficiently in this manner, SBT needs objective, computational values of a scenario’s complexity, but designers, software engineers and trainers operate without the necessary tools to objectively calculate Scenario Complexity (SC). This results in subjectively sequenced SBT that may be ineffective, inefficient, or designed without attention to sound instructional practices.

To address this issue, research in education, task complexity, task framework and cognitive resource principles was integrated and an innovative SC tool (patent pending) comprised of an algorithm and supporting process, was developed to objectively and computationally define SC. This paper presents findings from the use of the SC tool to validate a training matrix embedded in the United States Marine Corps’ M1A1 Advanced Gunnery Training System.

To establish that the SC tool is accurate and effective, it was first necessary to determine how consistent the Subject Matter Expert (SME) evaluations of the scenario’s characteristics were. Then, using the results of their input to the SC algorithm, determine how well the SME sequencing matched that of the training matrix. The objective was to use the SC tool to verify and validate the “crawl-walk-run” sequencing of the training matrix and identify any areas in need of adjustment.

After employing the SC tool, quantitative analyses showed that the SMEs were very consistent in their formulations. Importantly, the SC tool revealed that the training matrix deviates alarmingly from “crawl-walk-run” sequencing. This paper also presents the study’s methodology and algorithm, lessons learned and the future impact that this innovative SC tool may have upon design, development and evaluation of SBT and automated, adaptive training.
ADAPTIVE INSTRUCTOR OPERATING STATIONS: DESIGN TO DECREASE INSTRUCTOR WORKLOAD AND INCREASE EFFECTIVENESS

James A. Pharmer, Laura M. Milham
Naval Air Warfare Center Training Systems Division
Orlando, FL

John A. Valaitis, John Winters
Basic Commerce and Industries, Inc. (BCI)
Clifton Park, NY
Dahlgren, VA

Design of human computer interfaces that support instructors in conducting training events can be a challenge. In some cases, instructor operator stations (IOSs) are not designed around the task of instruction. Without a human factors approach to design, resultant systems can increase the workload of the instructors, possibly decreasing the training value of the event. The objective of the Office of Naval Research (ONR) sponsored Adaptive Training for Combat Information Center (ATCIC) effort is to utilize adaptive training research to drive the design of IOS concepts that support instructor effectiveness and increase efficiency through the reduction of workload for monitoring and debriefing scenario based exercises. To achieve this objective, the team utilized the McCracken & Aldrich (1984) method of predicting the Visual, Auditory, Cognitive, Psychomotor (VACP) task demands. As a measure of potential improvement in temporal demands on instructors, a time-based predictive workload analysis identified potential impacts of design improvements on time spent on each task within a scenario based training exercise. This guided the development and evaluation of an instructor interface to support observation of student performance, assessment, event driven performance checklists, and remediations. Results indicated a 26% reduction in total estimated instructor task time required to conduct a scenario based training event when supported by adaptive training tools. This approach complemented empirical user evaluations of the IOS in a field setting (Milham, Pharmer, & Fok, 2015). This paper will discuss the approach, findings, and how this method can be integrated into an iterative design approach to address workload issues with operators.
METRICS ASSESSMENT TOWARD A TRAINING EFFECTIVENESS EVALUATION OF AUGMENTED VIRTUALITY FOR CALL FOR FIRE TRAINING: INSIGHTS FROM A NOVICE POPULATION

2015 I/ITSEC Paper No. 15014

Julie N. Salcedo, Stephanie J. Lackey, Roberto Champney
Design Interactive, Inc.
Orlando, FL

Stephen R. Serge & Jonathan Hurter
Institute for Simulation & Training
University of Central Florida
Orlando, FL

Gino Fragomeni
Army Research Lab Simulation and Training Technology Center
Orlando, FL

