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Rehearsal Enabling Simulation Technologies

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14. ABSTRACT
The Air Force Research Laboratory's Warfighter Readiness Research Division continues to be 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 stovepiped 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 realtime data updates / changes, limiting overall fidelity across the DOD training and rehearsal systems. The REST program addressed these capability limitations in five research, development, and integration thrusts.

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Background:

The Air Force Research Laboratory's Warfighter Readiness Research Division continues to be 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 stovepiped 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 realtime data updates / changes, limiting overall fidelity across the DOD training and rehearsal systems.

The REST program addressed these capability limitations in five research, development, and integration thrusts. First, REST established a prototype DMO database generation and modification system to aid evaluation of, and identify improvements to, the end-to-end DMO database generation process supporting all DMO players. Second, open industry standard / defacto standard data storage and transfer formats useful for DMO were identified, evaluated, and developed as necessary. As part of the common data standards efforts, REST contributed expertise to and was leveraged by all five ongoing Air Force (AF), Navy, Army, Special Operations Command, and Joint Forces Command data standards initiatives. Third, automatic, rapid, and accurate capabilities to identify and generate cultural content in open industry standard formats were investigated and integrated. Similarly, fourth, capabilities to allow for automated, rapid, accurate, and correlated sensor simulation were 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 time phased weather, updated positional information, updated still / video imagery, and change / damage information, were identified, evaluated, and integrated as practical. This is the final Technical Report documenting the progress from 01 Aug 09 through 28 Feb 11 accomplished for the 6.2 Work Unit for the REST program.

Progress on the five main REST thrusts:

The Process: The REST program defined the REST DMO Database Process to establish a proposed optimum approach to Air Force training system acquisitions requiring DMO capable simulator visual or sensor databases. This process involves the use of expanded traditional and evolving nontraditional source data types and formats as input to develop DMO databases with improved resolution and content. Toolsets capable of manipulating both traditional and nontraditional data were investigated to best support rapid development of robust correlated visual and sensor DMO databases. As a critical part of the REST DMO Database Process, datasets are captured in commonly used industry standard storage and transfer formats and are archived in a DOD repository with DOD Title 50 use / reuse rights at the point where approximately 80% of the work has been accomplished. The use of industry standard formats makes the datasets usable for any DMO database developer. The industry standard use / reuse formats are described later in this report. The archived datasets are then available to other DOD simulation training and rehearsal programs as a starting point to save resources and enhance correlation. The other programs then make use of the archived datasets to meet or partially meet their own program specific requirements and enhance the datasets appropriately to meet their individual program objectives. Enhancements are then recaptured and rearchived, allowing for a continuously growing and improving collection of DMO datasets. A subset of this REST DMO Database Process was used in the development of highly successful Live, Virtual, Constructive technology demonstrations. In addition, AF DMO training systems acquisitions are beginning to use the REST DMO Database Process and are showing a positive return on investment. Figure 1 shows a highly simplified REST DMO Database Process.

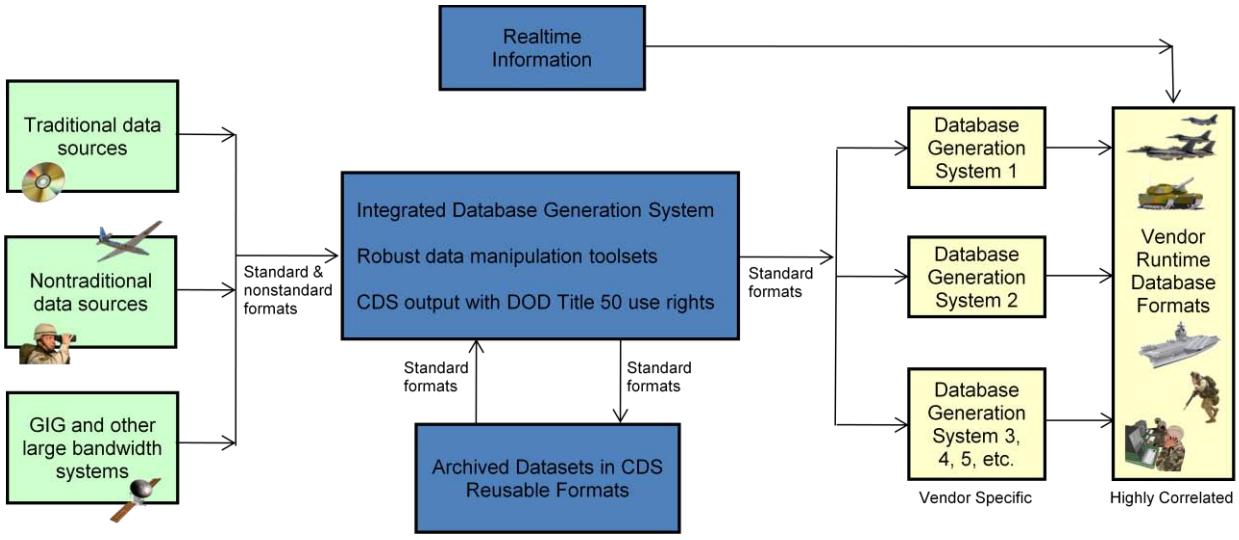

Figure 1. The REST DMO Database Process, simplest version.

