



WORLD LEADERSHIP IN MODELING AND SIMULATION

ALABAMA ARKANSAS COLORADO FLORIDA NETHERLANDS NEW MEXICO TEXAS UK WASHINGTON DC

AEgis
TECHNOLOGIES

DIRECTED ENERGY CAPABILITIES JUNE 2009

Instrumentation/Sensors

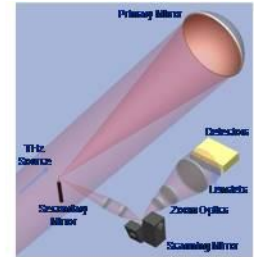
High Energy Laser (HEL)

Direct and indirect sensor systems that measure laser irradiance and target temperature on the target



High Power Microwaves (HPM)

Sensors that directly measure skin temperature and electric field strength on human subjects during ADS engagements and a beam profiling system for THz sources



Program Support

DE Program Office Support

Provide enterprise M&S support to include M&S programmatic support, performance assessment, wargaming, simulation development, and VV&A



Non-Traditional Assessment (NTA)

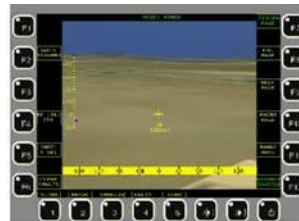
Characterize performance of HEL and HPM systems, report capabilities in terms of military utility



Simulation Development

Development of Virtual Simulators

Develop human-in-the-loop simulators of DE weapon systems for requirements development, TTP development, operator training, and wargaming



Modeling and Simulation (M&S)

Employ HEL and HPM models in operational engagement simulations and VV&A use of HEL/HPM models



Temperature and Irradiance Sensor Matrix (TISM)

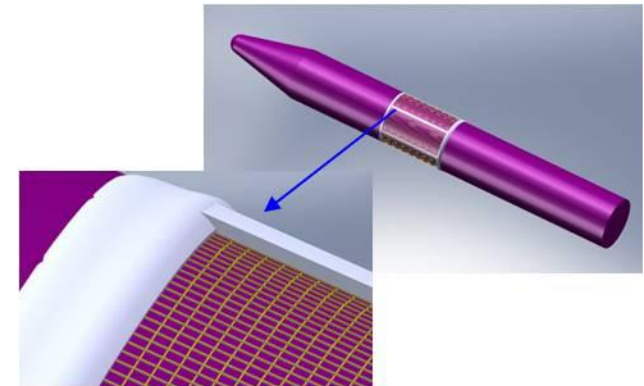


Unique Approach

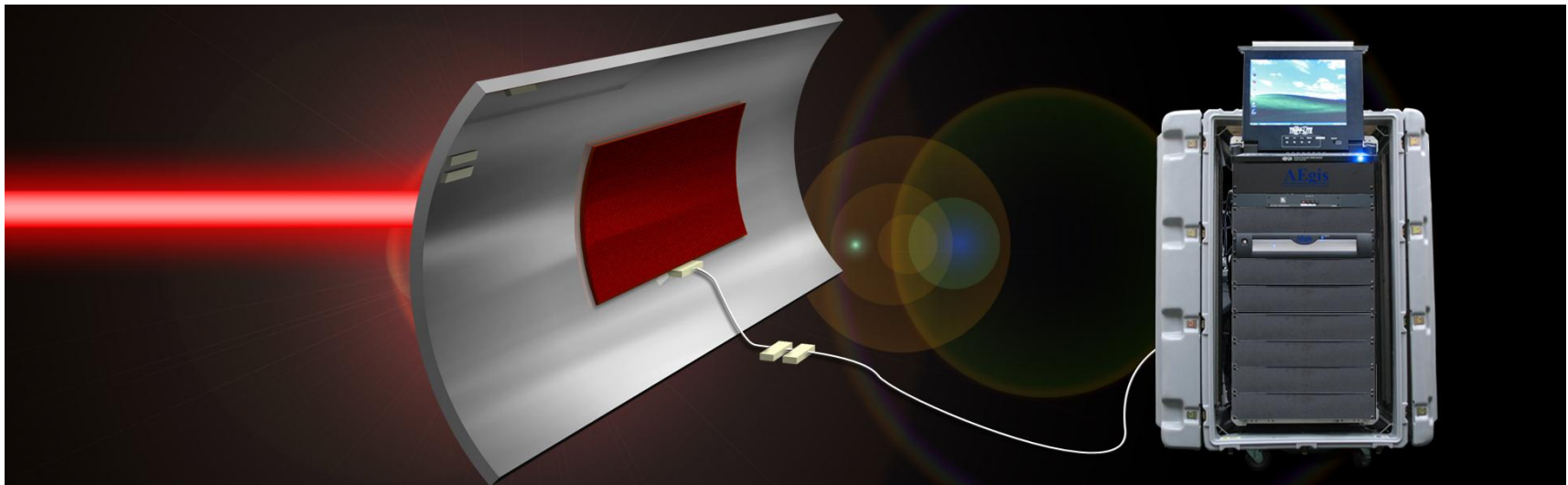
- Conformal sensor array
- Low profile, externally mounted
- Open mesh architecture

