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# **Dante & OpShed**: 3D Simulation Tools for Physical Security

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# Who Am I?




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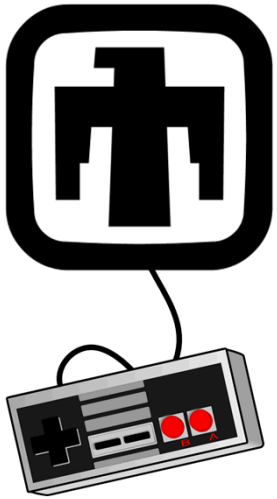
iFDM
Interdisciplinary Film & Digital Media Program
University of New Mexico



# National Security Challenges

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| 1950s | 1960s | 1970s | 1980s | 1990s | 2000s | 2010s |
|---|---|---|---|---|---|---|
| Nuclear weapons | Development engineering | Multiprogram laboratory | Missile defense work | Post–Cold War transition | Post 9/11 | Life Extension Programs START |
| Production and manufacturing engineering | Vietnam conflict | Energy crisis | Cold War | Stockpile stewardship | National security | National security challenges |


# Overview of Topics

- Modeling & Simulation
- Training Applications
- Research & Development

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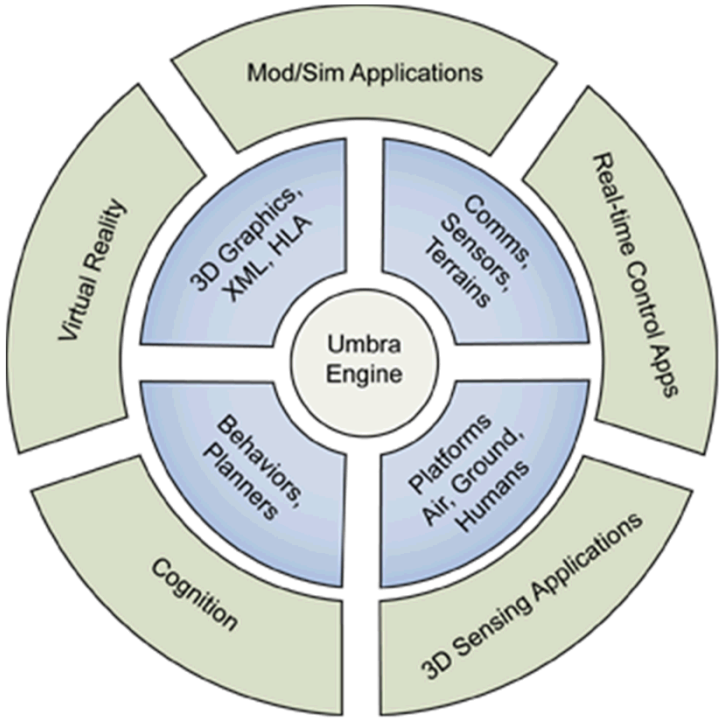
# MODELING & SIMULATION

# UMBRA Simulation Framework

- Physical simulation modeling engine originally developed in early 2000's
- Modular architecture for quickly generating new capabilities for use within simulations
- Real & discrete time simulation for physical and human behaviors
- Monte Carlo batch analysis capabilities to perform variations on simulated scenarios
- Utilized for creating both closed analysis and open, interactive applications



# Simulation, Gaming, Terrain Team (SGTT)

- Team created to satisfy lab-wide demand for highly-realistic visual models of secure facilities
- Proficient in: 3D scanning, GIS data, 3D modeling, 3D animation
- Models and terrains available for import into proprietary and commercial simulation environments

# Dante

DANTE™

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- **Force-on-force simulation**
  - Conduct closed-loop simulations that demonstrate engagements between attackers and security forces
  - Tactics, Techniques, and Procedures (TTPs) of characters modeled and validated by subject matter experts

- **Scenario Editor**
  - Import terrains/models that represent physical sites
  - Allows for developing attack plans and security force assets available for the situation

- **Batch Analysis**
  - Perform Monte Carlo simulation to examine several perturbations of the scenario
  - Results allow for researching key variables that led to likely scenario outcomes