Call for Fire (CFF) is a highly complex and dynamic task to train. Existing CFF training systems offer immersive training experiences, yet high set-up and implementation costs and limited system portability inhibit fulfillment of throughput requirements. Augmented Virtuality (AV) may be a viable solution to reduce costs associated with CFF Simulation-Based Training, improve system portability, increase throughput, and enhance the immersive experience. AV involves the blending of live and virtual training elements to create a highly immersive experience with greater task fidelity. This experiment represents an initial metrics and experimental protocol assessment in a series of training effectiveness evaluation experiments investigating the performance and learner perception tradeoffs of AV technologies applied to the CFF task domain. Results reveal trends toward increased learner self-efficacy, positive perceptions of system fidelity and usability, and high ratings for immersion, engagement, and presence. These findings confirm the validity of the selected performance metrics and subjective measures for the assessment of AV technologies for CFF training and also inform the empirical recommendations to improve the quality of follow-on training effectiveness evaluations.

EMPIRICALLY DERIVED RECOMMENDATIONS FOR TRAINING NOVICES USING VIRTUAL WORLDS

2015 I/ITSEC Paper No. 15038

Crystal S. Maraj, Karla A. Badillo-Urquiola, & Sherry L. Ogreten
Institute for Simulation and Training
University of Central Florida
Orlando, FL

Stephanie J. Lackey
Design Interactive, Inc.
Orlando, FL

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

The U.S. Army Training and Doctrine Command’s Army Learning Concept 2015 and Army Training Concept 2025 discuss the requirements for adaptive soldier learning models with flexible training delivery methods. Current Game-Based Virtual Environments (GBVEs) have the ability to provide Military Operations in Urban Terrain (MOUT) training based on the Army’s requirements, but only for small unit operations. Existing GBVEs lack the capability to support large numbers of users in the same environment at one time or allow the users to engage in critical thinking. Virtual World (VW) technology offers viable solutions to flexibility and scalability challenges found in traditional simulation-based MOUT training such as room clearing tasks, as well as demonstrated the ability to impart valuable training for such tasks. Previous research indicates less experienced Soldiers benefit from VW training (Lackey, Salcedo, Matthews, & Maxwell, 2014). The evidence suggests a need to empirically explore the impact of VW training for operationally relevant tasks on inexperienced populations. This paper presents the results from the second study in a multi-year series of VW Training Effectiveness Evaluations (TEE). The present experiment investigates performance outcomes and user perceptions of 64 novice Soldiers (e.g., ROTC Cadets) using traditional and VW training methods for a room clearing task. Results indicate significant Pearson’s product-movement correlation coefficients between the stress-state survey DSSQ and the workload survey NASA-TLX for each training condition and combined training. The survey results offer insight into performance outcomes for the room clearing task. Furthermore, the results reported herein contribute empirically-derived recommendations for the design, development, and implementation of VW training.
USING AUGMENTED REALITY TO TUTOR MILITARY TASKS IN THE WILD

2015 IITSEC Paper No. 15050

Dr. Joseph J. LaViola Jr., Brian M. Williamson, Conner Brooks, Sergiu Veazanchin
University of Central Florida
Orlando, FL

Dr. Robert Sottilare, Pat Garrity
U.S. Army Simulation & Training Technology Center
Orlando, FL

Intelligent Tutoring Systems (ITSs) have been shown to be effective in training a variety of military tasks. However, these systems are often limited to laboratory settings on standard PCs and laptops which focus on exercising cognitive skills (e.g., decision-making and problem solving) and may potentially limit the learning and retention of the dismounted Soldiers and Marines training to master physical tasks. Augmented reality presents the possibility of combining intelligent tutoring with hands-on applications in realistic physical environments. In this paper, we examine the use of an augment-reality based adaptive tutoring system for instruction in the wild, locations where no formal training infrastructure is present, and identify the challenges that arise when developing such a system. We began the transition from desktop tutoring to the wild by exploring an existing real life mockup of a market scene along with low cost commercial-off-the-shelf devices (e.g., HMDs coupled with depth cameras) and a 3D model of the environment. The goal of our scanning approach is to use “human in the loop” 3D scene acquisition via augmented reality so that the scene can be scanned efficiently and with complete coverage. Using this 3D model, intelligent tutoring systems can adaptively manage instruction while being aware of the physical and augmented objects in the scenario. Furthermore, with this awareness of the physical environment, we hope to provide augmented effects and objects (e.g., virtual humans) that register to the physical environment and respond realistically to interactions with the trainee. We also explored developing a training scenario for evaluation of our system that is made to work with emerging low-cost commercial augmented reality devices (e.g., Epson Moverio). Our approach examines the merging of intelligent tutoring with augmented reality to be used for hands-on immersive training of psychomotor tasks in a setting beyond the typical desktop tutoring session.

