FIGHT'S ON!

Published by the Warfighter Readiness Research Division
711th Human Performance Wing / RHA of the Air Force Research Laboratory
Human Effectiveness Directorate

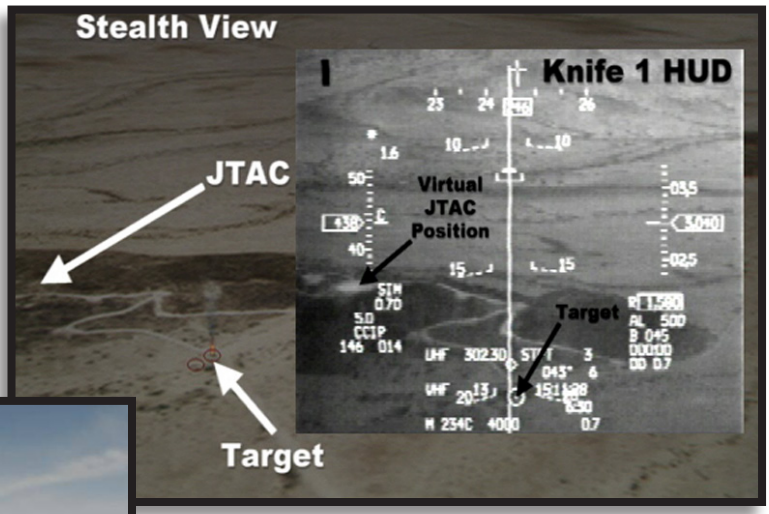
Volume 8, Issue 1
SPRING 2009

Rehearsal Enabling Simulation Technologies Team Contributions

The Air Force Research Laboratory's Warfighter Readiness Research Division is actively engaged to improve Distributed Mission Operations (DMO) visual and sensor simulation database development processes with the Rehearsal Enabling Simulation Technologies (REST) program. Simulation database development is an ever increasing percent of the cost and schedule to create DMO simulation capabilities. Current visual and sensor DMO simulation database creation involves stovepipe development of limited source data into simulation databases lacking in 3D cultural content and without adequate sensor attribution in largely vendor specific and miscorrelated runtime formats. Database generation across DMO is disjointed, miscorrelated, and not able to accept real-time data updates / changes, limiting overall fidelity across the DoD training and rehearsal systems.

Photospecific high resolution visual database of the Joint Terminal Attack Controller target area as viewed from the Joint Terminal Attack Controller position.

The REST program is addressing these capability limitations in five research, development, and integration thrusts. REST established a prototype DMO database generation system to aid evaluation of, and identify improvements to, the end-to-end DMO database generation process supporting all DMO players. Nontraditional data sources are being investigated to increase DMO database content. Open industry standard / de facto standard data storage and transfer formats useful for DMO are being identified, evaluated, and developed as necessary. As part of the common data standards efforts, REST is contributing expertise to and is leveraged by all five ongoing Air Force, Navy, Army, Special Operations Command, and Joint Forces Command data standards initiatives. Automatic, rapid, and accurate capabilities to identify and pop-up 3D cultural content in open industry standard formats are being investigated and integrated. Similarly, capabilities to allow for automated, rapid, accurate, and correlated sensor simulation are being investigated and integrated, also making use of open industry formats. Lastly, capabilities for expanded realtime insertion of information into DMO events, such as real world weather, updated positional information, updated still/video imagery, and change/damage information, will be identified, evaluated, and integrated.



View of the Live F-16 LVC participant, Knife 1, Heads Up Display video of the East Tactical Range target area that correlates with the background Virtual and Constructive visual database.

A robust visual and sensor Western Ranges Dataset (WRDS) was developed by the REST team in AF Common Dataset standard formats usable by all DoD DMO players. The WRDS comes with full DoD-wide Title 50 use rights. Ongoing WRDS enhancements include collection and manipulation of 3D source data of the Nellis AFB area, development of photo-specific 3D cultural content of Mercury, NV, and integration of robust 3D cultural content of the Ft. Irwin area to include the Tiefort City Military Operations in Urban Terrain site. Additional enhancements include a forward looking infrared dataset layer and a small area high resolution material encoded layer/dataset of the Mercury, NV area. Cross Service coordination of REST developmental activities is conducted extensively.