# Dante

- **Inputs**
  - 3D Terrain Environment
    - Terrain Surface
      - Openflight Terrain format
      - GeoTiff image
    - Buildings, Fences, Barriers
      - Support various formats
    - Roads, Water, etc…
- **Setup using Dante Scenario Editor**
  - Define up to 3 different sides
  - Create assets for each side
    - people, weapons, platforms, sensors
  - Create actions for each side (TTPs)
    - Breach, Patrol, Move, Drive, Fly, Mount, …
    - Connected to make a plan (fail and success)
  - Assign actions to a team or individual
  - Preview actions to confirm intended execution

Dante Scenario Editor

# Dante

- Battle outcomes between entities comes from automated behaviors and perceptions
  - Behavior
    - Set of selectable character behaviors
    - Behaviors are driven by the entities plans (sequence of planned activities)
    - Based on perception (both visual and acoustic) entity will react.
    - Dynamically seek cover from perceived threats when under fire
  - Visual perception
    - Probability of detection based upon line-of-sight obscuration, range and pose.
  - Auditory perception
    - Sounds are classified, i.e., footsteps, vehicle, explosion, shot (distant), crack (bullet aimed at entity).
  - Engagement
    - If reaction is to engage, Ph/Pk tabular data or Shot Distribution data is used.

# Dante

DANTE™

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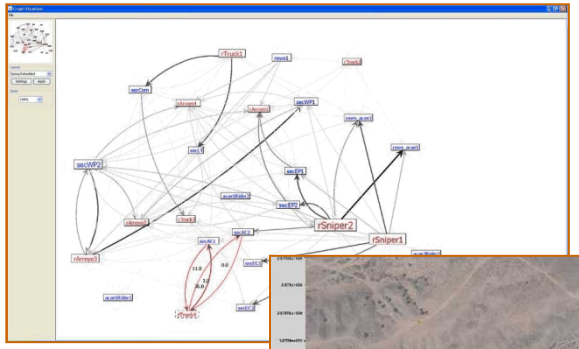
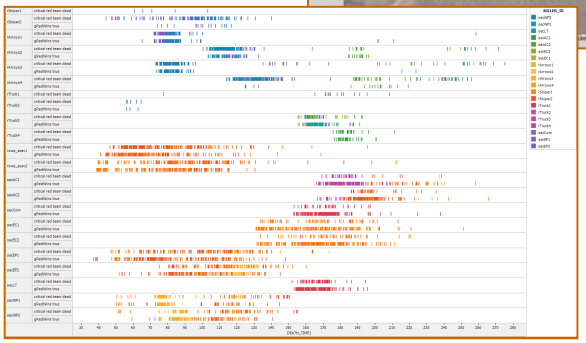
- **Execution Mode**
  - Interactive
  - Batch
- **Batch Statistical Analysis**
  - Provide insights into “key” players and events
  - Who Killed Whom, When, Where and with what statistical distribution
  - Supports probability of neutralization computation
- **Post Processing Output**
  - Data capture
    - XML files
    - Database enabled
  - Graphs and Plots
  - 3D Scenario Replayer
    - Interactively navigate and query

**Shot/kill affinity**



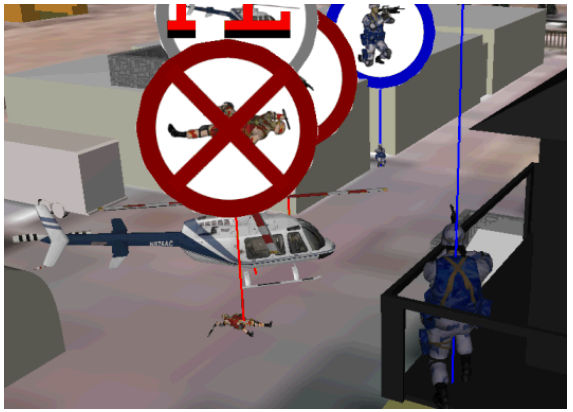
**Geophysical plots of shots and kills**



**Temporal distribution of kills**

# Dante Tabletop

- Distributed operation
  - Coordinated simulations for Red & Blue
  - “Fog of War” concealing hidden actions
  - Referee/Spectator view
- Trainer mode
  - Red side automated
- Multi-player mode
  - Participants control single character or groups
  - Integrated communication
  - Widely distributed (LAN or WAN)