Standards: Data storage and transfer formats are the glue for the REST DMO Database Process. REST was instrumental in the conception, development, and implementation of the AF Training Systems Product Group's (TSPG) Air Force Common Dataset (AFCD) standard, now in use in AF training system acquisitions, which follows the REST DMO Database Process, and captures value added source data at the point where approximately 80% of the work has been done in open industry standard storage and transfer formats with DOD Title 50 use / reuse formats. The entire DMO vendor base already uses and is comfortable with the established AFCD open industry standard formats. The REST team continuously promoted open data standards use for DMO dataset use, reuse, and correlation. In addition, REST is the only program in the DOD that participated in and contributed to the other four ongoing service, command, and joint DOD database standards initiatives. The Navy's NAVAIR Portable Source Initiative (NPSI) served as the blueprint for the AFCD and therefore the AFCD closely resembles NPSI. REST has also maintained close participating relationships with Army's Synthetic Environment Core (SE Core), Special Operations Command's Common Database (CDB), and Joint Forces Command's Joint Rapid Scenario Generation (JSRG) and Rapid Data Generation (RDG) initiatives. All of these initiatives use the same in-process industry standard storage and transfer formats which have allowed for much interservice / command / joint dataset sharing with associated resource savings and enhanced correlation. The use of AFCD formats, and therefore the related standards other service / command / joint initiative's formats, is now the established approach for DOD wide dataset / database reuse and correlation. International acceptance of the AFCD approach to dataset / database reuse and correlation is expanding.

The REST team was requested to represent the Air Force in a DMO Database Standards Special Event during the Simulation Interoperability Standards Organization (SISO)'s Simulation Interoperability Workshop in the fall of 2009. This Special Event resulted in the stand-up of the SISO Reuse and Interoperation of Environmental Data and Processes Study Group, or the RIEDP-SG. The proposed RIEDP approach is based on the REST DMO database process and the simplicity of the AFCD. Steve Stephens serves as co-chairman of this SISO SG. The RIEDP-SG collected detailed data format and process information from all service and command initiatives as well as several coalition partners. If all goes as planned, the RIEDP-SG will evolve into a SISO Product Development Group that will eventually establish an IEEE standard and a Standing North American Treaty Organization Agreement, a STANAG.

3D Cultural Features: The REST DMO Database Process includes the use of enhanced data manipulation toolsets that provide robust 3D cultural feature identification and pop up into an easily usable / reusable AFCD format. Numerous source data types have been investigated for this purpose to include single overhead images, stereo pairs overhead images, light imaging and ranging (LIDAR), interferometric synthetic aperture radar (IFSAR), space based imagery manipulation, and ground based data collection involving laser rangefinders and differential

global positioning systems (GPS). Methods now exist to use a single overhead image and, assuming an illumination angle, identify 3D cultural features by capturing cast shadows and then automatically pop up 3D models. The stereo pairs technology to pop up 3D cultural features is fairly mature and less expensive options using this general approach are being investigated. LIDAR point clouds can be interpreted to identify edges and corners that can then be assumed to define 3D cultural features and then be developed into 3D models. This capability was integrated into the REST DMO Database Process. IFSAR can similarly be interpreted into 3D cultural feature models, but suffers from the fact that data collection is typically taken from a long distance and therefore suffers from resolution and accuracy of the resulting 3D models. But, this option might be the best option available for covering geographic areas having denied access. Methods exist to use data collected from space based assets to develop 3D cultural models. But, this method also suffers from being dependent on the available resolution of the collected source data, which typically results in 3D models usable for viewing only from a long distance in DMO simulation. Technologies are evolving and are being investigated to use ground based data collection systems with a combination of laser rangefinders and differential GPS to collect highly positionally accurate point ant point cloud data which can then be transformed into 3D models usable for DMO database generation and modification. These investigations into technologies for improved 3D cultural content will continue under follow-on efforts.

Sensors: Sensor attribution continues to be problematic. Two general approaches to sensor database attribution were investigated by the REST team. One approach involves the material encoding of individual image texture elements (texels). This approach continues to be challenging due to technical limitations on identification of high resolution material mixes of individual texels over large geographic areas. The second approach involves the development of individual dataset image mosaic layers representing individual spectral responses. This approach limits the resulting dataset layer to only the conditions represented at the time of data collection combined with whatever data manipulation was required to optimize the result for consistency or artistic reasons. In either approach, the spatial resolution of the sensor associated source data is typically orders of magnitudes courser than the visual database source data of the same geographic area. For example, an area of a DMO database with 40 centimeter spatial resolution color overhead imagery coverage might have only a 15 meter spatial resolution sensor attribution dataset layer to, hopefully, correlate adequately with.

