JOINT SURVIVABILITY EXPERIMENT WITH NAVAIR (U)

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ABSTRACT (U)

(U) A Joint Survivability (JSURV) collaborative distributed simulation experiment was conducted between US Army Tank-automotive Research, Development, and Engineering Center (TARDEC) Intelligent Systems Embedded Simulations (ES) Team and the US Navy Naval Air Systems Command (NAVAIR) Air Combat Environment Test and Evaluation Facility (ACETEF), in direct support of the simulation component requirements for the Integrated Survivability (IS) Advanced Technology Demonstration (ATD). With support from the TARDEC Survivability Technology Area, the driving requirements for the simulation were derived to design an environment in which technology effectiveness could be tested for survivability of Army ground assets with (or without) call for fire support from Navy aircraft. A Commander's Decision Aid (CDA) component was added to the Crew Automation and Integration Testbed (CAT) Crew Stations, and interfaced to the Embedded Simulation System (ESS). Further, a relevant scenario was designed in support of the experiment with the help of a subject matter expert (SME). This paper discusses the collaborative effort and some of the experiment details.

(U) Introduction

(U) The Integrated Survivability (IS) Advanced Technology Demonstration (ATD) effort is being performed jointly by U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC) Vetronics Technology Area, Survivability Technology Area, National Automotive Center (NAC) Ground Vehicle Simulation Lab (GVSL), and U.S. Navy Naval Air Systems Command (NAVAIR). The simulation effort is aimed at demonstrating and evaluating new technology in areas of survivability to aid the soldier's situational awareness and protection. As this demonstration is being conducted in a simulation environment, the ESS software provides a simulation of the actual sensors, weapons systems, armor, vehicle mobility, and human performance models. The ESS software development effort is being performed by TARDEC, and surge contractors DCS Corporation (Alexandria, VA).

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(U) The Integrated Survivability Active Protection System (IS APS) demonstrates Platform Protection System (PPS) control architecture for the FCS Manned Ground Vehicles (MGV). An IS APS incorporating this control architecture and suitable sensors and countermeasures provide an effective response against anti-armor threats, thereby increasing the survivability of MGV and crew without adding heavy armor.

(U) CDA Architecture and Integration

(U) The CDA is a tool used to aid the soldier in survivability of the vehicle. This particular CDA implementation is used to protect against AT-5 missile and RPG-7 threats, simulated to engage the vehicle at various points of the scenario. The CDA fuses threat warning from the various simulated sensors, identifies threats, prioritizes them and allocates available countermeasure resources. The CDA communicates with warners, countermeasures and the vehicle electronics over various interfaces, all of which are simulated in the experiment.

(U) CDA software was acquired by TARDEC Survivability Area from BAE Systems (Nashua, NH) to be used in support of this experiment. The software was designed to run on the Sun Microsystems (Santa Clara, CA) 64-bit Sparc architecture processors running the Sun Solaris operating system. Conversely, the ESS software is designed to run under Red Hat (Raleigh, NC) Linux. Furthermore, the CAT Crew Station SMI used for this experiment is executable under the Microsoft (Redmond, WA) Windows operating system. Inherently, to have a working CDA for the ESS, an ambitious integration schedule was followed to ensure communication and compatibility between all the subsystems.

(U) Figure 1 shows the Soldier Machine Interface (SMI) screen created to support the CDA.

