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12-14 June 2007, at US Naval Academy, Annapolis, MD



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**Research, Development & Engineering Command/
Army Materiel Systems Analysis Activity (AMSAA)**



AMSAA Verification and Validation of the Infantry Warrior Simulation



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Technology to the Warfighter Quicker



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Overview



- IWARS Background
- Verification and Validation of IWARS Version 1.0
 - Process
 - Tools and Techniques
 - Areas of Review
- Sample V&V Results
- Release Approval
- Current Status





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Brief Description of IWARS



IWARS is:

- Analysis driven
- Entity-based
- Multi-sided simulation
- Focused on individual and small-unit dismounted combatants and their equipment
- Used to assess operational effectiveness across the spectrum of missions, environments and threats

IWARS v1.0 Approved For:

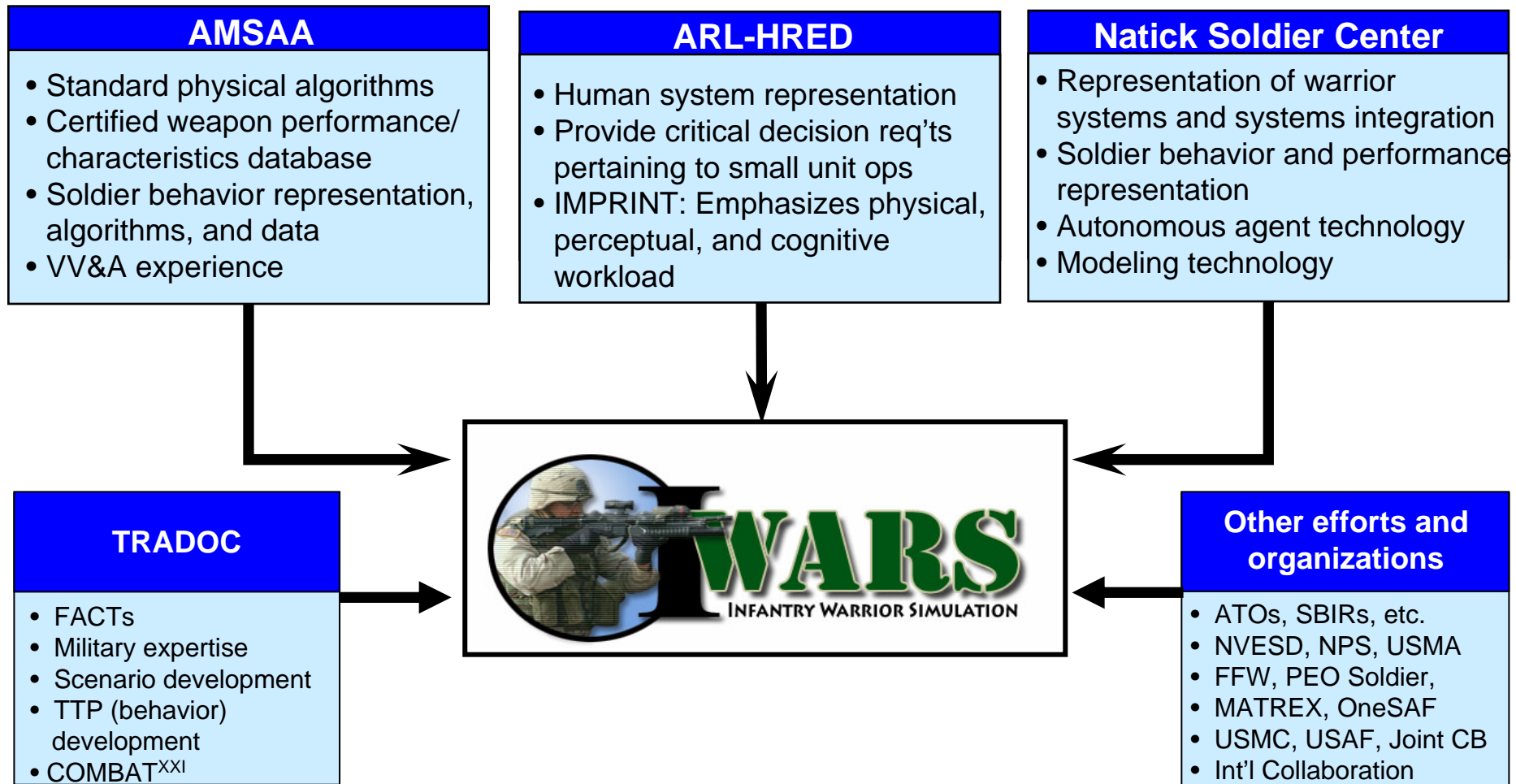
- Soldier Sensor Performance Analyses
- Soldier Small-Arms Lethality Analyses
- Soldier Survivability Analyses
- Limited Situational Awareness / Battle Command Analyses