Realtime Insertion of Information: Realtime insertion of information into DMO investigation has begun. The incorporation of real world time phased weather data was the most investigated option to date. Correlated weather effects across DMO continue to be beyond the current capabilities. Another realtime option being investigated is the use of damage servers across DMO. As an example of what is being investigated, it should be routinely possible to allow for a DMO participant to drop a specific type of bomb with a specific fusing into a second story window of a 3D cultural building feature within numerous correlated multivendor image generator DMO databases and have the bomb crash through the building and explode, say, near ground level with resulting realistic and correlated damaged results to the building and the ground / terrain, to include rubble, across all participating DMO players. Yet another realtime option being investigated is realtime / near realtime imagery insertion into DMO. The imagery can be individual stills or video and should be acceptable from ground, air, and / or space based platforms. Also, realtime updating of terrain and cultural feature positional information is being investigated to allow for on-the-fly improvements to positional accuracy across DMO of selected items of interest. This capability should allow for Warfighters from anywhere around the world to provide realtime updated positional information (nearly) immediately usable across DMO for realtime / near realtime updating of multiple DMO databases.

Related Progress:

REST Western Ranges Dataset: A robust visual and sensor 22 geocell Western Ranges Dataset (WRDS) was developed by the REST team in AFCD formats usable by all DOD DMO players for evaluation and operational DMO training systems use. The WRDS comes with full DOD-wide Title 50 use /reuse rights. The WRDS has an overhead imagery mosaic that includes a five meter spatial resolution colorized background with large areas featuring one meter, 60 centimeter (cm), and two foot spatial resolution inset areas. Of note, the entire Nellis Gunnery Range Complex's Red Flag live drop area and Fallon Naval Air Station Range B-21 areas are covered with 60 cm spatial resolution imagery. Other high resolution area coverage includes; Nellis AFB, Creech AFB, Edwards AFB, Fort Irwin, China Lake Naval Air Station, and the cities of Mercury, NV and Palmdale, CA. In addition to National Geospatial-Intelligence Agency (NGA) Digital Terrain Elevation Data (DTED) coverage, the WRDS

includes 30 and 10 meter spacing digital elevation models. A night vision goggle image mosaic is included. 3D culture is generally lacking due to the wishes of the Warfighter customer funding source, but includes the major 3D cultural features of Mercury, NV. The originally delivered 3D model dataset of Mercury is currently being upgraded to be highly accurate with photospecific sides. A robust 3D cultural dataset of the Fort Irwin area, to include the Tiefort City military operations in urban terrain site, with associated additional high resolution ground imagery was procured with DOD Title 50 rights and was integrated into the WRDS. A vector dataset layer is registered to the imagery mosaic in the Mercury area. In addition to these AFCD formatted dataset layers, the WRDS includes additional experimental dataset layers available for evaluation by other programs. These experimental layers include a cultural cast lighting irradiance mosaic, a horizon mapping layer allowing for realtime cast shadows, and real world time phased weather. Multiple dataset layer combinations are possible. A forward looking infrared dataset layer is in development. A high spatial resolution Mercury area (only) material encoded dataset layer was also integrated into the WRDS. An updated imagery mosaic covering a 1x1 degree area of the Nellis ranges with one meter spatial resolution and correlated one meter resolution material encoding was integrated for Red Flag as well. Under follow-on efforts, a high fidelity 3D cultural dataset of the Nellis AFB area will be integrated into the WRDS. During the summer of 2008, Nellis AFB ground level imagery was collected from both sides of the "red line" for the purpose of developing high fidelity 3D cultural features for integration into the WRDS.