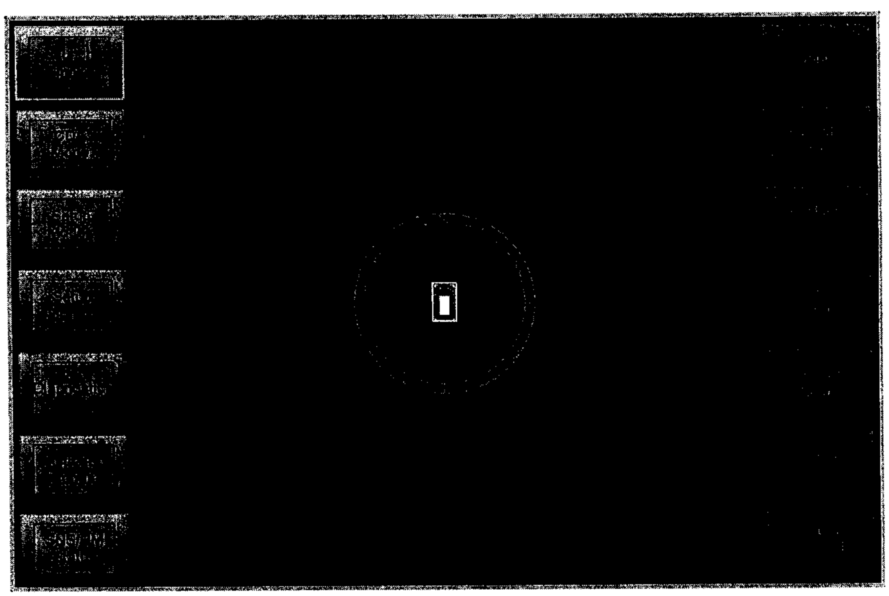

Figure 1. (U) Commander's Decision Aid Soldier Machine Interface

(U) Additional screens shown in Figures 2 and 3 show various status and diagnostics screens for the CDA component as integrated into the CAT Crew Station and ESS. In the status screen, details on the communications between various components critical to the CDA application are shown. Similarly, the diagnostics screen shows the availability and link mode of each of the critical components. Note: for purposes of capturing screenshots, the initial run of the CDA displayed in "Fail" mode, as reflected in the figures below, however, when the system is fully activated, each component must be checked as "Pass."

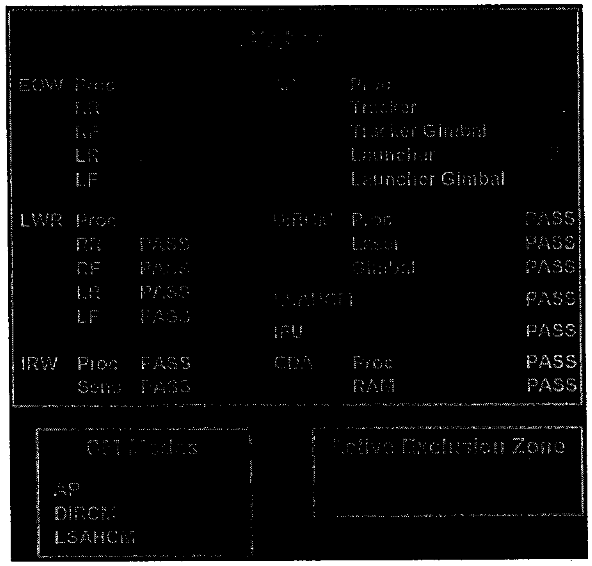

Figure 2. (U) Status Screen

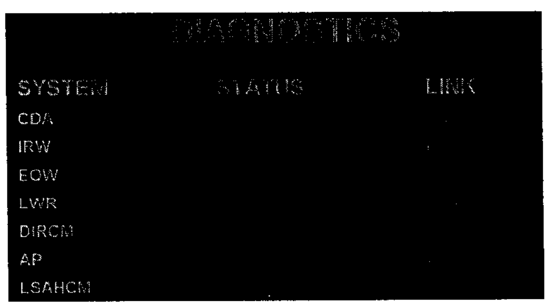

Figure 3. (U) Diagnostics Screen

(U) <u>Anti-tank (AT-5) Spandrel Threat</u>

When engaged by an AT-5 anti-tank missile, the vehicle crew will be notified by the CDA via the ESS and the CDA will initiate a countermeasure response. If engaged by the laser rangefinder, and the CDA is in automatic mode, the vehicle will 'pop' smoke or will queue the crew to perform evasive maneuvers and to 'pop' smoke if in semi-automatic mode. If, when the AT-5, is fired, the line-of-sight is not obscured by the smoke cloud, the infrared warner will detect the missile launch and the CDA will attempt to defeat it with the MFCM. The APS is also cued by the laser warning receiver (LWR) or IRW and will track and defeat the missile. In the event that the CDA determines that the MFCM is not available for any reason, it will enable the smoke grenade launchers as above.

(U) Rocket Propelled Grenade (RPG-7) Threat

When engaged by an RPG-7, the vehicle crew will be notified by the CDA via the ESS after the IRW detects the launch. Since the RPG-7 is an unguided "short range" munitions, it has no guidance system that can be disrupted. In addition to the vehicle crew performing a "Sagger Drill", the APS will have been queued by the IRW and will defeat the RPG if launched beyond ~200m.