WEDNESDAY, 2 DECEMBER, 2015 ROOM S320A

T-3 Physician Know Thyself! Enhancing Surgical Team Skills through Gaming and Simulation

0830
Developing Game-Based Leadership Training for Robotic Surgeons (15198)

0915
The Use of Hyper-Realistic Surgical Simulation (15244)

NOTES
DEVELOPING GAME-BASED LEADERSHIP TRAINING FOR ROBOTIC SURGEONS

Roger Smith & Alyssa Tanaka
Florida Hospital Nicholson Center
Celebration, FL

Steve McIlwain & Brad Willson
ARA/Virtual Heroes
Raleigh, NC

All surgeons must simultaneously perform as skilled practitioners and effective team leaders in the operating room. This is further complicated in robotic surgery because the surgeon is removed a short distance from the operating table and works from within a specialized cockpit. This separation creates a unique hurdle when a crisis arises that requires the surgeon to disengage from the immediate steps of the surgery to provide leadership and guidance with issues involving the team, the equipment, the room, or the patient.

To develop and test these skills we initially created a series of scenario-based videos with quizzes to evaluate surgeon understanding of these leadership responsibilities. Using these as a guide, we developed a game-based virtual environment containing the same information as the videos but in a 3D interactive space which is accessible through a web browser. This environment presents accessible and engaging scenarios that include a scoring mechanism which can assess the time to react to events, the actions that occur before and after a decision, and the correctness of the decision made. The tool can also present alternative or repetitive scenarios when the student does not take the correct action. This paper describes the development process and the interactions with the surgeons and operating room teams which drove the design and content of the virtual environment. The paper also describes the longer term plans to determine the return on investment (ROI) of simulation training dollars. With diminishing training dollars, more effective ways to determine ROI and reduce performance anxiety, through intensive immersion training. This innovative medical simulation research may present potential to medical students to a full comprehension of medical issues. This awareness often develops only after firsthand experiences in the clinic. In order to enhance student competence and confidence as well as increase students’ ability to apply knowledge and technical skills prior to commencing third year clinical clerkships, Rocky Vista University College of Osteopathic Medicine (RVUCOM) in Parker, Colorado, has developed an Intensive Surgical Skills Course (ISSC). This immersive short course mimics a General Surgery rotation, and utilizes the Human-Worn, Partial-Task Simulator (also known as the “Cut-Suit”) (Mueller, Moloff, Wedmore, Schoeff, LaPorta, 2012), (Hunt, B; Wall, V; LaPorta, A.J.; Rush, R; Moloff, A; Schoeff, J; Tieman, M; Lea, M; 2012), (Mueller G.; Hunt B.; Wall, V.; Rush, R.; Moloff, A.; Schoeff J.; Wedmore, I.; Schmid, J.; LaPorta, A.J.; 2012). The balance between beneficial stress (induction of enhanced memory and recall performance) and detrimental stress (impairment of memory and learning) may represent a fine line. Measuring the students’ reaction to stressful events before, during, and after realistic education scenarios creates a biomarker profile of the educational event, which then is correlated with the training tasks. This profile, along with other qualitative or quantitative measures such as technical tasks and cognitive knowledge, can be modeled in a simulation that increases the complexity of training without overstressing the individual. This simulation model allows a professor to develop a course that maximizes the habituation and works from within a specialized cockpit. This separation creates a unique hurdle when a crisis arises that requires the surgeon to disengage from the immediate steps of the surgery to provide leadership and guidance with issues involving the team, the equipment, the room, or the patient.