Provides

- Direct measure of laser irradiance on target
- Thermal response of missile body
- Spatial dynamics of laser spot
- Minimal impact on flight
- 90% of target surface exposed to the laser

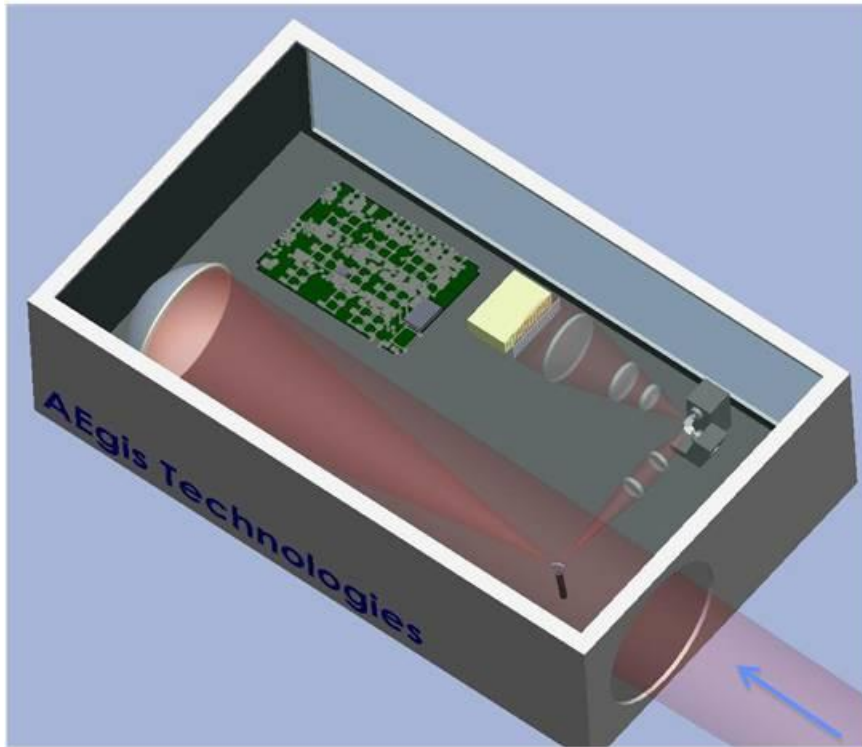


- **Inversion-derived Resistive Temperature Sensor (IRTS)**
 - Disposable temperature sensor array
 - Resistive temperature detectors (RTDs) are faster, more accurate, and have higher resolution than thermocouples
 - An integrated IHC model that is tightly coupled with the RTD sensor array
 - Utilizes a direct heat conduction solver in conjunction with an optimization algorithm
 - Validate the coupled system