(U) Laser Warning Receiver (LWR)

The LWR is an instrument for increasing situational awareness of laser threats (enemy's target acquisition systems, projectile guidance, etc.). LWR will be used as part of overall IS APS suite. Will also be used alone on infantry carrying vehicle (ICV) when rest of IS APS suite is not on vehicle. Scenarios will be run for ICV, with and without IS APS, assuming we can get enough hardware for 4 copies of CDA. Scenarios will be run with ARV having LWR and not having LWR, with a comparison of mission performance.

(U) Scenario

(U) With the support of an SME, and in collaboration with the Survivability Area and NAVAIR, a simulation scenario was created on a commonly available terrain database. For ease of distribution and use between TARDEC and NAVAIR, the database was distributed in the OpenFlight format, originally developed by MultiGen-Paradigm, Inc. (San Jose, CA) and now a leading visual database standard. Internally to TARDEC, for use on the ESS, the database was converted for proprietary X-IG Image Generator format, developed by Carmel Applied Technologies Inc. (Seaside, CA), and also in the Compress ARC Digitized Raster Graphics (CADRG) and the Digital Terrain Elevation Data (DTED) formats for map displays on the CAT Crew Station SMI.

(U) Figure 4 shows a map view of the terrain database. The "start point" was placed behind sufficient terrain obstacles and tree-lines to avoid initial spotting by enemy vehicles (discussed below) at the immediate start of the scenario. The purpose of this scenario was for the driver of the infantry carrying vehicle (ICV, details of assets discussed below) to safely arrive at the town, following the path, or an alternate tactically feasible or more suitable path, as shown. While traversing the terrain, the commander should conduct reconnaissance, surveillance and target acquisition (RSTA) at various locations to detect enemy, and avoid, deter, or engage enemy assets through direct engagement or call-for-fire requests to NAVAIR assets as necessary.

(U) For basic scenario configuration, as mentioned above, the mission was to deliver the ICV to town outskirts safely. In addition to the ICV, provision was made for an additional unmanned ground vehicle (UGV), as well as three "wingman" vehicles surrogated by Human Performance Models (HPM). The HPM systems were designed to detect and/or engage enemy assets in order to reduce burden on the ICV and UGV / forward observer assets.

