Validation of a Live-Virtual Field Experiment using Constructive Simulation

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During the Rapid Force Projection Initiative Advanced Concept Technology Demonstration (RFPI ACTD), 1993-1999, the combat simulations Janus, the Battlefield Environments Weapons Systems Simulation (BEWSS), the Modular Semi-automated Force simulation system (ModSAF), and the Combined Arms and Support Task Force Evaluation Model (CASTFOREM) were all used to determine and refine the tactics, techniques and procedures of the systems which encompassed the RFPI Hunter/Stand-off Killer System of Systems (HSOK SoS). These results were embodied into the RFPI Operations and Organizations manual published by the US Army Infantry Center Dismounted Battlespace Battle Laboratory (USAIC DBBL) and used by the 101st Airborne Division during its conduct of the RFPI Live/Virtual Field Experiment in 1998.

This field experiment involved the use of the simulations ModSAF, Target Acquisition and Fire Support Model (TAFSM), the intelligence functions simulator FIRESTORM, and the Interactive Distributed Engineering Evaluation and Analysis Simulation (IDEEAS) tied through a common Distributed Interactive Simulation (DIS) port on a local area network/wide area network (LAN/WAN) between Redstone Arsenal, AL and Ft. Benning GA. Manned simulators representing the Integrated Acoustic Sensor (IAS,) the Enhanced Fiber Optic Guided Missile (EFOGM,) the Hunter Sensor Suite/Remote Sentry, and the ground based sensor system (GBS) to a common data collection/ PDU translation center. These, along with approximately 2000 live soldiers, comprise the largest live/virtual field experiment ever attempted. TRAC-WSMR's FY99 post-field experiment analyses methodology incorporates the RFPI Live/Virtual Field Experiment scenarios into CASTFOREM, a non-interactive stochastic constructive simulation. This involves translating the operations orders (OPORDS) and recorded RFPI Live/Virtual Field Experiment actions into CASTFOREM data input formats using the position information from the field experiment as recorded by the Redstone Technical Test Center, translated through the use of TRAC-WSMR's Operational Test Visualization (OT/VIS) system. This allows analysts to research and develop the initial positioning, survivability movement, target pairing, mission prioritization, round/missile allocation, mission processing times, emplacement/displacement timelines, munition/missile availability. This information is provided for use to the TRAC-WSMR CASTFOREM analysts as they prepare the constructive simulation scenarios replicating the action in the field. Once input into CASTFOREM, the field experiment may be replayed, with modifications made to the systems or TTPs, thereby allowing further analyses of interactions or contingencies at will. These further examinations, to include the development of an analytical base case, would not have been feasible using the live soldiers in a field setting. This was due to the constraints of available time, money, lack of live fire due to the presence of a live OPFOR, and the fact that some of the systems could still be represented solely in simulation. The purpose of this presentation and paper is to describe this CASTFOREM development process, with emphasis as to how live-virtual experiment and constructive simulation representation is valuable to the Army in support of Test and Evaluation, and Experimentation and Analysis for Army After Next.

The presentation will present for the panel the means and methods used to represent the field experiment in the CASTFOREM constructive simulation, from creating a constructive base case due to the lack of field data, to constructing a "tactically sound" version of the field experiment, then compromising this to attempt to come close to the results seen in the field experiment. The paper will not dwell on the purpose or results of the study, but will concentrate more the method used.

The question/problem to the panel is, given all the steps taken, and given the limitation that the experiment existed in a point in time and is not replicable:

1. Is the work toward validation reasonable, sufficient, and adequate?

2. Given that such an experiment will be conducted again in the future, (and several are in the planning stages, such as the Joint Contingency Force Advanced Warfighting Experiment (JCF AWE)): What
3.
4. would enhance the design and analyses of live-virtual exercises that may be specified a priori that will enhance the process' value to the Army?