HPM BEAM PROFILER

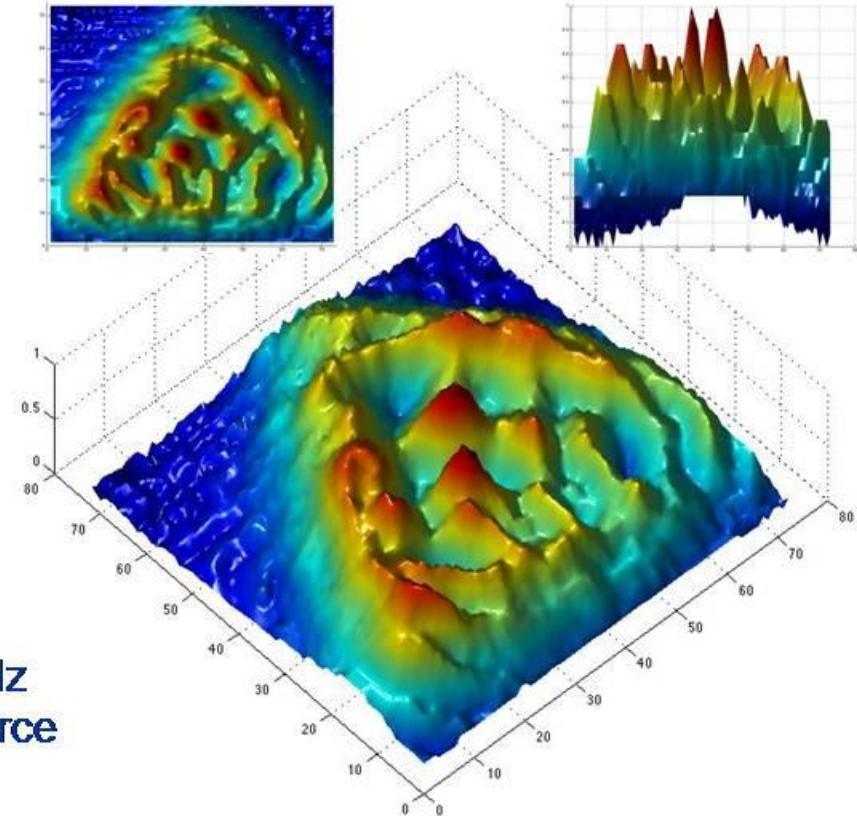
TIPA engaged with THz source



THz
Source

THz Beam Profile

(655 GHz source scanned with single pixel system, requiring ~40 minutes to collect entire profile)



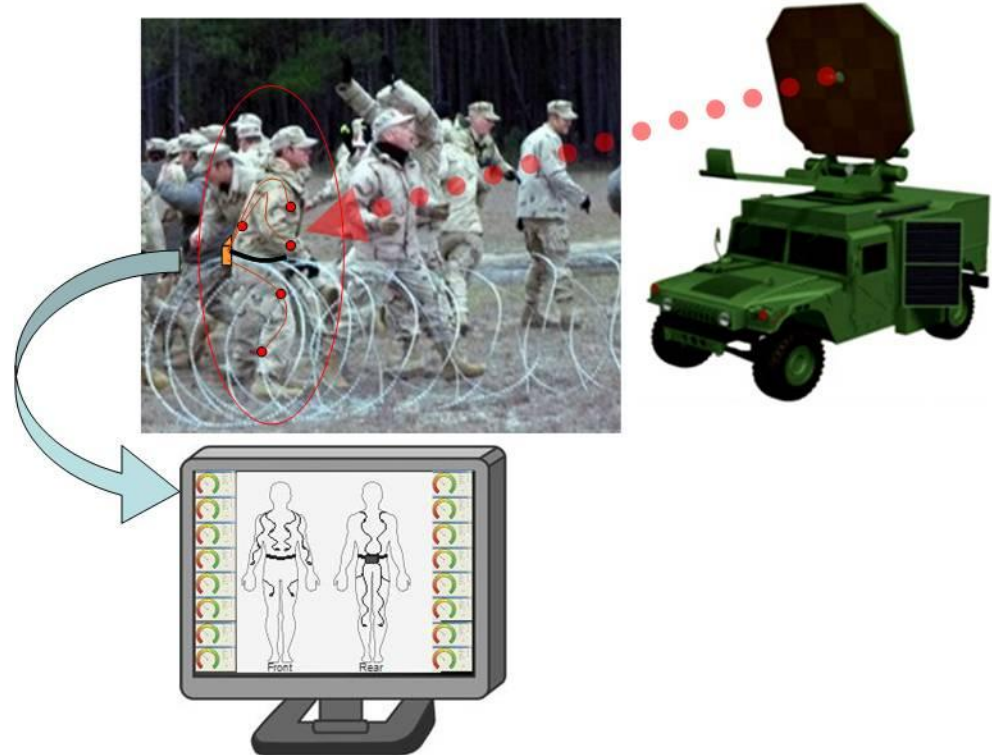
Provides:

- Direct detection of THz source beam profiles
- TIPA covers an extremely wide frequency range

Skin Heating and Electric Field Strength (SHEF)

Measurement Sensor Network

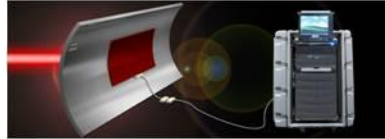
- Self-contained, portable sensor system – waist-worn electronics
- Sensor system consists of small patches worn by test subjects
 - Integrated with ordinary clothing
 - Separate sensor for skin temperature and W-band electric field strength
 - Data stored for later analysis or transmitted via telemetry
- System supports live-fire tests



- **6 plus years providing Enterprise Modeling and Simulation (M&S) management for ABL Program**
- **Program Management Support**
 - Overall technical focal point for ABL M&S
 - Developed M&S Support Plan – documented needs and capabilities
- **Modeling and Simulation Development**
 - Lead developer for all Tier 1 (Campaign Level) models
 - Software Engineering/Project lead for other efforts
- **Analysis Support**
 - Exercise and Wargame analysis and experiment leads
 - Analysis for test support and external study requests
- **Verification, Validation and Accreditation (VV&A) lead**

From laboratory research to operational field tests

Instrumentation



Industry leading development of instrumentation designed to measure high energy laser and high power microwave energy directly on the targets

Non-Traditional Assessment



Supported over 30 Advanced Concept Technology Demonstrations, Joint Capability Technology Demonstrations, and Battlelab Demonstrations over the past 10 years

Traditional Test and Evaluation



DTC at WSMR: IED Defeat, FCS
ARSTRAT: Global War on Terror
ABL: VV&A on laser models using live test data

Range Support



Access to 1000s of acres with varied topography – both land and airspace – certified as Army Experimental Test Site



About AEGIS Technologies

- Provides world-class , modeling and simulation, advanced technology development and professional training.
- Small Business
- Established in 1989
- Headquartered in Huntsville, AL
- 2007 Revenue \$35M

Of our 175+ Employees

- 37% have Master's Degree or better
- 63% have Engineering or CS degrees
- 35% have Military Service experience

Relevant Facts

- Recognized three times on INC Magazine's "INC 500" list of the fastest growing privately held companies in America
- Recognized on the *Military Training Technology* Top 100 list of companies that have made significant contributions to the military training industry
- Recognized by the Better Business Bureau for Marketplace Ethics
- Recognized by the Society of Financial Service Professionals for Ethics in the Business Community



DAVID THOMAS
Vice President, Microsystems

dthomas@AEgisTG.com

KENT TAYLOR
Manager, Directed Energy Programs

ktaylor@AEgisTG.com

PAT CANNON
Vice President, Southwest Region

pcannon@AEgisTG.com

DAVID DUBUQUE
Director, DE M&S Programs

ddubuque@AEgisTG.com

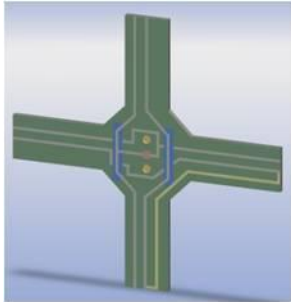
The AEGIS Technologies Group, Inc. • 631 Discovery Drive • Huntsville, Alabama 35806
Phone: (256) 922-0802 • Fax: (256) 922-0904