REST hosts biannual status update briefings for the five ongoing service and joint DoD database standards initiatives at both the IMAGE Society Conference and the Interservice/Industry Training Simulation and Education Conference (I/ITSEC). The briefings feature status updates from Air Force's Training Systems Product Group Common Dataset Standard (CDS) initiative, Naval Air Systems Command Portable Source Initiative, Army's Synthetic Environment Core initiative, Special Operations Command's Common Database initiative, and Joint Forces Command's Joint Rapid Scenario Generation effort.

With continued investigations the REST team integrates real

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 2009	**Newsletter**	**01-04-2009 to 30-06-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Fight's On! Newsletter	**FA8650-05-D-6502**
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER **62202F**

6. AUTHOR(S)	5d. PROJECT NUMBER
Gina Cinardo	**1123**
	5e. TASK NUMBER **AS**
	5f. WORK UNIT NUMBER **09**

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Air Force Research Laboratory/RHA,Warfighter Readiness Research Division,6030 South Kent Street,Mesa,AZ,85212-6061	**AFRL; AFRL/RHA**

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
Air Force Research Laboratory/RHA, Warfighter Readiness Research Division, 6030 South Kent Street, Mesa, AZ, 85212-6061	**AFRL; AFRL/RHA**
	11. SPONSOR/MONITOR'S REPORT NUMBER(S) **AFRL-RH-AZ-NL-2009-0001**

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Fight's On! Newsletter, Volume 8, Issue 1, Spring 2009

14. ABSTRACT
Newsletter contains the following articles: Stephens, S., Rehearsal Enabling Simulation Technologies Team Contributions; Rowe, L., Research Explorations: Quantifying Live and Virtual Training Needs for Operational Implementation; Crane, P., Cooperative Research Project Helps Swedish Air Force (SwAF) Prepare for Red Flag; Kleinlein, B., Testbed Upgrade for Helmet-Mounted Cueing System; Symons, S., Dynamic Motion Seat Undergoes Fidelity Assessment and Tactical Enhancement Study; Barrera, K., & Rickard, R., 711 HPW/RHA Technology Incorporated into Boeing Project Alpine II Demo; and Barrera, K., & Neterer, J., USAFE, EUCOM, & PACAF, PACOM Collaboration Update.

15. SUBJECT TERMS
Rehearsal enabling simulation technologies; Teams; Live, virtual, and constructive; LVC; Coalition research; Red Flag; Testbed; Helmet mounted cueing system; Motion seat; Fidelity assessment; Tactical enhancement; Boeing; Project Alpine; Collaboration; Deployable tactical trainers; Simulation; Flight simulation; Training

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Public Release**	**4**	

Research Explorations: Quantifying Live and Virtual Training Needs for Operational Implementation

In July 2008, Air Combat Command (ACC) teamed with the 711th Human Performance Wing to develop a strategy and methodology to determine the appropriate mix of live and virtual training. During a series of three workshops, subject matter experts, field personnel, and researchers collaborated to develop a methodology quickly and effectively to assess training needs. One of the critical components in developing this methodology was keeping the warfighter in the loop.

In order to assess the Warfighters opinion on necessary training, a survey was developed to measure how many live and virtual training events an experienced/inexperienced pilot needs to complete in order to be highly proficient in Air Force required training events. There were also several follow-up subjective questions on the survey, for instance, "If you were part of a team completely redesigning your training program that included live fly and high-fidelity simulation, what decision would you make with regard to the ratio of simulator training to live fly training?"

Over a two-month period, 16 data collectors went to 25 different USAF Bases in the U.S., Italy, Germany, England, Korea, and Japan to collect over 500 surveys from Instructors, Squadron Commanders, and Directors of Operations across 10 different platforms. The data collected indicates that, generally, warfighters would like to train more events in a virtual environment then they presently do and that they need at least the same amount of live training that they are currently receiving. Due to the importance of these results to ACC and the USAF, the reliability of the process was assessed by calculating the internal consistency. Initial findings indicate that the data is highly consistent, for instance the F-15 C/D internal consistency is between .95 and .98 across the eight training events required of this airframe.