THE USE OF HYPER-REALISTIC SURGICAL SIMULATION

Anthony J. LaPorta, M.D., FACS, Professor of Surgery and Military Medicine, Rocky Vista University School of Medicine
Parker, CO

Mark Lea, M.D., FACS, Associate Professor of Anatomy and Surgery Rocky Vista University

Roy Alon, M.D., PhD, key for Prehospital Care, Wake Forest University, Medical Director of Disaster Services, NC

Michael Czekajlo, M.D., PhD, Director of Simulation, Hunter Administration, Virginia Commonwealth University

Alan Moloff, D.O., MPH, United States Army Retired Special Operations and Aerospace Medicine

Douglas Robinson, MS4, Senior medical student at Rocky States Army

Reginald Franciose, M.D., FACS, Chairman of Trauma

Lawrence Gaul, M.D., FACS, Chief Medical Officer United States

Douglas Granger, Ph.D, Director of Salivary

Tuan Hoang, M.D., FACS, Commander

United States Army

United States Army

Vista University

Surgery at Vail States Ski Team, Arizona State University and Salimetrics, Inc.

Winston-Salem, NC

Valley Medical Center

Vail Valley Medical Center

San Diego, CA

Traditional didactic educational approaches, though necessary to acquire basic biomedical knowledge, often fail to bring medical students to a full comprehension of medical issues. This awareness often develops only after firsthand experiences in the clinic. In order to enhance student competence and confidence as well as increase students’ ability to apply knowledge and technical skills prior to commencing third-year clinical clerkships, Rocky Vista University College of Osteopathic Medicine (RVUCOM) in Parker, Colorado, has developed an Intensive Surgical Skills Course (ISSC). This immersive short course mimics a General Surgery rotation, and utilizes the Human-Worn, Partial-Task Simulator (also known as the "Cut-Suit") (Mueller, Moloff, Wedmore, Schoeff, LaPorta, 2012), (Hunt, B; Wall, V; LaPorta, A.J.; Rush, R; Moloff, A; Schoeff, J; Tieman, M; Lea, M; 2012), (Mueller G.; Hunt B.; Wall, V.; Rush, R.; Moloff, A.; Schoeff J.; Wedmore, I.; Schmid, J.; LaPorta, A.J.; 2012). The balance between beneficial stress (induction of enhanced memory and recall performance) and detrimental stress (impairment of memory and learning) may represent a fine line. Measuring the students’ reaction to stressful events before, during, and after realistic education scenarios creates a biomarker profile of the educational event, which then is correlated with the training tasks. This profile, along with other qualitative or quantitative measures such as technical tasks and cognitive knowledge, can be modeled in a simulation that increases the complexity of training without overstressing the individual. This simulation model allows a professor to develop a course that maximizes the habituation and works from within a specialized cockpit. This separation creates a unique hurdle when a crisis arises that requires the surgeon to disengage from the immediate steps of the surgery to provide leadership and guidance with issues involving the team, the equipment, the room, or the patient.

2015 I/ITSEC Abstracts

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ASSESSING THE EFFECTS OF VIRTUAL EMERGENCY TRAINING ON MINE RESCUE TEAM EFFICACY

2015 I/ITSEC Paper No. 15119

Hoebbel C, Bauerle T, Macdonald B, Mallett L
The National Institute for Occupational Safety and Health
Pittsburgh, PA

