

FIGHT'S ON!

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Tactical Digital Holograms Favored Over Conventional 2D Imagery

Tactical digital holograms (TDH) are large-scale 3D static imagery presentations that resemble large sheets of x-ray film and allow 3D visualization of any object, geographic area, or other complexity that can be digitally modeled. TDHs are reflective and must be illuminated for viewing, but the illumination may be from any point light source; no special projectors or light sources (e.g., lasers) are required. A typical TDH is comprised of over 500,000 individual holographic elements (hogels), with each hogel containing up to a million different perspective views. TDHs thus provide full image parallax, e.g., simultaneously correct viewing perspectives for all individuals viewing them.

TDHs have been operationally employed by the Army as mission planning tools for several years, and demand has steadily grown, but initial information on their utility was anecdotal in nature with little or no quantitative data available to evaluate their value. In 2007-2008, 711 HPW/RHA (Mesa Research Site) conducted the first research to begin quantifying the utility of TDHs. The Mesa Research Site centered on close air support mission planning and execution, with specific focus on the joint terminal attack control (JTAC) mission, and was conducted at the 9th Air Support Operations Squadron (the JTAC "school house") at Fort Hood, TX. Due to the Army's previous use of TDHs, 711 HPW/RHA invited the Army Research, Development and Engineering Command's Simulation and Training Technology Center (RDECOM-STTC), located in Orlando, FL, to collaborate. The study utilized written realistic mission scenarios, individual interviews, and structured questionnaires in which

personnel subjectively rated the utility of TDHs and conventional 2D maps of the same area, at the same scale and resolution, for 13 specific tasks using a scale of 1 (poorest) to 10 (best). The results clearly indicated that TDHs can be an effective tool for improving JTAC mission planning and execution tasks. The most frequently cited benefits included determination of relative heights of buildings and other objects, lines of sight and fire, positioning of teams and snipers, and

visual stimuli based on identical sample data sets, subjective utility rating data were collected. A comparative analysis of time and accuracy assessed 2D conventional tools against the 3D TDH capability for mission planning and situational awareness in various mission taskings. Mean results across all tasks consistently favored TDHs over conventional 2D imagery. The data demonstrated that TDHs can improve accuracy and reduce the time required to visually identify tactical

and terrain-related features, compared to using conventional 2D maps and imagery. More recently, RDECOM-STTC and 711 HPW/RHA collaborated to evaluate the effectiveness of TDHs used during mission training exercises conducted at the Joint Multinational Readiness Center at Hohenfels, Germany.

A visual scene of a 3D world is a more intuitive and natural representation than a 2D display, and a single integrated object reduces the need for mental integration of two or three separate representations (Wickens, 1990; & Rossi, et al., 2007). Joint

711 HPW/RHA and RDECOM-STTC research to date indicates that TDH imagery of an area, when compared to conventional 2D imagery of equal resolution and scale, enables people to more rapidly and/or accurately identify subtle terrain profiles, features, potential threats, and obstacles. 711 HPW/RHA is conducting further research to expand and capitalize on the capabilities offered by TDHs in other mission areas and domains.



Representative tactical digital hologram of Urban Area with 3D Height Scale Overlay.

JTAC over-watch locations. Averaged across all tasks, users rated the utility of conventional 2D maps at 5.2, whereas the utility rating for TDHs was 8.2.

Building on 711 HPW/RHA research, RDECOM-STTC subsequently conducted research to collect data quantifying the value of TDH imagery in the performance of certain Army-specific mission scenarios. In May 2009, RDECOM-STTC conducted research on TDH effectiveness at Camp Blanding, FL, in which they invited 711 HPW/RHA to collaborate. The Mesa Research Site contributed significant portions of the experimental protocol. Using

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Gaming and Training: Examining the Learning Potential of Games in Live, Virtual, and Constructive Operations



There is significant interest in the exploitation of online interactive gaming environments for training across a number of applied domains including military operations. A number of multinational research organizations are interested in developing lower cost, high fidelity environments based on games that can be interfaced with other live, virtual, and constructive (LVC) environments for learning. The 711th Human Performance Wing, Human Effectiveness Directorate, Warfighter Readiness Research Division (711 HPW/RHA) is conducting research to explore game-based applications for training.