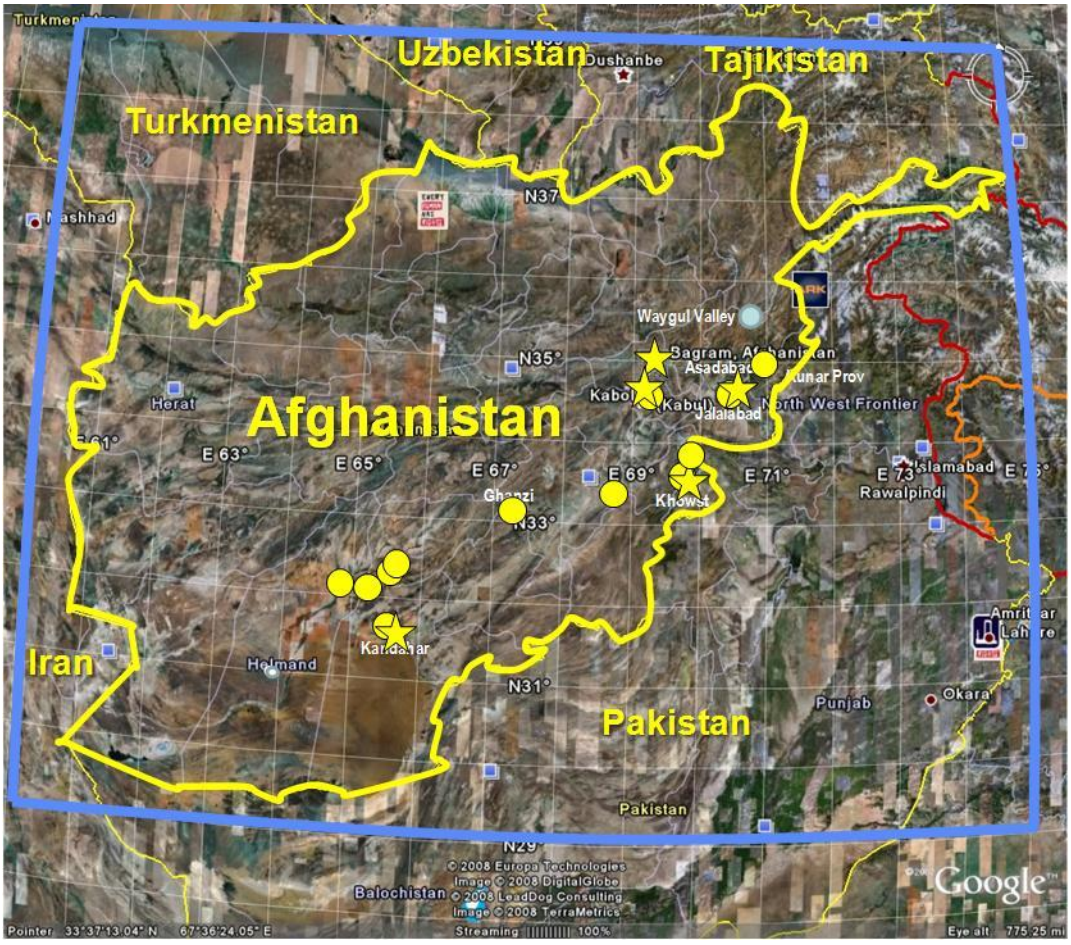

Figure 2. The blue box represents the border of the Afghanistan dataset. Yellow stars and circles are hand-modeled airfields and high-resolution areas.

Afghanistan Dataset: A high fidelity visual and sensor dataset of Afghanistan is also being collaboratively produced with NAVAIR in AFCD formats, with DoD Title 50 rights for use across all DoD programs. This dataset uses a 10m elevation model, with 2.5m imagery throughout Afghanistan and 60cm imagery within 5-10 nautical miles of airfields and other high-resolution areas. Hand-modeled airfields are being incorporated for Bagram, Jalalabad, Kabul, Kandahar, and Khowst. There are also hand-modeled high-resolution areas including Asadabad, Peywar Pass, Ghanzi, Kandahar City, Kabul City, Jalalabad City, Khowst City, Tirin Kot, Farah, Kajaki Sofla, Musa Qala, and Sangin. The dataset will include models and data reused from Army, Special Operations Command (SOCOM), Air Force (AF), U.S. Marine Corps/Navy (USMC/USN), and United Kingdom Ministry of Defence (UK MoD) programs, resulting in tremendous savings in both time and money. The dataset includes a material classification layer for sensors. This dataset is to be delivered in March 2011. Figure 2 describes the areas covered by this dataset.

Alaska Dataset: A high fidelity Alaska dataset is also being developed. It will be available in AFCD formats, with DoD Title 50 rights for use across all DoD programs. 3D airfield content is to be reused from AF programs, and models from the Army SE Core will be used. This dataset is being developed by Renaissance Sciences Corporation (RSC) in collaboration with Elmendorf Civil Engineering, Joint Pacific Area Range Complex (JPARC) management, the Army CH-47F simulation program, NAVAIR, and the Air Force F-22 simulation program. It will contain 15m imagery, with hi-resolution areas containing <1m imagery, and 5m imagery within 25 nautical miles of the hi-res areas. The high-res areas include numerous targets in JPARC ranges, Fairbanks IAP, Allen AAF, Anchorage IAP, Eielson AFB, Ft. Wainwright, and Elmendorf AFB. This dataset is to be delivered in May 2011. Figure 3 describes the areas covered by this dataset.