To reach trapped miners, underground mine rescue teams might be required to perform a variety of non-routine tasks (e.g., fight fire, pump water, support unsafe roof) as they encounter hazardous and rapidly changing conditions. Due to risks associated with such conditions, underground mine rescue team training has traditionally been performed using live exercises in the form of competitive drills in above-ground facilities or open fields. Oftentimes these contests utilize printed paper placards to represent environmental conditions and have strict rules which were developed for comparative assessment purposes. Although widely used, these contests have undetermined ‘real world’ application, are low fidelity, and have limited documented evidence for effectiveness. Both miners and subject matter experts have emphasized the need for more realistic and engaging training environments to enhance the learning experience of all miners and emergency responders. To this end, the National Institute for Occupational Safety and Health (NIOSH) has developed a fully immersive dynamic virtual training environment for mine emergency responders. During training scenarios, rescue teams approach the problem and perform as they would in “real life” utilizing virtual representative equipment, with success dependent on effective communication and group decision-making. This study represents the first documented empirical attempt at evaluating the effectiveness of virtual reality training for mine rescue teams in the United States, and this paper discusses the utility of such environments for not only delivering realistic and engaging training, but for conducting behavioral research activities. Associations among psychosocial factors such as training climate, team familiarity, and team efficacy are examined and, in general, the study results support findings and recommendations found in the emergency teamwork literature. The results of this effort will add to the research base on mine emergency response training and assessment as well as provide insights into emergency response team behavior.
ALTERNATIVE FRONT END ANALYSIS FOR AUTOMATED COMPLEX SYSTEMS
2015 IITSEC Paper No. 15121

Natalie Drzymala, Tim Buehner
Natim Research
Tallahassee, Florida

M. Glenn Cobb
U.S. Army Research Institute
Fort Benning, Georgia

John Nelson
Engility Corporation
Leavenworth, Kansas

Linda Brent
The ASTA Group, LLC
Pensacola, Florida

A growing body of literature reports that task-based analyses alone are not sufficient for determining training requirements for highly automated, complex systems that rely upon multilevel command and control integration. This has spurred concerns among Army leaders that the traditional Systems Approach to Training (SAT) Front End Analysis (FEA) strategy may not sufficiently identify training requirements for some emerging systems, and provided impetus for our research effort to develop an alternative FEA strategy better suited for these types of systems. The first phase of our effort focused on the research and design of potential alternative FEA strategies. The second phase provided a use case application of an alternative FEA to existing air and missile defense system training to validate and refine the strategy. During the third phase of our effort, we applied the alternative FEA to an emerging integrated air and missile defense architecture. The refined alternative FEA strategy supplements traditional SAT analyses with team-based and expertise-based analyses and was used to successfully identify requirements beyond those found through traditional SAT methods alone.

EVALUATING DISTRIBUTED TEAMS WITH THE TEAM MULTIPLE ERRANDS TEST
2015 IITSEC Paper No. 15264

Jamiahus Walton, Stephen Gilbert, PhD., Eliot Winer, Ph.D.,
Michael Dorneich, Ph.D., Desmond Bonner
Iowa State University
Ames, IA

Modern day teams, whether in the military or civilian workplace, have the ability to achieve goals that are otherwise unobtainable by individuals. The timing and characteristics of feedback that teams receive during training are critical. Though there is a solid foundation of research on optimal feedback, there is limited exploration of what constitutes ideal team feedback including addressing the individual team member versus the whole team and whether that feedback is public (visible to the entire team) or private (visible only to one member of the team).

Previous research that studied the effect of feedback on team performance has yielded slightly different conclusions. For example, research focused on the privacy of feedback suggests that public feedback can have a motivational effect that improves performance. The aim of this work is to discover the most effective combination of the target and privacy of feedback.