www.AEgisTG.com

Copyright © 2008 The AEGIS Technologies Group, Inc. All Rights Reserved

Backup Slides

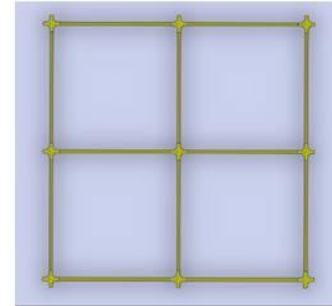
Sensor Node



Protective Coating



Open Mesh

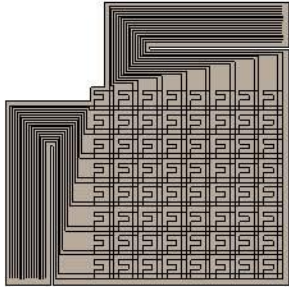


Telemetry

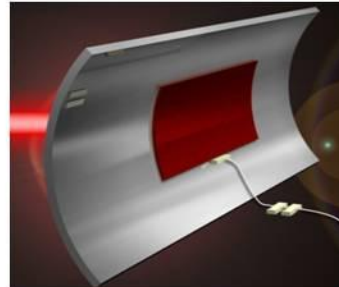


- Individual sensor nodes
 - Quantum dot irradiance sensor
 - Resistive temperature detector
 - Electrode lines provide power and route signals to readout electronics
 - Metal foil substrate
- Protective coating
 - Aperture and hohlraum design reduces energy on the sensor by several orders of magnitude
 - Gold-coated foil provides high reflectivity, good thermal conductivity
- Open mesh architecture
 - Individual sensor nodes are located at intersecting lines
 - Open areas are exposed to laser
- Readout electronics and telemetry
 - Electronics located in ribs or embedded inside target
 - Data transmitted to ground via telemetry
- TISM array
 - Spatial profile of laser irradiance on target and target temperature vs. time.

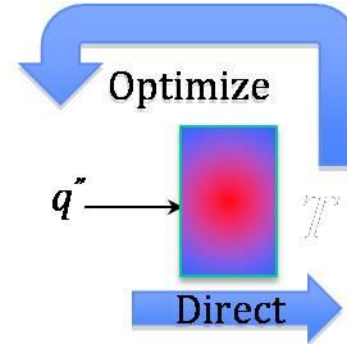
Temp Sensor Array



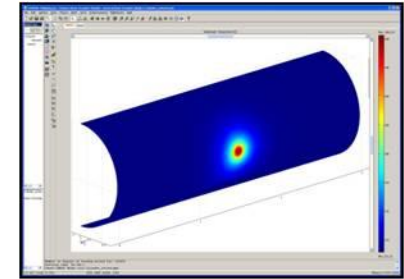
Data Acquisition



Software Model



Visualization



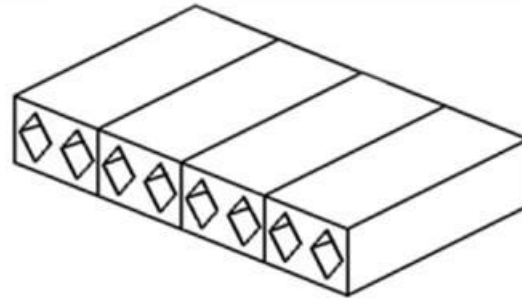
- Resistive Temperature Sensors
 - Printed nanoparticle sensors on metal foil substrate
 - Adhered to back side of target
- Data acquisition
 - Records temperature profile on back side of target as a function of time
 - Rugged interconnect accommodates disposable sensor and re-use of readout electronics

- Inverse Heat Conduction Model
 1. Solve direct heat transfer problem
 2. Iteratively adjust flux q'' until solution converges to measured temperature profile
 - Iterative convergence is accelerated based on knowledge of sensitivity coefficients
 - Method allows use of COTS direct solver
- Visualization
 - Temp sensor profile with time
 - Heat flux profile front and back with time