This effort provides Warfighter input to assess critical questions within the training community and provides a foundation to examine the possibilities of a proficiency-based training approach. Future analyses will focus on drawing a mission-by-mission picture to gain an understanding of which Ready Aircrew Program missions can effectively be trained in each type of training environment.

Leah Rowe
L-3 Communications
Link Simulation and Training

Cooperative Research Project Helps Swedish Air Force (SwAF) prepare for Red Flag

Fourteen Swedish AF pilots prepared for their nation's first ever participation in a Red Flag-Nellis exercise with help from AFRL in cooperation with the Swedish Defence Research Agency. In May 2008, 711 HPW/RHA with support from the 65th Aggressor Squadron worked with a team from the Swedish Defence Research Agency's (FOI) Air Combat Simulation Center (Flygvapnets Luftstridssimuleringscenter [FLSC]) to conduct a spin-up training research exercise for Swedish AF pilots who would be participating in a Red Flag for the first time. The AFRL-FLSC team developed and conducted scenario-based training designed to improve the Gripen pilots' preparation for the Red Flag environment.

In 2005, the Warfighter Readiness Research Division entered into an International Cooperative R&D Project Arrangement, "International Mission Training Research", with FLSC to apply principles from cognitive and instructional science to enhance warfighters' team and inter-team skills. RHA and FLSC simulator facilities both have multiple fighter cockpits, air battle manager stations, control and observation facilities, and replay and debrief systems.

Preparation for Red-Flag Spin-Up (RFSU) began with the Swedish research team conducting an analysis of SwAF training needs to determine what experiences could be provided at FLSC. Based on their experiences from participating in Red Flag-Alaska 2006, the SwAF team leaders elected to focus training resources not on practicing tactical missions but on Nellis flight control procedures, ground operations, communications protocols, and training rules. Using the principles of structured training, FLSC focused training on these specific tasks by devising scenarios that started on the ground including engine start, taxi, take-off, airspace management, and entry into the gaming area all with appropriate radio communications as these location specific elements were recognized as being new to the pilots. In order to maximize the tactical performance at Red Flag airspace management and familiarization with the gaming area were the focus of the spin-up. A team from Mesa including two researchers, two experienced fighter pilots, and Capt Brandon Abel, an F-15C pilot from the 65th Aggressor Squadron at Nellis arrived at FLSC in June 2008. After receiving extensive briefings from Capt. Abel, three flights of four Gripen simulators each flew several missions over a week with AFRL personnel serving as the Wing Operations Center, ground control, the tower, departure/approach control, range control, and the Air Battle Manager. Simulator flights also included area familiarization and sample missions. Follow-on data collection at Red Flag demonstrated that the simulator training at FLSC was highly effective at enhancing pilot readiness. Gripen pilot Capt Stefan Kaarle who participated in both Red Flag-Alaska 2006 and Red Flag-Nellis 2008 emphatically supported pre-deployment training at FLSC with significant emphasis on local-area procedures training. The feedback from the Red Flag cadre was that the SwAF team performed superbly, having no airspace or training rule violations, excellent ground operations discipline, and outstanding communications discipline throughout the exercise. More importantly Swedish pilots served as mission commanders for three flag missions and the SwAF team was chosen as Combat Search and Rescue operations personnel. Finally, in almost two weeks of flying, the Swedish team was the first, and only one of two teams, to successfully complete the Reconnaissance task which was to locate a mobile trailer erector launch system that was moving in the desert.

The SwAF has been invited back to participate in a Red Flag-Nellis in July 2010 and plans are in progress for RFSU-2 in May 2010. The centerpiece of RFSU-2 will be a link with Mesa's F-16 Distributed Mission Operations Testbed.

The Air Warfare Center at Nellis has expressed serious concerns regarding the preparation of incoming air forces for Red Flag exercises. The AFRL-FLSC training research project concept is being considered as a model for training other nations' Red Flag teams.