To accomplish this goal a modified version of the Multiple Errands Test (MET) was developed to evaluate the performance of three-member teams, the Team MET (TMET). The MET, normally used for evaluating cognitive processing, requires that specific rules be followed while completing multiple tasks within a time constraint. Participants performed the TMET while coordinating purchases in a virtual mall. In each of four timed shopping sessions, participants received feedback on their performance as an individual and team. Feedback was given in one of four conditions: individual private, team private, individual public, and team public. Task performance and rule errors were measured as dependent variables. Results did not yield a broadly significant effect of feedback condition on team or individual performance. However, the study did demonstrate the validity of the TMET as a platform for assessing a team's ability to perform under heavy cognitive load.
### 0830
**Exercise Management Considerations for Live, Virtual, and Constructive (LVC) Training**

(Katherine P. Kaste, Kelly Neville & Melissa Walwanis)  
Naval Air Warfare Center Training Systems Division (NAWCTSD)  
Orlando, FL

As integrated training events evolve to include Live, Virtual, and Constructive (LVC) entities, multiple safety considerations, inside and outside of the cockpit, need to be considered. The current Navy Aviation Simulation Master Plan (NASMP) states, “Safety must be an integral part of planning and execution. Live blue and red platform displays, training mode functionality and training rules must help mitigate safety risks associated with an LVC environment” (NASMP Policy IV). The Office of Naval Research’s (ONR) Science and Technology (S&T) effort, Virtual and Constructive Representations on Live Avionics Displays (VCR LAD), has identified multiple areas through interviews and thematic analysis where LVC has the potential to impact integrated training. In this paper, we focus on implications for training exercise management, including Range Training Officer (RTO) and Range Safety Officer (RSO) activities. There are various areas of concern within training exercise management, including delegation of workload amongst personnel (e.g., RTOs, RSOs) and whether existing interface designs and work support tools can adequately support the conduct and oversight of LVC training. Additionally, new positions may need to be introduced and integrated into the exercise management team. Further, new exercise management practices may need to be adopted. This paper presents initial findings and associated recommendations for exercise management technologies, roles, responsibilities, and practices, as well as, future research needed to determine and evaluate specific solutions to those recommendations.

### 0900
**Integrating Warship Bridge, Combat, and Deck Teams in LVC Environment**

(15191)

### 0930
**Capability Assessment of Test and Live Training Systems for Real Time Casualty Assessment**

(15364)
INTEGRATING WARSHIP BRIDGE, COMBAT, AND DECK TEAMS IN LVC ENVIRONMENT
2015 I/ITSEC Paper No. 15191

Eric Phipps
Engility, Incorporated
San Diego, CA

Richard Gaughen
Camber, Incorporated
San Diego, CA

This paper investigates means to integrate USN surface warship bridge, deck and combat watch teams in a Live, Virtual, Constructive (LVC) training environment. Issue: Currently the US Navy’s LVC distributed training environment (called Fleet Synthetic Training - FST) only incorporates ship’s combat watch teams and squadron staffs, participating from their ships in serious games (i.e., scenarios), but do not include integral decisions and actions made by bridge and deck watch teams. Yet bridge and deck watch teams are an integral part of the combat effectiveness of a ship, especially in the visual environment in which many actions take place. Some examples of required total watch team integration are defense against fast, small boat threats, critical infrastructure/critical asset protection, and vessel Visit, Board, Search and Seizure (VBSS) operations. But in FST the bridge and deck watch teams are role-played by the white cell, muting the team-building required to create a cohesive, effective combat crew, and missing the chain-of-command interactions from gun crews to other ships to the squadron commodore. Means: This paper looks at two possibilities for incorporating bridge and deck teams into scenarios. The first is to use a dedicated bridge training facility integrated into FST. The second is to use virtual reality or augmented reality headsets, worn by watchstanders aboard ship, and integrated into FST. Applications of both approaches are closely examined, including the Office of Naval Research current effort to connect key personnel from the bridge, deck crews and Combat Information Center aboard ship with helicopter crews in a common simulated scenario. Optimal use of both virtual and augmented reality is examined.