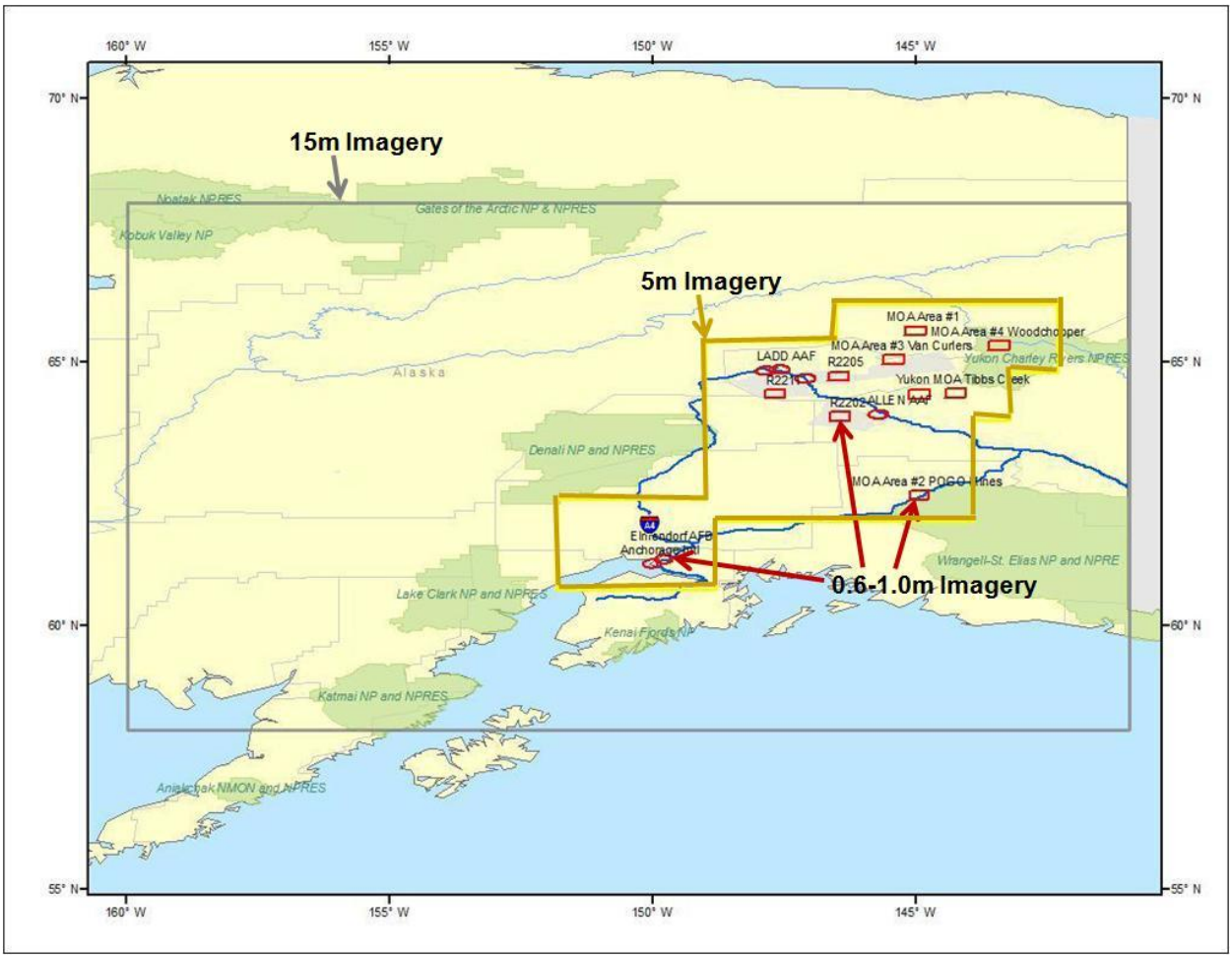

Figure 3. The areas covered by the Alaska dataset.

Biannual DOD Database Standards Initiatives Briefings: The REST team hosted or assisted the hosting of biannual status update briefings for the five ongoing service, command, 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 AFCD, NPSI, SE Core, CDB, and JSRG/RDG initiatives.

OpenFlight Users Group Meetings: Once the defacto standard OpenFlight format was chosen to be a major part of the AFCD and other related service / command database standards initiatives, the Presagis company decided, with REST team encouragement, to start hosting semiannual OpenFlight Users Group meetings. Presagis owns the OpenFlight standard and sees an expanding opportunity to improve the standard for improved performance DMO simulation applications and as an opportunity to attract additional users / customers. The OpenFlight Users Group meetings continue.

Real World Time Phased Weather: As part of the continuing investigations of integration of real world time phased weather into DMO events, the REST team initiated a program to integrate 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 time phased weather data layer as a part of the REST WRDS and it is available to government and industry working DOD programs 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.

Live, Virtual, Constructive Technology Demonstration Support: The REST team contributed to the Division's recent Live, Virtual, and Constructive (LVC) technology demonstrations. The team used a subset of the REST DMO Database Process to provide highly correlated photospecific simulation databases including fixed and moving models and special effects across multiple image generator platforms. The LVC technology participants have included a two-ship of Live F-16Cs from Luke AFB interacting with the Virtual and Constructive participants via Link 16, T-1, and Distributed Interactive Simulation network protocols. Virtual participants have included; a two or four-ship of Multi Task Trainer F-16Cs from the RHA's DMO Testbed in Mesa, AZ, two F-16C Deployable Tactics Trainer simulators on the show floor, a Joint Terminal Attack Controller (JTAC) simulation on the show floors, and a "stealth" station located on the show floor. Constructive participants included numerous red and blue air and ground players. Image generation systems used included Aechelon Technologies, MetaVR, SDS International, and Mak Technologies. Scenario requirements defined the common geographic bounding box within Arizona's Barry M. Goldwater Range (BMGR) East Tactical (ETAC) Gunnery Range, the 3D cultural content, and the moving models and special effects required by all Virtual and Constructive demonstration participants. Limited Distribution NGA DTED, an AFCD format, was acquired for the BMGR. A 40 cm natural color imagery mosaic dataset of the BMGR was acquired in AFCD GeoTiff format with DOD Title 50 use rights. Fixed and moving models and special effects required for the LVC technology demonstration were collected in with DOD Title 50 use rights in AFCD OpenFlight format. Selective "close enough" replacements were permitted as required. These common source datasets were provided to the Virtual and Constructive LVC participants for their vendor specific database development. The resulting simulation databases were highly correlated, allowing for fully successful Air Force Association and I/ITSEC LVC technology demonstrations. The acquisition of the "recently" collected high resolution color overhead imagery mosaic of the BMGR area ensured that even the live players were highly correlated to the other LVC participants. Figure 4 shows the database of the BMGR LVC area as viewed from the Virtual JTAC position. Figure 5 illustrates how the Virtual database correlates highly with a Live participant's view.