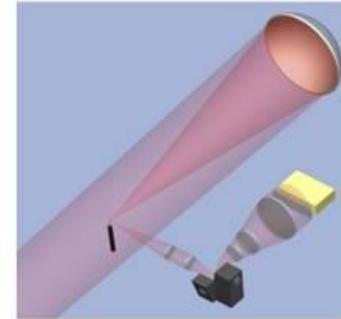
Detector



Reconfigurable Array

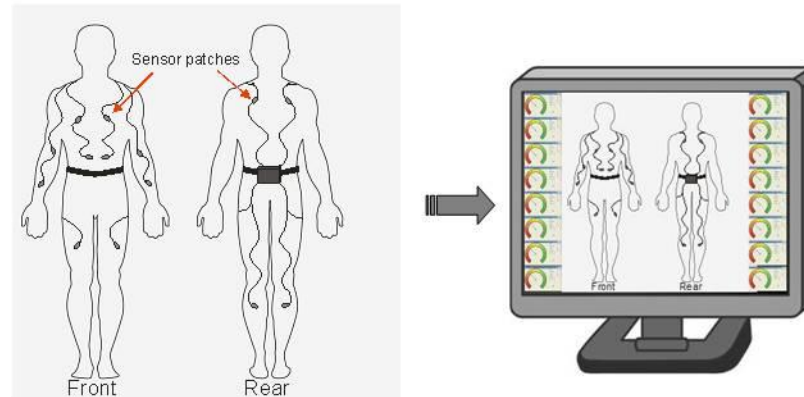


Optical Design



- Schottky Diode Detectors
 - Planar non-linear diode mounted in waveguides
 - Provide required spectral coverage
 - Extremely fast response time compared with other room temperature detectors (e.g., Golay cells, bolometers)
- Reconfigurable Array
 - Custom fabrication to package the detectors in cubes (including the 30 dB gain horns) that can easily be snapped together in a variety of configurations to meet specific profiling/imaging needs
- Scanning Optical System
 - Develop optical system that achieve maximum spatial, temporal, and dynamic resolution
 - Lenslets maximize fill factor
 - Scanning system reduces detector count and cost
- Data Acquisition and GUI
 - Fast readout: 16 pixels per second in a linear array or 1,600 pixels per second in a staring array
 - Automates calibration – assists with alignment
 - Assembles multi-spectral data cube

- **Skin temperature:** temperature-dependent fluorescence provides an optical measure of material temperature
- **Electric field strength:** antenna-based transducer converts microwave energy to an optical signal
- Both use optical fibers to probe sensors non-intrusively



- **7 years as lead test contractor for ADS assessments**
 - Designed an overall assessment strategy for Systems 0, 1, and 2
 - Planned and executed operationally realistic test events in desert, MOUT, and littoral environments
 - Deputy Principal Investigators certified to conduct test events using human safety protocols
- **Developed training simulator for ADS crews**
 - Incorporated as part of System 1 curriculum
 - Overlaid 3-D terrain database with overhead imagery and system interface for realistic environment



Program Activities

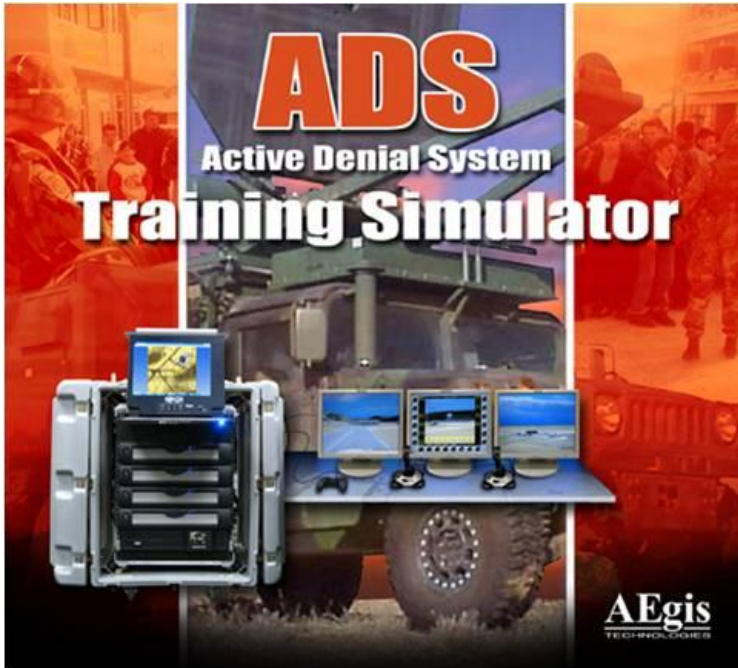
- '05 Wargames
 - ACE-I (Kirtland AFB)
 - AAEF (Ft. Benning)
- '06 Wargames
 - ACE-II (Kirtland AFB) Wargame
 - Urban Resolve 2015 (CVC - Pentagon)
- '07 Wargames
 - ACE-III (Kirtland AFB) Wargame
 - Urban Resolve 2015
- Developed ATL, Tac-Relay, & CM weapon systems
- Terrain DB development – Azerbaijan & Korea

Program Accomplishments

- Success ACE-II/AAEF involvement
- Supported JFCOM's JVTSE demo during I/ITSEC'05
- Supported PEO STRI's Capitol Hill Demo
- Ground work laid for Tactical Relay Mirror System (TRMS) with Boeing-SVS.