# OpShed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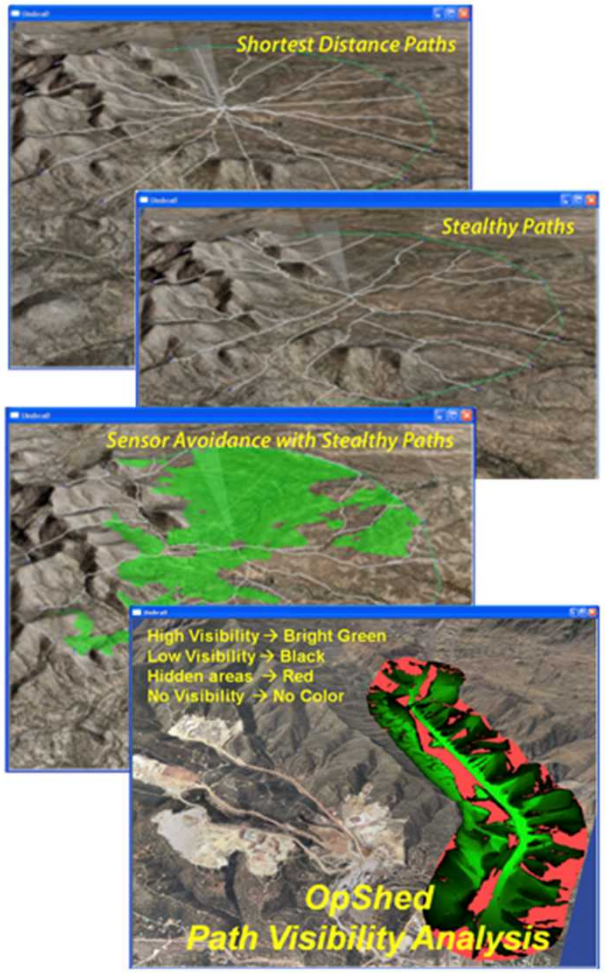
- **Visualization & Analysis**
  - OpShed models visual and proximity sensors
  - Sensors layouts can highlight areas of coverage for sensors with a particular terrain
- **Vulnerability Detection**
  - Run simulated characters through scenes for predicting effectiveness of sensor layouts
  - Characters may plan routes using either stealth or time-efficiency based upon sensor and environment conditions
- **Sensor Optimization**
  - Users can quickly alter sensor(s) and re-examine layout effectiveness to discover best strategies.



# Demos

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# TRAINING APPLICATIONS

# Video Games for Training Incident Commanders

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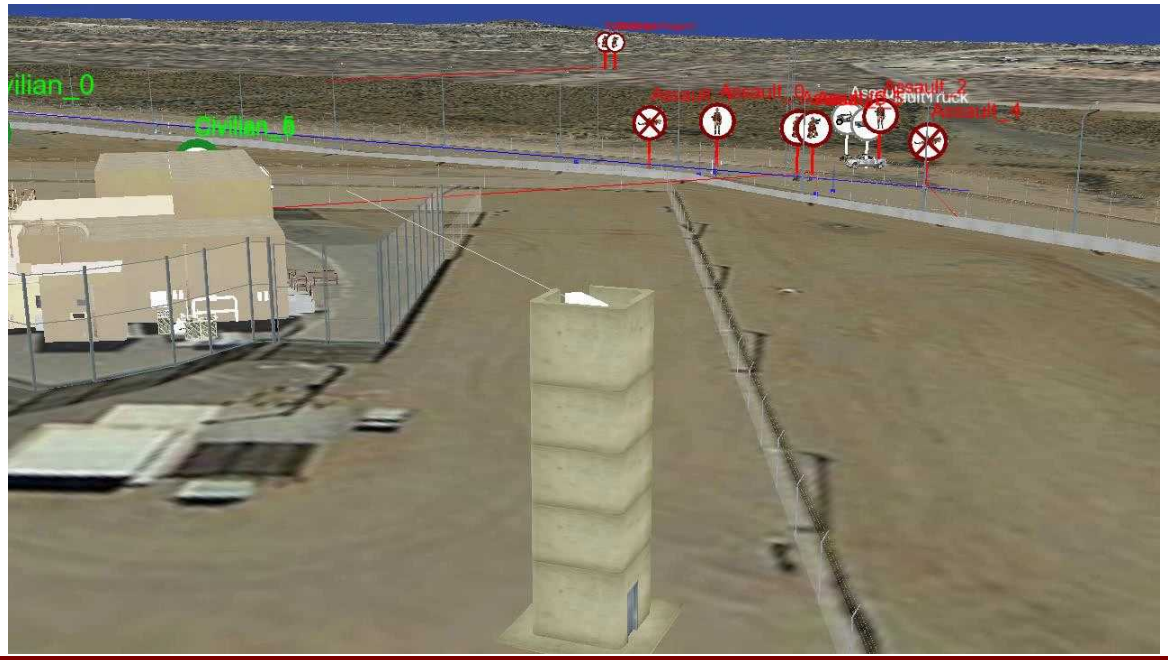
- Partnership between USC Game Pipe Lab and SNL
  - SNL provided human character modeling & tech supervision
  - USC students developed game environment
- Games released to Sandia Protective Force and Department of Homeland Security