Figure 4. Photospecific high resolution visual database of the ETAC main airfield target complex as viewed from the Virtual JTAC position for LVC.

REST also successfully produced correlated databases for technology demonstrations at I/ITSEC 2010. These demonstrations took place between virtual players in the Air Force booth and long haul networked with the Swedish Air Force. By using the REST DMO Database Process, the team was able to create a dataset in reusable AFCD formats, which was then converted into correlated databases in the various required runtime formats, including MetaVR, OpenFlight, and the gaming format VBS2. The dataset was also supplied to other vendors, who created databases in Xplane, Crysis, and L-3 BlueBox formats which also highly correlated. The dataset was created by reusing archived 5m, 1m, and 60cm imagery mosaics, a 10m elevation model, and dozens of 3D models supplied by the Army's SE Core and the UK MoD in AFCD OpenFlight format. The REST team also modified over a dozen OpenFlight moving models supplied by the Army's SE Core which were used in the demonstration. Hundreds of spectators at I/ITSEC were able to view these seemingly identical databases in several different DMO image generation systems and runtime formats.

Mercury 3D Cultural Feature Development: The REST team expanded the development of a 3D cultural feature model dataset of the Mercury, NV area. The REST team travelled to Mercury in late 2007 to take high resolution digital photos of 3D cultural features. These photos were used to create high fidelity, photospecific 3D building models for use in air and ground simulation. Because all of the photos were taken from the ground, modeling the rooftops was somewhat difficult. Also, getting the dimensions of the buildings was difficult since we only had the building center points and not footprints.

Geobase Evaluation: Related to the 3D cultural feature development for DMO, the REST team investigated the Geobase program. The Geobase program is in the process of capturing CE and security data in geospatial information system formats of all major worldwide DOD installations. This data should prove invaluable for DMO database development and modification. Most Geobase associated interaction has so far been with the Nellis AFB CE team.

Metadata Investigation: Management of very large amounts of data / datasets was also investigated by the REST program. The general approach was to leverage the continuously maturing data management toolset and metadata standard developed from the NPSI program, which is called the Geospatial Data Management System (GDMS). This data management and metadata approach is based on the extensible markup language, commonly