Dr. Peter Crane, 711 HPW/RHAS

Testbed upgrade for Helmet mounted cueing system

The Warfighter Readiness Research Division (711 HPW/RHA) recently completed the integration and testing of a Helmet Mounted Cueing System (HMCS) in the high-fidelity F-16 simulators within the Distributed Mission Operations (DMO) Testbed. The HMCS upgrade, funded by Air Combat Command, is an Electro-Optical device that mounts on the pilot's helmet and displays target, threat, weapon, and flight data onto the visor in front of the pilot's right eye helping the pilot to build a three dimensional picture of the battle environment. With the ability to cue sensors and both air-to-ground and air-to-air weapons off bore-sight using the HMCS as the aiming reference, pilots can quickly engage targets of opportunity.

HMCS consisting of a standard HGU-55 helmet with a Display Unit and head tracking sensors. Photo by Bruce Liddil.

DMO Testbed engineers utilized an acoustic head tracker, as opposed to the magnetic system used in the actual aircraft, to track head movement and identify where the pilot is looking. This acoustic system provides high-fidelity tracking at a lower cost and with minimal maintenance. Information from the head tracker is provided to the F-16's Operational Flight Program (OFP) used in the simulator to drive the symbology displayed on the visor.

Helmet mounted in the high-fidelity F-16 cockpit within the DMO Testbed. Photo by Bruce Liddil.

The HMCS video, embedded in an out-the-window display, is recorded during a DMO training research mission and is available during debrief along with each aircraft's cockpit displays, Air Battle Manager display, audio communications, and a "God's Eye" view of the mission.

Screenshot of the mission debrief video showing the key cockpit displays and the pilot's view through the HMCS. Photo by Bruce Liddil.

The addition of the HMCS to the DMO Testbed will allow researchers to establish human performance baselines with the HMCS and compare them to baseline performance without HMCS. Researchers will also baseline the current generation of HMCS in terms of their fidelity and potential simulation artifacts that may impact warfighter training. Once this performance baseline is established it can be used as a point of comparison for other HMCS training solutions and to develop metrics of mission performance driven by HMCS integration and use in tactical training.

Bart Kleinlein, 711 HPW/ Lockheed Martin

"REST Team Contributions" continued from page 1

world time phased weather into DMO events. Current efforts involve integration of real world weather data from the Air Force Combat Climatology Center (AFCCC) into Expert Common Immersive Theatre Environment (XCITE) threat simulations. AFCCC created an experimental real world weather data layer as a part of the REST WRDS and it is available to Government and Industry for analysis, testing, and potential application in DoD simulations. Follow-on efforts will create standard visual and sensor weather effects that correlate across image generation vendor types and with XCITE.

The REST team contributed to the Division's recent Live, Virtual, and Constructive (LVC) technology demonstrations. The team used the REST DMO database generation process to provide highly correlated photospecific simulation databases including fixed and moving models and special effects across multiple image generator platforms. Scenario requirements defined the common geographic bounding box within Arizona's Barry M. Goldwater Range (BMGR) East Tactical Range, the 3D cultural content, and the moving models and special effects required by all LVC demonstration participants. Common source datasets were provided with DoD Title 50 rights and provided to all VC participants for database development. Selective "close-enough" replacements were permitted as required. Acquisition of a recent high resolution color overhead imagery mosaic of the BMGR area ensured that even the live players were highly correlated to the other LVC participants.

The REST team is composed of 711 HPW/RHA government, L-3 Communications Link Simulation and Training and Renaissance Science Corporation. The team continues to provide as needed consultation to numerous individual Air Force and other service simulation programs in the subjects of; data/dataset standards, dataset reuse, the benefits of the REST process, DMO LVC multiplayer considerations, program contract wording content, and multiple image generation platform DMO data-base correlation.