One goal is to develop and demonstrate a "Family of Complementary Trainers" where game-based environments and training are part of an integrated training "enterprise" that includes games, part-task trainers, deployable simula-

tors, full-mission trainers, and live operational systems. By sharing common technologies, authoring and scenario scripts, metrics, and tools for feedback, the costs for each system and for the entire enterprise can be substantially reduced and each system can be tailored to support training and learning at appropriate levels of fidelity.

A second goal is research activity with a number of universities around the country to establish first-order principles for designing and delivering learning-enabled, game-based scenarios.

Key research questions include: What are the specific and common design features that are critical to training systems? What are the specific and common design features of gaming environments? Which features of gaming environments facilitate or impede their application as training systems and learning environments? What are the essential changes to a candidate gaming environment that must be made to apply it as a training/learning environment? What design recommendations and standards can be developed for future training system and gaming environment development?

The 711 HPW/RHA is also examining the development of an authoring system for adding instructional components to games statistics as well as the develop-

ment of synthetic task environments based on gaming for military and academic experimentation. The 711 HPW/RHA has developed a prototype gaming laboratory to explore these research questions and to enable the Mesa Research Site to leverage game-based approaches to learning to promote readiness. Known as the Game Research Integration for Learning (GRIL) laboratory, the newest testbed includes technology and tools for a variety of commercial, academic, and government collaborators to integrate and evaluate with the research questions and goals.

GRIL is leveraging several Creative Research and Development Agreements (CRADA) to increase both technology and human resources. Two of these collaborators will be highlighted at I/ITSEC 2009: Products from Aptima displaying a Distributed Dynamic Decision making task environment, and L-3 Communications (Bluebox) will be working together through middleware developed in the GRIL. By collaborating with both universities and industry 711HPW/RHA hopes to accelerate the process of developing training options for the warfighter.

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711 HPW/RHA Begins Analysis of Joint Terminal Attack Controller Training Effectiveness

In preparation for our Joint Terminal Attack Controller (JTAC) Warfighter Training Effectiveness Research project, the 711th Human Performance Wing, Human Effectiveness Directorate's Joint Close Air Support (JCAS) team began conducting fidelity studies in the JTAC domes at the Mesa Research Site. The goal of the fidelity study is to define the requirements JTACs will need to maximize the realism of the training received in simulated training events.

During the months of August and September, members of the 13th Air Operations Squadron (ASOS) and 20th ASOS participated in Warfighter Training Research Events (WTRE). Two-man JTAC teams trained on several different scenarios that incorporated their JTAC



20th Air Support Operations Squadron evaluates JTAC performance during September Warfighter Training Exercise. Photo by Bruce Liddil.

specific toolkit items. At the conclusion of WTRE, the teams were given an opportunity to provide feedback to the

researchers on their experiences. Specific questions were asked to determine their opinion on the appropriate level of fidelity, the best mix of live vs. simulated controls for maintaining proficiency, and the best dome configuration (1/2 vs. full dome) for training.

The JCAS team incorporated several changes based on the feedback received and while conclusive data has not yet been received, the initial feedback is positive. The fidelity study will continue through the end of the year, at which time the team will shift the programs focus to JTAC training effectiveness research and training gap analysis.

Lt John Neterer, 711 HPW/RHAE

Experimental Deployable Tactical Training Testbed (X-DTT) Goes to Aviano Air Base, Italy for 18-Month Field Evaluation



Live, Virtual, and Constructive Control System planned for deployment to Aviano AB, Italy by summer 2010. Photo by Bruce Liddil

The 711 HPW/RHA researchers and engineers recently completed the development and testbed evaluation of a less-than-full-physical-fidelity simulation environment for F-16 air-to-air and air-to-ground tactical training. They also completed the development of several new training support, management, and evaluation tools for debriefing and for routinely tracking and assessing performance and proficiency. All of these innovations are being deployed in an integrated package to Aviano AB, Italy for a collaborative Air Force Research Laboratory, Air Combat Command, and United States Air Forces in Europe field evaluation. Research and operational readiness data will be gathered to assess the impact and practical utility of such devices for routine training.