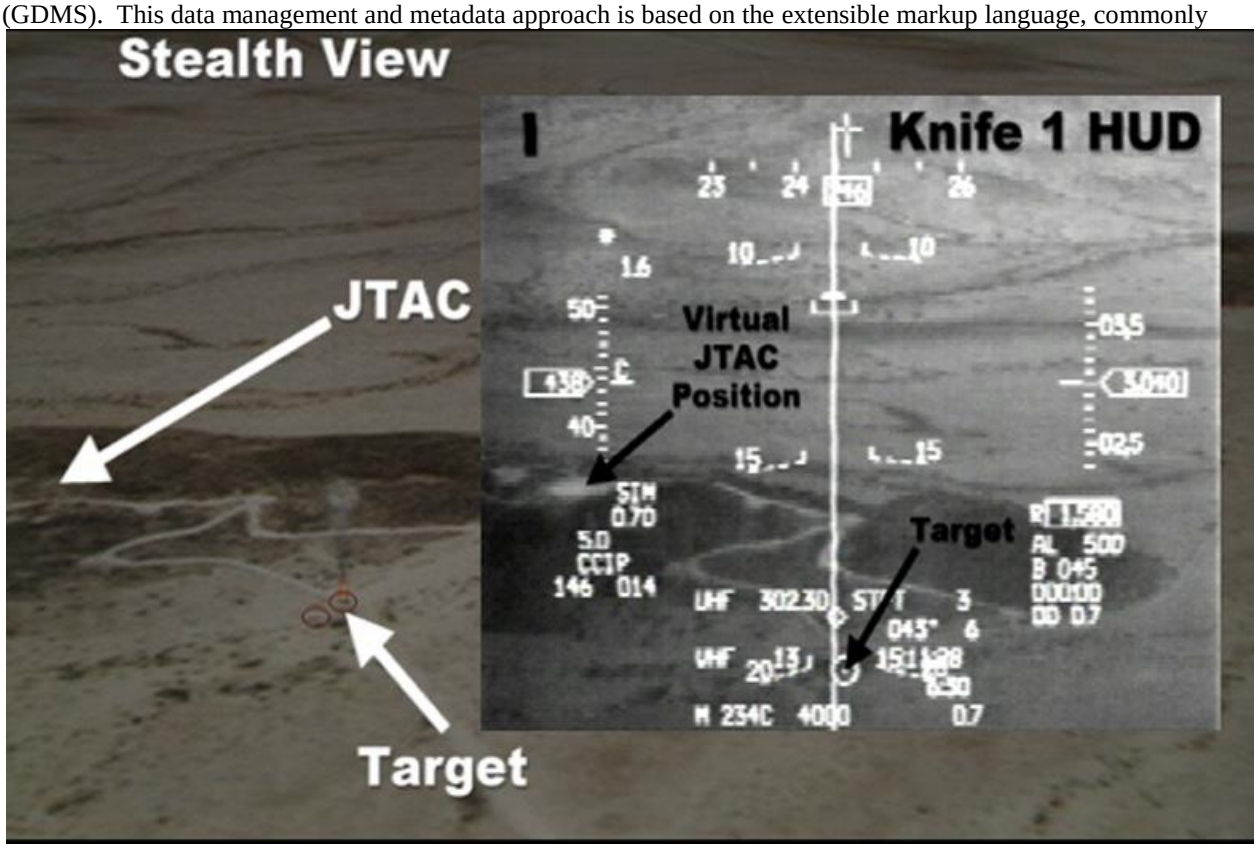

Figure 5. View of the Live F-16 participant, Knife 1, Heads Up Display video (inset) of the ETAC target area that correlates with the background Virtual and Constructive visual database.

known as "XML" data schema. The REST team has acquired copies of the GDMS for continuing evaluation, upgrade to include optimization for Air Force applications, and potential integration into the AFCD.

Database Sharing: The REST team supported an Air Combat Command (ACC) sponsored DMO Database Sharing Meeting on 13 Nov 08. This meeting was attended by most ongoing ACC and Air Mobility Command programs and by all major image generation and database DMO industry. The benefits of the REST DMO Database Process and especially the use of AFCD formats to capture, archive, and redistribute datasets gained momentum during this meeting. Notable was the announcement that the B-1 program intended to purchase a robust one meter spatial resolution imagery mosaic covering the continental United States (CONUS) in AFCD format with full DOD Title 50 reuse rights, which happened thereafter. This purchase alone will greatly aid database development for all follow on DOD DMO databases requiring CONUS geographic coverage at no additional cost.

The REST team supported the Simulator Database Facility (SDBF) at Kirtland AFB. The SDBF serves as the repository and dataset redistribution center for Air Force and other service simulator training system programs. The

REST team made all of its data available to the SDBF, as well as ensuring that other DoD simulation programs are aware of the purpose and importance of the SDBF. REST also facilitated transitioning the GDMS mentioned previously to the SDBF in order to help them manage the very large amounts of data that they have stored.

The REST team also visited the Army Synthetic Environment (SE) Core program to discuss sharing of data and technology. SE Core specifically requested REST team consultation to achieve their desire to change the current SE Core business model to include, as an additional SE Core program standard product, AFCD and NPSI formatted datasets. SE Core also wants to set up, with REST team assistance, a process to supply their already substantial dataset assets to the other services and to coalition partners. These changes to the SE Core business model have been a strong suggestion from the REST team since 2009. SE Core has supplied the REST team with over 500 high fidelity multiple level-of-detail visual/infrared 3D models and the extensive associated texture library, as well as nearly 70 data manipulation, quality control, and management toolsets developed by SE Core. These datasets and toolsets are conservatively valued at three to five million dollars, a substantial positive impact to REST team capabilities. As well as reusing these datasets at RHA, the REST team has copied them to the SDBF at Kirtland AFB for continuing reuse by other DOD training system simulation programs, thus providing cascading high dollar savings with improved fidelity DMO databases requiring less individual program resources, as well as providing enhanced DMO correlation across program databases. Additional SE Core dataset sharing with other service, national, and coalition DMO training system programs will provide additional multiples of positive impact. This REST team supported SE Core business model improvement will provide a major positive impact on national and international DMO database standards initiative interactions, database asset reuse, DMO event database correlation, and the reduction of the currently substantial duplication of DMO database development efforts.

Office of the Secretary of Defense Support: The REST team provided support for an Office of the Secretary of Defense study of ongoing successful initiatives for simulation database correlation and reuse. The REST team highlighted the AFCD and associated other service / command / joint initiatives as current operational example programs that have shown and continue to show success.

NGA Specifications and Potential Metadata Support: Input was provided by the REST team to the NGA concerning their potential future data specifications. In addition, the REST team is working with NGA and the NPSI team to have NGA include NPSI, AFCD, SE Core, and CDB metadata on their website. NGA is particularly interested in including 3D models metadata on their site, which has not been accomplished previously. REST has also conducted a study whose purpose was to enhance the capabilities of Air Force training system programs through increased use of refined NGA vector mapping data products for culture features in spatial databases. This was accomplished by interviewing many experienced Air Force personnel to find out the strengths and weaknesses of NGA culture feature data and finding ways to improve it.

Joint Photographic Experts Group 2000 Specification Support: The REST team provided input to both the Joint Photographic Experts Group, commonly known as JPEG, in their evaluations of potential format upgrades to the JPEG 2000 and GeoTiff specifications. Such upgrades will have an effect, hopefully a positive effect, on the AFCD.