ACTIVE DENIAL SYSTEM (SYSTEM 1)

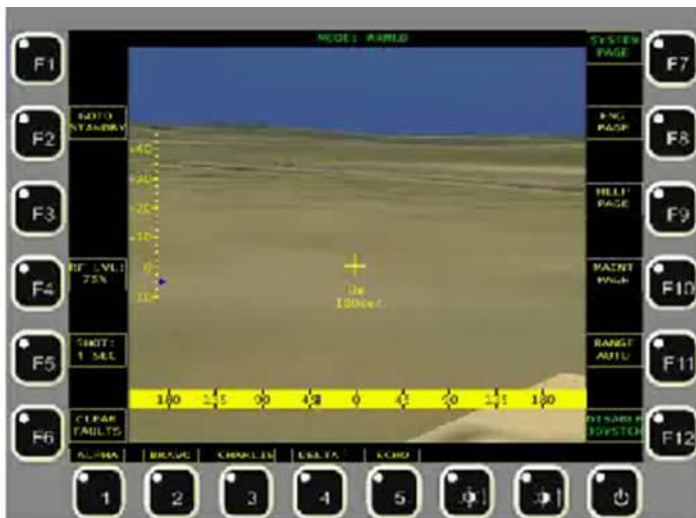


Program Activities

- ADS trainer supported multiple MUA's during CY'05
- ADS system purchased by ACC/AFRL
- Support the ACE-II wargame @ DMOC (Kirtland AFB)
- Demonstrated at the DEPS National Conference
- Participated in ACE-III and Urban Resolve 2015

Program Accomplishments

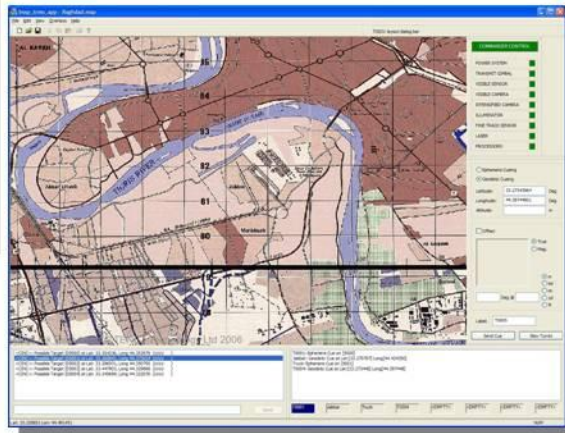
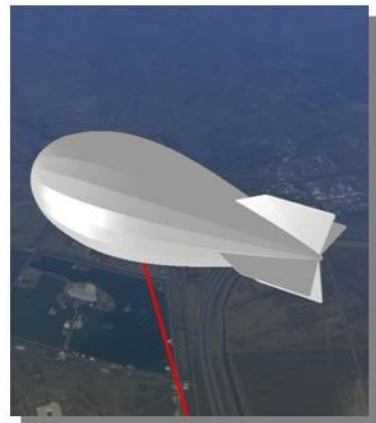
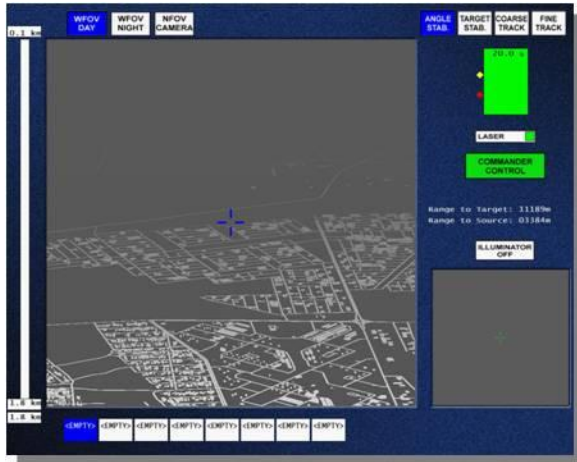
- Persistent training assets for all ADS Military Utility Assessments (MUA'a)
- Successful participation in several wargames
- Demonstrated to JNLWD, SMDC, AMRDEC, PM CMDS
- Integrated into the DEPS Directed Energy 101 course