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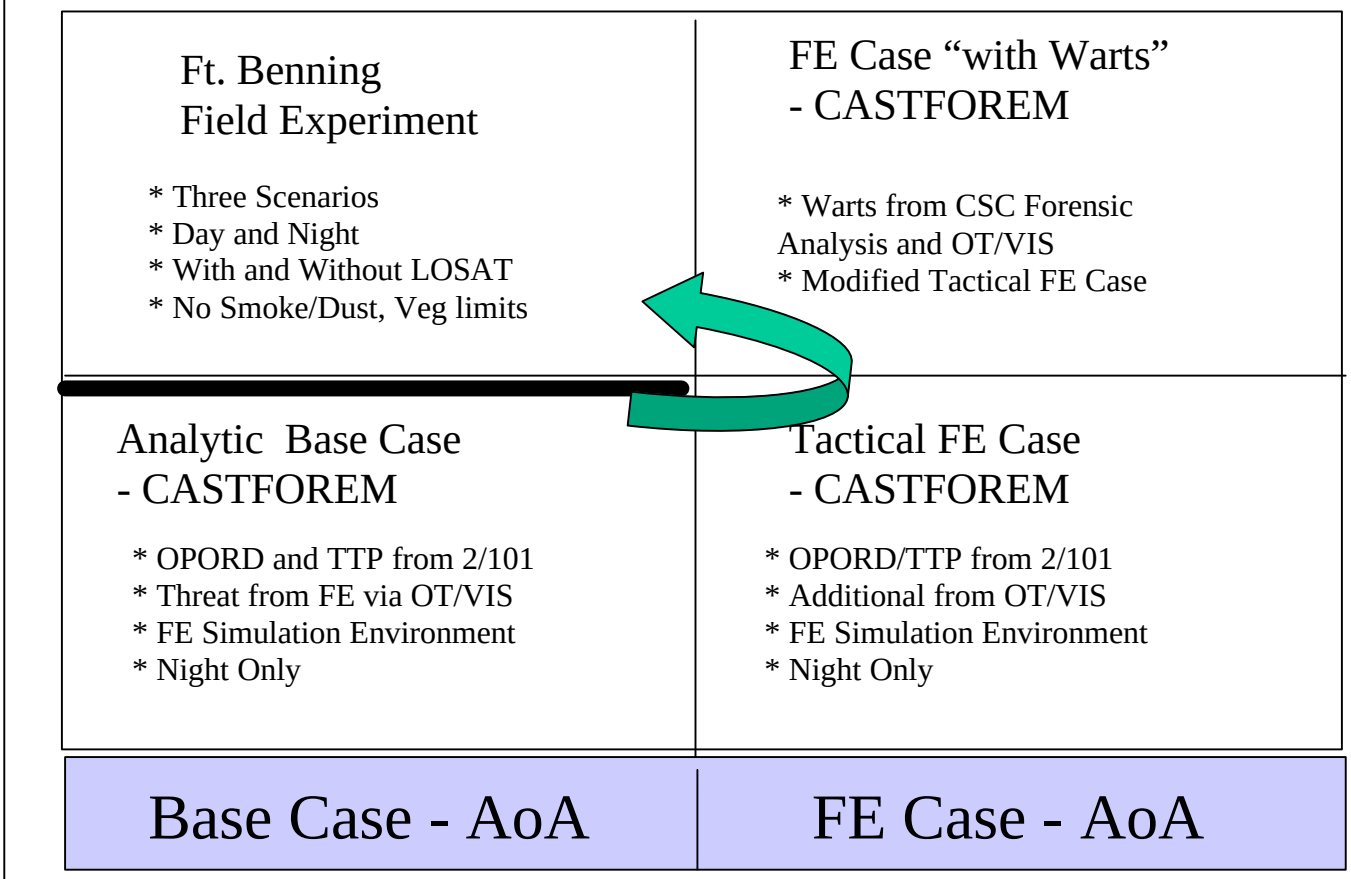
Progression toward Field Experiment Validation