CAPABILITY ASSESSMENT OF TEST AND LIVE TRAINING SYSTEMS FOR REAL-TIME CASUALTY ASSESSMENT
2015 I/ITSEC Paper No. 15364

Joan H. Johnston
U.S. Army Research Laboratory (ARL)
Human Research and Engineering Directorate (HRED)
Simulation and Training Technology Center (STTC), Orlando, FL

Margaret D. Nolan
Training Analysis, Design & Evaluation Division
Naval Air Warfare Center, Training Systems Division (NAWCTSD)
Orlando, FL

Jake Caldwell
University of Central Florida (UCF)
Orlando, FL

The Army needs the ability to characterize the effectiveness of test and live training systems to improve realistic training and real-time arbitration of casualties. For years, the Army testing and live training communities have strived to develop a robust Real Time Casualty Assessment (RTCA) capability. Currently, both communities are working closely to develop the ability to characterize the degree to which specific, identified capability upgrades to test and live training systems could improve RTCA. This project leveraged a capabilities based assessment method developed for the USMC Squad Immersive Training Environment (previously published as an I/ITSEC paper- Johnston, Dunfee, et al., 2012). This paper describes the methods and findings of the Systematic Team Assessment of Readiness Training (START) method as it was applied to a use-case of the Bradley Fighting Vehicle (BFV) crew training. A baseline capability assessment of the live training environment for the BFV is described in terms of its ability to support effective live Force-on-Force (FoF) training and RTCA. We describe how the START method was employed to establish environmental attribute (e.g., battlefield effects) capability gaps that are used to prioritize investments in test and live training systems based on the degree to which the investments could improve training and RTCA effectiveness. Using the methodology, quantitative and qualitative data on current testing and training capability was collected. The results of this data collection will be presented in this paper. This is a collaborative effort among the Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI), the Army Test and Evaluation T&E Command, the Naval Air Warfare Center Training Systems Division (NAWCTSD), and the US Army Research Laboratory Human Research and Engineering Directorate (ARL-HRED).
THURSDAY, 3 DECEMBER, 2015 ROOM S320A
T-6 ISR, CRM, TDM, Oh My! – Different Domains, Universal Strategies

1030 Improving Military Crew Resource Management Using a Commercial Strategy Game (15097)
1100 Simulation and Training Challenges for Intelligence, Surveillance and Reconnaissance Analysts (15175)
1130 Effectiveness of Process Level Feedback at Training Tactical Decision Making (15201)

NOTES

IMPROVING MILITARY CREW RESOURCE MANAGEMENT USING A COMMERCIAL STRATEGY GAME
2015 I/ITSEC Paper No. 15097

Christopher Roos, Jelke van der Pal, Ghanshaam Sewnath & Johan Meijer
National Aerospace Laboratory NLR
Amsterdam, The Netherlands

Lt. Col. Michel de Rivecourt
Centre for Man in Aviation CML,
Royal Netherlands Air Force
Soesterberg, The Netherlands

Crew Resource Management (CRM) training has been among the staple diet when addressing Human Factors within military aviation, both in the initial and recurrent training phases. In recurrent training, CRM modules traditionally focus on creating awareness of the role of non-technical skills such as decision making in safe operations. While awareness can be successfully raised by CRM courses, actual change of non-technical behavior is still a challenge. Military aviators often claim it is difficult to implement the theoretical aspects of CRM training in practice. Therefore, a solution is needed where non-technical skills can be applied in a relatively rich way, including team aspects and time pressure, to create situations where human factors issues may be experienced and trained. At the same time, the solution is subject to many constraints: it needs to be short (to fit into a regular CRM training day), cost effective and easy to use.

To address this challenge, the potential of commercial video games was evaluated empirically. Based on the CRM training module, a ‘suitability analysis’ was performed on a range of different commercial video games, decomposing the different game elements of each game. Resulting from the analysis, a training solution using the game “XCOM – Enemy Within” was developed. This training solution was subsequently applied in a CRM training course. Using video recordings, team and individual behavior have been analyzed thoroughly to identify the game’s potential for producing CRM behavior as well as effect on dynamics of group behavior and decision making.