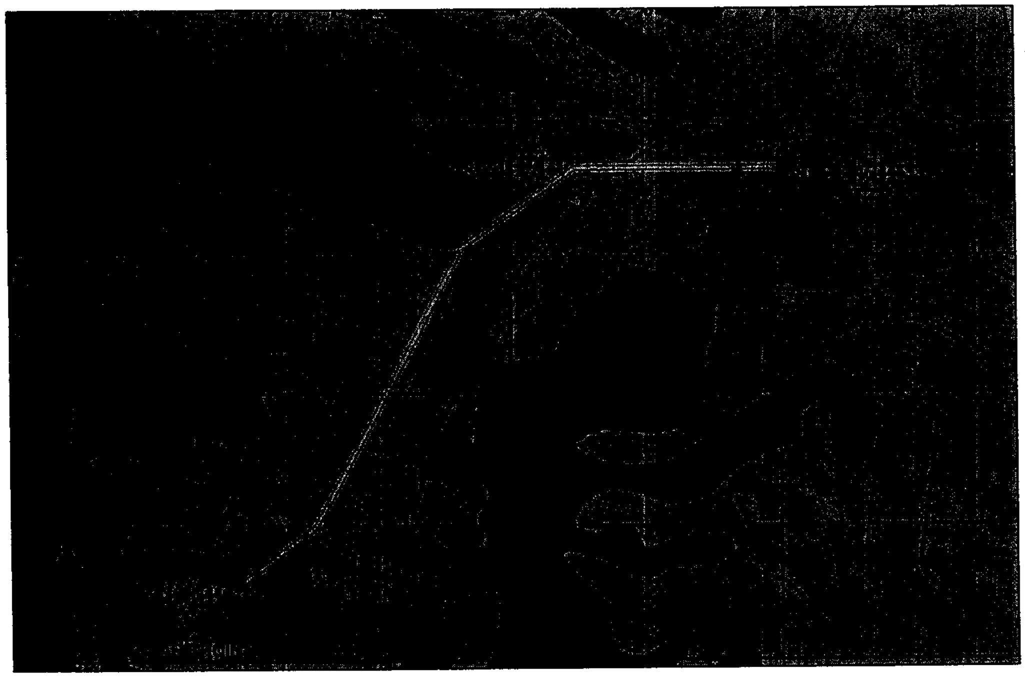

Figure 4. (U) Rural Scenario Overview

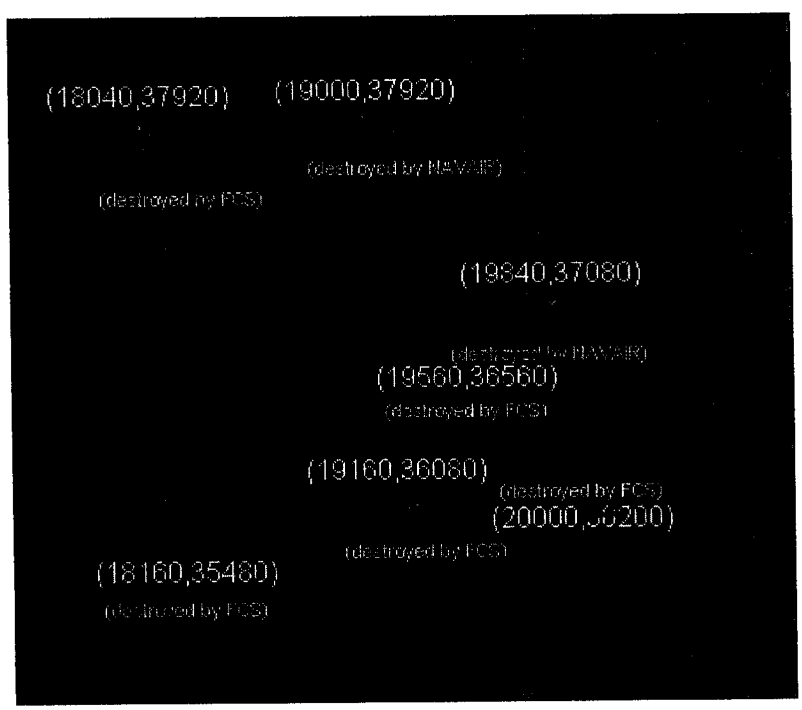

Figure 5. (U) Placement of Enemy Targets in Rural Scenario

(U) As shown in Figure 5, several enemy assets (BRDM's) were placed in various locations with oversight onto the route leading to the city. As such, the drivers of the ICV and UGV vehicles, as well as the HPM models, would need to carefully and plan their routes and conduct the RSTA scans several times. Apart from fire support from NAVAIR, the vehicles can also receive intelligence reports from the airborne assets when they detect confirmed enemy locations or glints.

Figure 6. (U) Urban Scenario Overview

(U) As shown in Figure 6, the Urban Scenario consisted mostly of RPG-7 threats to exercise the Electromagnetic Armor (EMA) simulation component part of the IS suite. The objective of this component of the scenario was to arrive safely at the ending location. Throughout the scenario, several RPG-7 threats were scattered throughout the town as well as on rooftops, to simulate insurgent activity. As defined by the Survivability Team, the EMA simulation was primarily geared towards evaluation of that technology based on probabilistic models of the threat (accuracy, range, etc.), how many hits each EMA panel may sustain prior to vehicle hull breach, as well collecting data points on how many hits each vehicle sustains in the simulation. NAVAIR involvement in this component involved providing intelligence on enemy whereabouts, as well as providing fire support if called upon.

(U) Data collection requirements for this experiment were also driven by the Survivability Area. In consensus with ESS and NAVAIR, agreed parameters were recorded during the experiment runs and provided for after action reviews and analysis.

(U) Conclusion

(U) Through this effort, interagency and intra-Army collaboration greatly enhanced the value gained by conducting the simulation experiment. Interoperability of the simulation environment, through which TARDEC was linked to NAVAIR and vice-versa, allowed the Survivability Area to gain valuable insight into how availability of NAVAIR assets impacted scenario outcomes. Furthermore, with the experience and knowledge gained by each participant, we were able to lay the groundwork for future integration of other components, such as the CDA in this effort, as required to support current and future customer needs, and hold more extensive joint experiments benefiting the warfighter and the R&D community through inter- and intra-agency collaboration.

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