The fielded environment provides researchers, engineers, and operators with a capability to systematically assess the "tradespace" for environment fidelity while, at the same time, providing a robust training capability for operational personnel. In other words, it will be possible to objectively determine "how much of what kind of fidelity is needed to train a given set of tactical tasks?"

We have recently developed, validated, and demonstrated a subjective-rating and objective mission performance data-driven integrated methodology for evaluating simulation environment fidelity. The methodology permits quantifying the impact of different levels of fidelity on training effectiveness and transfer. The process can be used to support a new generation of simulation environment assessment and certification processes where fidelity baselines are established

and compared to expected values to identify gaps. Technical activities to support the study and the deployable trainer concepts leveraged the 711 HPW/RHA pioneering work in the application of versatile module europabus architecture-based simulation environments and extensive training and instructional design research. Researchers and engineers defined and developed a deployable and reconfigurable tactical training environment and tools that support training and after action review along with routine performance measurement and tracking. The 711 HPW/RHA has also demonstrated and validated a capability to rapidly load different operational flight program (OFP) software, tools, databases and models in the deployable trainers while maintaining a reasonable level of tactical and instructional fidelity and validity. This capability to load, run, train, download, load new, run, and train multiple OFPs and related targeting pod models and simulations in the same environment in a very short turn time is crucial to this community as there are OFPs in the F-16 fleet today that represent different capabilities and mission parameters.

The data from this field evaluation will inform several ongoing areas of research including: (a) the application of performance measurement and visualization tools to after action review; (b) the development of a more comprehensive approach to mixing live and virtual training opportunities; (c) evidence-based approach to simulation certification and accreditation for training; (d) the level of fidelity required to train specific training tasks; and (e) assessing the feasibility of tools for routinely tracking performance and proficiency to better

and compared to expected values to identify gaps.

Technical activities to support the study and the deployable trainer concepts leveraged the 711 HPW/RHA pioneering work in the application of versatile module europabus architecture-based simulation environments and extensive training and instructional design research.

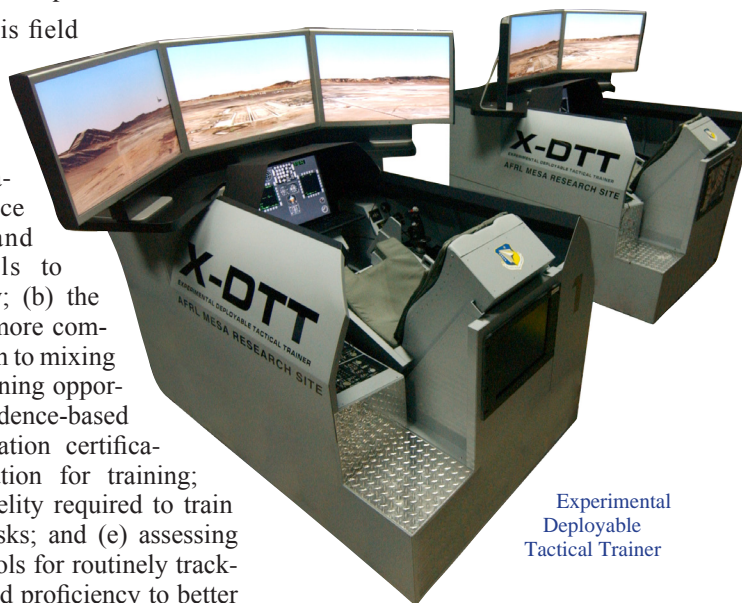
inform squadron.

Finally, as part of an ongoing collaboration with the Naval Air Systems Command in Orlando and the Navy's PMA-205, we have invited our colleagues to participate with us in the evaluations and to use the Aviano deployment as an opportunity to gather data for deployable trainers for Navy and Marine Corps operators. Lessons learned from our development work with the F-16 community is informing our design work for a reconfigurable F-16/F-35 deployable training concepts and environment. The first two-ship will be in the field at Aviano by mid-December. A full four-ship is expected to be in place by summer 2010.