Support to Numerous DMO Programs: In the course of promoting the REST DMO Database Process, the advantages of using the AFCD, and data / dataset reuse and correlation, the REST team has been and is in a unique position to support numerous DOD training system acquisition programs. A partial list of programs supported include; Airborne Warning and Control System, A-10, B-1, B-2, B-52, C-17, C-130, F-16, F-22, F-35, numerous SOCOM aircraft, numerous Navy aircraft, likely some Army aircraft, and multiple semi automated forces platforms as well as continuing support and data / dataset population of the SDBF at Kirtland AFB.

International Event Support: In addition to supporting numerous national training events and technology demonstrations, the REST team has provided support to international training events and technology demonstrations to include; Coalition Mission Training Research (CMTR) Exercise Condor Capture, CMTR exercise Red Skies, and CMTR exercise Battle Buzzard. The previously mentioned I/ITSEC 2010 technology demonstration featured long haul networked interaction with Sweden, allowing their JAS 37 aircraft training systems to participate. The RIEDP-SG will enable much expanded international correlated DMO events.

Pop-Up Support: The REST team occasionally supported various Division and higher level pop up efforts such as day and night aircraft accident investigations and area familiarization initiatives.

Published Work: The REST team produced several publications concerning the DMO database generation process. The REST program was the feature article for the Division's Fall 09 Fight's On! The REST team contributed a paper and presentation to the 2009 IMAGE Society Conference titled, "A Method to Compensate for Display System Contrast Ratio Differences in Distributed Simulation." This presentation was specifically identified by an editor representing the Armed Forces Journal (AFJ) as being the best presentation at IMAGE 09. This IMAGE paper was republished in its entirety in the Training & Simulation Journal. In addition, the REST team presented at the Fall 09 Simulation Interoperability Standards Organization conference in Sep 09. The presentation included a description of the REST program, an explanation of the REST WRDS, REST support for LVC, and a description of the AFCD initiative along with a declaration that this is now the established method for DOD to best accomplish DMO dataset reuse and correlation. The REST team contributed a paper entitled "The Emerging DoD Requirement for More Realistic Weather in Flight Simulation" to the 2010 IMAGE Society Conference. The REST team also contributed words and bullets to numerous other publications and briefings. An interim report on the REST program was submitted in February 2010. The REST team received by-name requests to present at the International Training Equipment Conference in both 2010 and 2011.

REST Team Composition: The REST team is composed of 711 HPW/RHA government, L-3 Communications Link Simulation and Training, and Renaissance Science Corporation. The team provided 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 database correlation.

REST Program Collaborations: The REST program was leveraged by numerous program collaborations. The AFRL/RYJM Leafcutter program is investigating small lightweight LIDAR collection systems on small UAVs that could serve as additional nontraditional source data for DMO database generation and modification. The Data Integration Tools program leveraged the military aspects of the REST program for integrated military and civilian emergency fire, medical, and law enforcement responders and managers for Homeland Security applications. The Army Research, Development, and Engineering Command's Rapid Unified Generation of Urban Databases program is investigating and developing robust capabilities for urban database development that closely correlates with REST goals. The Army Geospatial Center's Buckeye program collects high resolution imagery and LIDAR from helicopter platforms that can be used as a nontraditional data source for DMO database development. The REST team has a cooperative effort with the Department of Energy for modeling of selected sites on the Nevada Test Site. REST works with the AF Combat Climatology Center and the AF Weather Agency to define and evaluate prototype standard real world time phased weather for DMO applications. The REST team works closely with the ACC Combat AFs DMO Standards Development Working Group in areas that include DMO data standards, common dataset efforts to include the REST WRDS, other potentially useful AFCD and experimental datasets, and DMO database correlation metrics collection. REST coordinates with NGA on data standards and data manipulation toolset issues. The REST team supported and leveraged the Defense Advanced Research Projects Agency RealWorld program in the areas of data acquisition, data manipulation toolsets, and realtime image generation. REST maintains a close relationship with the Nellis and Luke AFB Range Management Offices for the purposes of accurate and updated range target modeling. The Microsoft ESP program, recently canceled by Microsoft, had the potential to revolutionize DMO and leveraged REST expertise to a great extent. REST supports and contributes to all five ongoing service / command / joint database standards initiatives. Again, the REST team was instrumental in development and implementation of the TSPG AFCD, now in use in Air Force training system acquisitions, as well as the development of the concept of operations. And again, the REST team also works closely with the NPSI, SE Core, CDB, and JSRG initiatives.

Recognition: The REST team was nominated for the William T. Pecora award at the AFRL level for the team's contribution to the understanding of the earth through the novel use of remote sensing technologies in 2010. They were also nominated for the Air Force Organizational Excellence award at the division level and the Integrated Theater Combat Operations Training Research Team Commander's Cup (Team) at the division level in 2011. In

addition, Steve Stephens was the Division level nominee for the 2008 David M. Clark Technology Transition Award.

Conclusion: The REST 6.2 in-house program to investigate, integrate, and demonstrate individual breadboard capabilities to develop and update robust, correlated, and reusable DMO visual and sensor databases more rapidly, accurately, and with improved content was largely successful. A follow on 6.3 program, scheduled to start in FY11, will develop and demonstrate a robust end-to-end DMO database generation system and introduce limited realtime insertion of information into DMO events.

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