Key training effectiveness evaluation points included depth and variety of challenges posed by the game, trainee potential to implement CRM and instructor possibility to evaluate CRM behaviors. Results indicate the game is effective in developing CRM behavior in trainees and leads to sufficient feedback input for instructors.

Papers are available on the 2015 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 2015 may also be ordered through the www.iitsec.org portal.
SIMULATION AND TRAINING CHALLENGES FOR INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE ANALYSTS
2015 I/ITSEC Paper No. 15175

Lisa Tripp, Elliot Humphrey, Christine Covas-Smith, Jonathan Diemunsch
Air Force Research Laboratory
WPAFB, OH

Mike Garrity, Cullen Jackson, Mike Keeney, Sterling Wiggins
Aptima
Washington, D.C.

Aircrews have leveraged simulation for several decades to immerse themselves in complex mission situations, develop new concepts of operations (CONOPS) and tactics, techniques, and procedures (TTPs) for the next fight, test new capabilities, and develop robust and adaptable mission performance. While the Air Force endorses simulation-based training as a vital need for aircrews, currently there is not an analogous capability available for intelligence analysts. This gap becomes more crucial as we prepare the next generation of analysts for potentially drastically different operational environments where Air Supremacy is not guaranteed, denied environments are the norm, and cyber warfare plays a frightening role. Simulation-based training is needed to prepare analysts for these environments. Although, in general, simulation-based training is thriving across many domains (e.g., flight simulation, driving simulation, shooting simulation), little work has focused on training for Intelligence, Surveillance, and Reconnaissance (ISR) professionals. Requirements for developing a realistic, simulation-based training environment for ISR tasks are distinctive from those required for Aircrews. Simulation of the large variety of information sources is the key. The objective of the current effort was to identify the requirements underlying development of a simulation-based training capability to maximize the efficiency and effectiveness of training for ISR. To tackle this complex problem set, the Air Force Research Laboratory (AFRL) Warfighter Readiness Research Division leveraged Mission Essential Competency analysis in conjunction with cognitive task analysis to identify key requirements for high fidelity, simulation-based training for the ISR. This paper will describe the challenges facing creation of simulation-based training for ISR, work to develop a training capability for these critical warfighters, and our vision for future ISR simulation-based training.

EFFECTIVENESS OF PROCESS LEVEL FEEDBACK AT TRAINING TACTICAL DECISION MAKING
2015 I/ITSEC Paper No. 15201

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

Erica Viklund
Pacific Science and Engineering
San Diego, CA

Decision making is a critical skill throughout all echelons of the military. From command and control to the front line, Warfighters must be trained to quickly and effectively make decisions. Key to the development of effective decision makers is the utilization of targeted learning strategies, designed to improve an individual’s decision making process. One such strategy is process level feedback, which provides information regarding how effectively an individual is utilizing task strategies or performing task sub steps necessary to achieve task goals. Process level feedback can be employed to improve decision making skills by identifying and correcting breakdowns in the decision making process. A process level feedback method to target decision making skills was developed for use in simulation-based training. This feedback method incorporates outcome feedback with process level feedback aimed at decomposing decision making performance into sub-processes using the OODA loop as the theoretical model (Observe, Orient, Decide, Act; Boyd, 1987). Feedback is provided on errors/error patterns across these sub-processes. This feedback strategy was evaluated in a series of experiments conducted both in the laboratory and in the field with Marines. In the laboratory study, participants who were recruited from the community performed tactical decision making tasks in a simulation testbed and either received the process level feedback or a control condition of outcome feedback. A similar study was conducted with experienced Marine Corps squad leaders. Marines at the School of Infantry East received training utilizing either a simulation-based training approach which incorporated this process level feedback method or simulation training with methods traditionally used in the Marine Corps. This paper will describe the process level feedback method, present results of both experimental studies, and discuss implications and lessons learned for implementing this method in a military training setting.
PDF FILES OF THE 2015 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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