Feedback data from comparative fidelity studies being conducted with the Experimental Deployable Tactical Trainer (X-DTT) and our full fidelity simulations has indicated that a more full field of regard for the X-DTTs would be worthy of exploration. Therefore, we are looking at alternative approaches to increase the field of view for the X-DTTs to provide a more realistic environment for training. The alternatives must be easily sustainable, requiring limited maintenance and alignment so that field support and routine adjustments are not required to maintain good training capability. The 711 HPW/RHA expects to showcase one or more alternatives very soon as part of the continuing program of research.



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Experimental Deployable Tactical Trainer

TARGETS OF OPPORTUNITY

Game-Based Defensive Counter Space Training Exemplar Transitions to Field

The 711th Human Performance Wing, Human Effectiveness Directorate, Warfighter Readiness Research Division (711 HPW/RHA), in collaboration with Sonalysts, Inc. Aptima, Inc., and the USAF Space education, training, and operational communities, recently completed the development and transition of a new gaming and training environment for defensive counter space operations. This effort directly aligns with ongoing 711 HPW/RHA research evaluating how games can best be used to support operational training, rehearsal, and exercise. It also responded to a specific need for effective training in counter space operation and for tools to enable the USAF Space community to examine alternative tactics, techniques, and procedures that will contribute to their ability to detect, identify, track, and locate or disrupt national space asset threats in a flexible and realistic environment. As the costs associated with

high fidelity modeling and simulation-based training continue to skyrocket, there is a substantial opportunity to evaluate games and game-based tools and fidelity for addressing cost and training gaps that exist in the operational Air Force today. Moreover, the USAF Space community in particular and the US space community in general do not have a capability to examine alternative approaches for those types of space operations in a realistic environment. The 711 HPW/RHA developed a gaming environment where specific space operations tasks can be trained and rehearsed in a realistic set of scenarios and simulations. The environment includes object models to simulate interactions between satellites and ground stations plus a capacity for multiple players to participate, providing command and control, tactical, and operational information. The team's solution applies gaming and training system development expertise with

advanced human engineering and performance expertise to demonstrate an innovative and economical training system. Leveraging both commercial gaming engines and tools, along with scenario design and embedded robust individual and team performance measurement, the team developed and evaluated conceptually valid scenarios of sufficient fidelity to support the key operational tasks. It also allowed team researchers to examine and evaluate alternative approaches to instruction and assessment within a robust and commercially viable gaming architecture. This project is transitioning to the space community as a Phase III Small Business Innovation Research effort where additional development work will continue and where a series of controlled field evaluations are planned.



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BRIEFS AND DEBRIEFS

711 HPW/RHA Exercise Recognized by Community of Interest

The 711th Human Performance Wing, Human Effectiveness Directorate, Warfighter Readiness Research Division (711 HPW/RHA) joint Training Research Exercise (T-REX) has been approved by Air Combat Command as a minor exercise for Air and Space Operation Center (AOC) training requirements. T-REX research trials use team level instructional design approaches, creating a performance measurement development research venue for team decision making and kill chain execution.

The trials, while having high research validity, are also designed to provide a realistic and immersive environment for integration and testing of emerging AOC technologies and methodologies. T-REX trials are conducted twice a year. Minor exercise status allows RHA's AOC Training Research team to deconflict with other major and minor exercises and lessens the burden on the experienced AOC Warfighters that are vital to data validation of T-REX. This allows data pooling and trend identification.

Recognizing T-REX as a minor exercise is not only a major win for the research team, but for the operational community as well. It expands the pool of research subjects available, but also provides increased selectivity of appropriate subjects for the training events and research protocols. Although the focus of the event is research, the participants receive excellent training on emerging techniques at the operational level. Participating in our exercise now fulfills the Warfighters' annual requirement to train at one major and three minor exercises.

The more qualified participants possess the expertise required to provide feedback and performance data to be analyzed to answer research questions and to further AOC training research while increasing our operational credibility in this important community. T-REX is reaching the same level of effectiveness as our F-16 research. Like the Viper community, the AOC cadre is recognizing the importance of this exercise and are pushing them-



Observers measure warfighter performance during training research exercise. Photo by Bruce Liddil.

selves and other available command and control experts to return to the 711 HPW/RHA for the next event.

Finally, this accreditation will strengthen the AOC training research and operational stakeholder relationship ensuring that research products are transitioned more rapidly and completely to the communities of interest and practice.



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