TACTICAL RELAY MIRROR SYSTEM

Program Activities

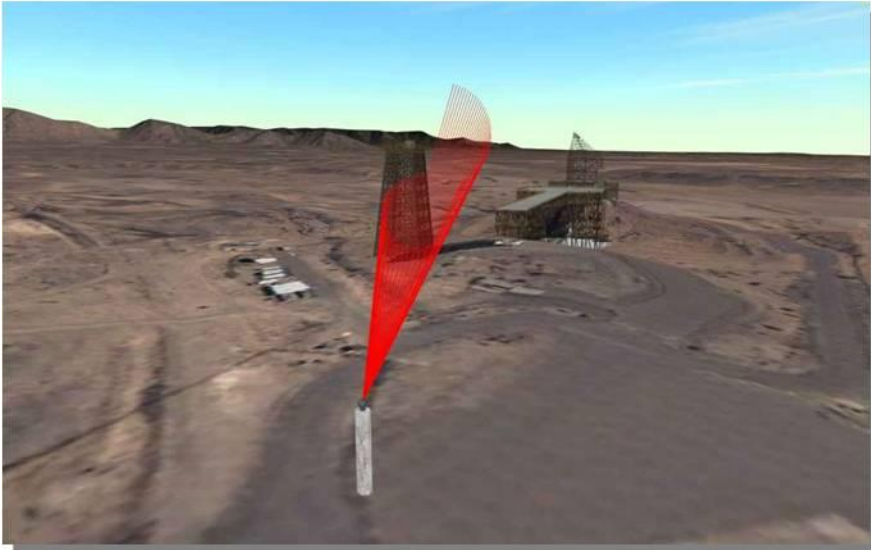
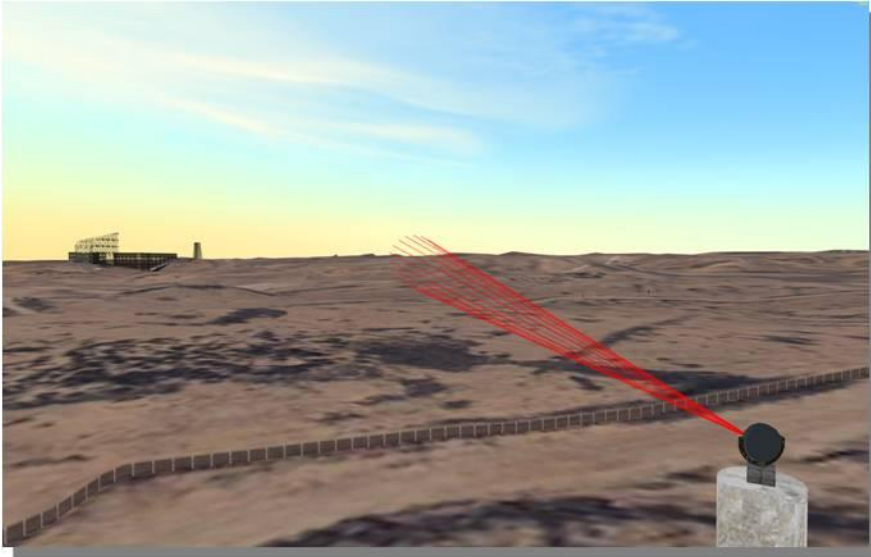
- Simulation of Tactical Relay Mirror System (TRMS) Operator Interface Simulator (OISIM) using BattleStorm framework
 - Mirror system mounted to Aerostat or UAV
- Purpose of simulator development
 - Develop initial operator interface design
 - Identify issues with operational concepts thru participation in wargaming exercises
 - Demonstrate operational utility of DE system to warfighter



Program Accomplishments

- Simulator successfully delivered and received with commendations
- Successfully participated in JFCOM's Urban Resolve 2015 and AFRL's ACE '06 experiments
- Customer interest in further simulator development and participation in additional exercises, including ACE '07 and Noble Resolve

LONG RANGE ACOUSTIC DEVICE SYSTEM



Program Activities

- Visualization of the Long Range Acoustic Device (LRAD) system using Nspire framework
 - Ground based system to project acoustic energy
- Purpose of simulator development to...
 - Visualize the system in action and the beam in a virtual environment
 - Provide operator situational awareness
 - Accurately model the demonstration area on Kirtland AFB to include terrain and buildings

Program Accomplishments

- Simulator successfully delivered and received well
- Simulator provided visualization of the system as well as a representation of the beam to operators and observers
- Customer interest in further simulator development including the addition of BattleStorm to simulate the system, a training mode with simulated targets and future participation in exercises