# Remote Operated Weapon Systems (ROWS) Trainer

Umbra provides a flexible software framework that allows for the development of physics-based, 3D simulations.

- ROWS simulators provides ample opportunities for training with realistic hardware in a virtual setting.

- ROWS Trainer commissioned by USAF for sites with systems
  - First delivered in December 2014



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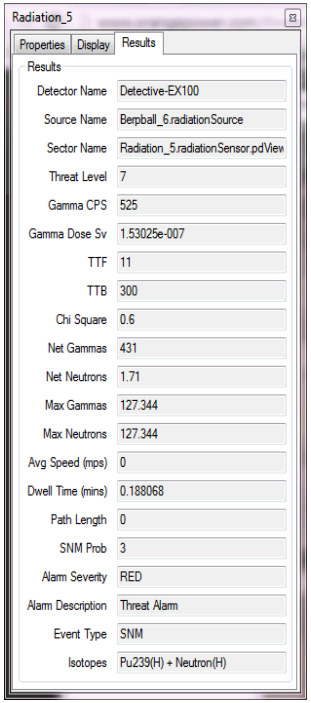
# RESEARCH & DEVELOPMENT

# Leveraging Sandia Internal Research for Umbra

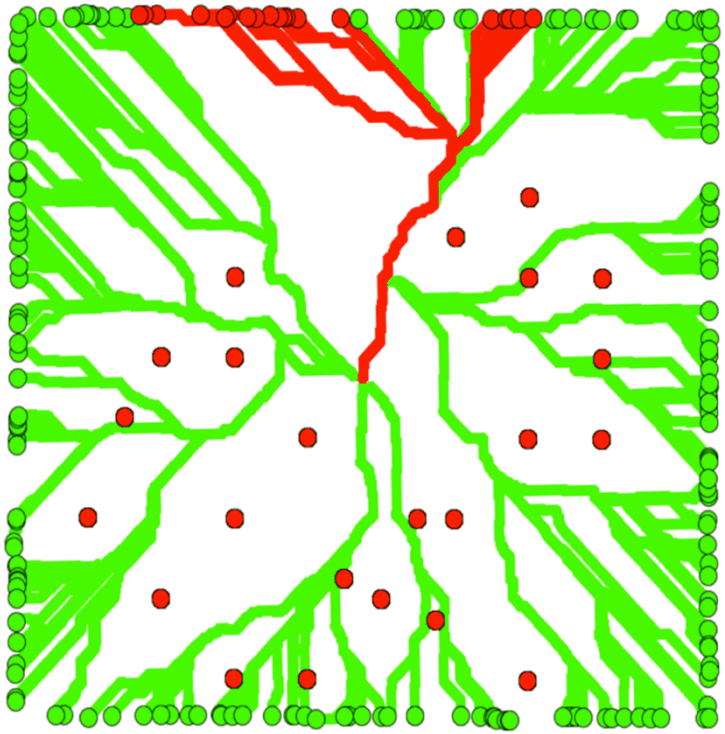
- Co-Simulation for Improved Radiation Modeling
  - Integrate Digital Inject Book within Umbra to allow for rapidly creating radiation simulations
  - Allow for scenarios that involve moving sensors/sources





# Leveraging Sandia Internal Research for Umbra

- Multi-Layered Security LDRD
  - Uses genetic algorithms to improve probability of interruption within physical security systems
  - Could serve as recommender system for novel security profiles
  - Leveraging prior work on Relational Blackboard (RBB) to *determine combat effectiveness* tactics attempted during simulations

# Summary

- Umbra Simulation Engine provides basis for a wide variety of physical security simulation applications.
- **Dante** examines “what-if” scenarios with force-on-force engagements and provides sensitivity analysis through running several iterations of these scenarios in batch
- **OpShed** provides analysis on surveillance coverage on a targeted area through simulating various sensors

# Thanks

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http://umbra.sandia.gov