Mr. Steve Stephens, 711 HPW/RHAE

Dynamic Motion Seat Undergoes Fidelity Assessment and Tactical Enhancement Study

How much of what kind of fidelity is important and relevant to the operator? What experiences are enhanced and ultimately what knowledge and skills are impacted with varying levels of fidelity? Is the pilot more immersed in the environment with the addition of different cues to tactical employment of the weapon system? For a given level of immersion from a variety of fidelity options, what learning and performance occurs? These questions and many others are being explored by the 711 HPW/RHA as part of a large-scale fidelity assessment research effort. The research team has partnered with a small business, ACME Worldwide Enterprises, Inc., via a Cooperative Research and Development Agreement, to install their Dynamic Motion Seat (DMS) into one of the research environments. The high fidelity force-cueing seat provides motion cues to the pilot. It also adds inertial cues experienced in the operational system using state-of-the-art solid state technology along with sophisticated mathematical algorithms that match the actions to the operational aircraft flying model in the deployable tactical training device. The DMS delivers vibration and motion cues in five independent axes of control creating unprecedented realism. The DMS can also replicate G-forces as well as gun firing and weapons release. The goal of this partnership is to conduct operationally relevant research that permits quantification of the fidelity-learning-performance tradespace recommendations for enhancing smaller, less expensive fast jet simulation environments for training.

Lt Col Steven Symons, 711 HPW/RHA, and Dr. Winston Bennett, 711 HPW/RHAS

711 HPW/RHA Technology Incorporated into Boeing Project Alpine II Demo

In the most dramatic and realistic example to date of the training potential of Live, Virtual, and Constructive (LVC) Operations, 711 HPW/RHA participated in a Boeing led demonstration on 18 Nov 2008 called Project Alpine II. In the second of a three-part Boeing demonstration program, a software-modified live F-15E aircraft flew three separate tactical scenarios with a virtual F-15E against virtual and constructive air and ground forces. The aircraft was modified to show live, virtual, and constructive data on the radar, the radar warning receiver, the situation (datalink) display, and the targeting pod – all without hardware modification to the aircraft. 711 HPW/RHA subject matter experts supported scenario development, performance data tracking, and reporting specifications for the demo. They also supported integration of the recently graduated, highly successful CAT 1 Advanced Technology Demonstration system, the Warfighter Readiness Assessment and Performance Measurement Tracking System (WRAPMTS). WRAPMTS provided real-time performance data on tactical LVC operations with live aircraft. The successful interoperation with a non-familiar network without code change was a major success in proving the flexibility of the WRAPMTS architecture, and lays the groundwork for performing a similar demonstration led by RHAS at Nellis AFB later in FY-09. The event not only showcased the viability of software modifications to 4th and 5th generation aircraft, but also some very tactical, safe, and money saving solutions to many of the training problems that these aircraft face in the real world.

Ms. Kristen Barrera, 711 HPW/RHAS, and Mr. Robert Rickard, RCG, Inc.

USAFE, EUCOM & PACAF, PACOM Collaboration Update

The proposed Joint Capabilities Technology Demonstration (JCTD) effort with US Air Forces in Europe and the European Command recently shifted to a Global War on Terrorism spiral funding effort. The 711 HPW/RHA has completed the first two of four Experimental Deployable Tactical Trainers (X-DTT) to deploy to Aviano Air Base, Italy. The team has procured the equipment for the Brief-Debrief (BDB) system which ships with the first pair of X-DTTs. Mesa Engineers and subject matter experts are currently integrating the cockpits and BDB system. When the Aviano facilities are ready, the initial capabilities will ship by Military Air, along with a 711 HPW/RHA integration and support team.

In preparation for JCTD collaboration with the Pacific Command (PACOM) and the Pacific Air Force, the MRS team is evaluating technical options for a dome which will provide high fidelity and fused reality training capabilities, including helicopter operations for PACOM Search and Rescue forces. Para Rescue Personnel and Combat Rescue Officers from Davis-Monthan Air Force Base will visit MRS later this month to discuss design concepts and requirements.

Ms. Kristen Barrera, 711 HPW/RHAS, and 2Lt John Neterer, 711 HPW/RHAE

Fight's On! is published by the Warfighter Readiness Research Division
711th Human Performance Wing / RHA of the Air Force Research Laboratory Human Effectiveness Directorate
6030 S. Kent Street, Mesa, AZ 85212-6061.
Fight's On! Point of Contact:
Ms. Gina Cinardo, 480-988-6561 x 589, DSN 474-6589 and e-mail gina.cinardo@mesa.afmc.af.mil
PA Approval No. 88ABW-2009-1777