FE Unclassified Data; CASTFOREM Classified and Unclassified Data Se

This diagram represents the stages of the CASTFOREM scenario construction. It shows the progression from the Live-Virtual field experiment in the Summer 1998, to the construction of the tactically sound Base Case scenarios, to the tactically sound representation of the Field Experiment scenarios, with the RFPI residual set of equipment being played. Then to the scenarios in which the tactically sound FE experiments had applied the limitations and work arounds of the Field Experiment, then the attempt to minimize or explain differences between this "WARTS" case and the actual filed experiment results. In the Ft. Benning field experiment, there were three distinct scenarios: Deliberate Defense of the Tactical Assembly Area (or "Defense"), Hasty Defense of the Forward Operating Base (FOB) (or "FOB_Hasty"), and Deliberate Defense of the FOB (or "FOB"). There were two separate lighting conditions: day and full-moon night. The same threat, representing a generic Soviet trained 2006 force, was used throughout and acted in a free play manner, given the limitation of the terrain and the objective, under the direction of an experienced threat force commander. The friendly force remained the Second Brigade/ 101st Air Assault, augmented with elements of the XVIII Corps, operating under the current Table of Organization and Equipment (TOE) modified to take into account the RFPI systems brought on board. The RFPI experimental equipment designated the Residual equipment (intended to remain with the troops after the field experiment) was used throughout the scenarios (i.e. no base case). The Line of Sight Anti tank (LOSAT) system was swapped in and out of scenarios, replacing the TOW systems on a one-for-one basis. An unclassified data set was used to ease concerns about passing classified data over the DIS LAN/WAN. Also, due to peculiarities of the simulation systems being used, battlefield smoke and dust was not represented, helicopters had a limited see-through-vegetation capability to equate (somewhat) the LONGBOW radar system. Conventional minefields were represented with Wide Area Mines (WAM) of equivalent density, again due to simulation limitations.

Valid field test results were obtained from the following:

1. A Defense run with LOSAT at night;
2. An FOB_Hasty run at night (LOSAT was never intended to be used in this scenario)
3. An FOB run in the day;
4. An FOB run in the day with LOSAT;
5. An FOB run at night.

The CASTFOREM scenarios were created using a classified set of weapons effect and platform vulnerability data (called a "Standard" data set), and were then rerun using the data set used in the field experiment (called the "Notional" data set). Both data sets were supplied by the Army Materiel Systems Analysis Activity (AMSAA). One difference from the field experiment lie in the artillery data set. In the field experiment there was no one data set in use because a number of different simulators each with their own explicit internal data sets were in use. AMSAA supplied an artillery data set that could be considered benign, and could serve as an analysis focus for the determination of the proper artillery effect estimations used.

Due to limitations in time and resources, only the night setting was represented in the CASTFOREM scenarios. This is because night is the most challenging case, and the three field test chosen to be represented were all night scenarios (numbers 1, 2, and 5 in the list above.)

The CASTFOREM scenarios created, using both the Standard and the Notional data sets, were:

1. Defense Base Case
2. FOB_Hasty Base Case
3. FOB Base Case
4. Defense Tactically Sound FE case
5. Defense Tactically Sound FE case with LOSAT
6. FOB_Hasty Tactically Sound FE Case
7. FOB Tactically Sound FE Case
8. FOB Tactically Sound FE Case with LOSAT

In addition, using only the Notional data set

9. Defense FE Case with WARTS
10. Defense FE Case with LOSAT with WARTS
11. FOB_Hasty Case with WARTS
12. FOB FE Case with WARTS
13. FOB FE Case with LOSAT with WARTS

Now, and obvious hole to generalization to the whole field experiment is not having any of the scenarios created played using day conditions. Given that the interest is in the verification and validation of the field experiment as well as pointing out the contribution of the RFPI System of Systems, what other areas could give cause for concern. Again, the analysis progresses from the Base Case to the Tactically Sound FE case to see the benefit of the RFPI System of Systems in the Ft. Benning setting. Then from the Tactically – Sound FE Case to the FE Case with WARTS to see the effect of experimental work-arounds and problems on the performance of the systems as represented in CASTFOREM. Finally, the with-WARTS scenarios will be compared beck to the field experiment results to point out areas of similarity and areas of difference. The hoped for result would be a statement on the validity of the Ft. Benning Live-Virtual Field Experiment, verified by comparison to the previously verified simulation model CASTFOREM.