Army Requires Small Unit Combat Simulation Capabilities to Address Integrated “Soldier-as-a-System” Issues



IWARS Development & Collaboration Team



Leverage Multiple Organizations' Key Competencies



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V&V Purpose



Purpose of M&S V&V:

- Ensure model functions as originally conceived and designed (AR 5-11)
- Ensure the model's credibility in its depiction of real-world functions (AR 5-11)

IWARS V&V Purpose:

- Show simulation functions properly and is easy to use
- Examine model architecture to ensure its stability and flexibility
- Examine software for correctness, efficiency, and maintainability
- Find and correct problems with the model's implementation
- Perform pilot study to show model is ready for analyses
- Ensure documentation exists and is clear and correct
- Ensure Configuration Management (CM) process in place and functioning properly

Ensures Model is Doing it Right, and Doing the Right Thing



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V&V Guidance



V&V consistent with guidance provided by:

- DoD Modeling and Simulation (M&S) Management, DoD Directive 5000.59
- DoD Modeling and Simulation (M&S) Verification, Validation and Accreditation (VV&A), DoD Instruction 5000.61
- Army Model and Simulation Management Program, Army Regulation 5-11



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V&V Process



- **Verification Testing:**

- Perform tests on individual behaviors and methodologies
- Perform Integration tests to assess model in its entirety
- Perform limited study (e.g. weapons trade, sensor trade)
- Review documentation for correctness

- **Validation:**

- Methodologies – Reviewed by SMEs to check equations, data, procedures (Mounted Combat Team, Target Acquisition Team, Infantry Warrior Team)
- Behaviors – Reviewed by SMEs to assess tactical correctness of soldier behaviors (USAIC, US Marine Corps, Infantry Warrior Team)

- **Pilot Study:**

- Employ IWARS as it will be used for analyses
- Identify problems not discovered during testing
- Show that IWARS output varies appropriately to changes in scenario (weapons/equipment, behaviors, situations, etc)
- Demonstrate IWARS suitability for Army studies
 - Soldier Sensor Performance Analyses
 - Soldier Small-Arms Lethality Analyses
 - Soldier Small-Arms Delivery Accuracy Analyses
 - Soldier Survivability Analyses
 - Limited C4I/SA

IWARS V&V Will Ensure IWARS Analysis Capability

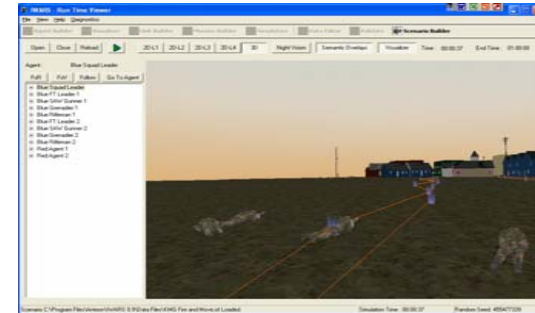


V&V Tools and Techniques



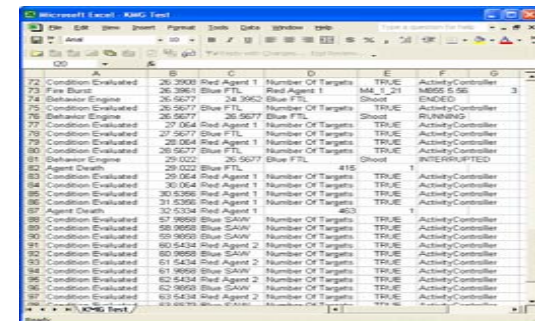
Runtime Viewers

- Viewers reflect mission actions
- Known Agents list populated
- Active skills displayed
- Shot Lines show status of engagement
- Agent location, speed, posture tracked



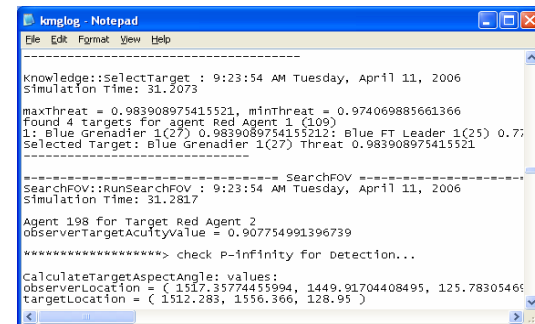
Output Analysis Tool

- Track acquisitions, engagements, communications, behaviors
- Evaluated conditions correctly begin/end skills
- Events filtered for in-depth post-processing
- Events saved in CSV format for follow on processing



Custom Logs / Script Files

- Flexibility to track items not in Output Tool
- Formatted to support follow on processing
- Automatic running of study cases by batch file



Collection of Tools and Results Used to Verify Model



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Problem Reporting

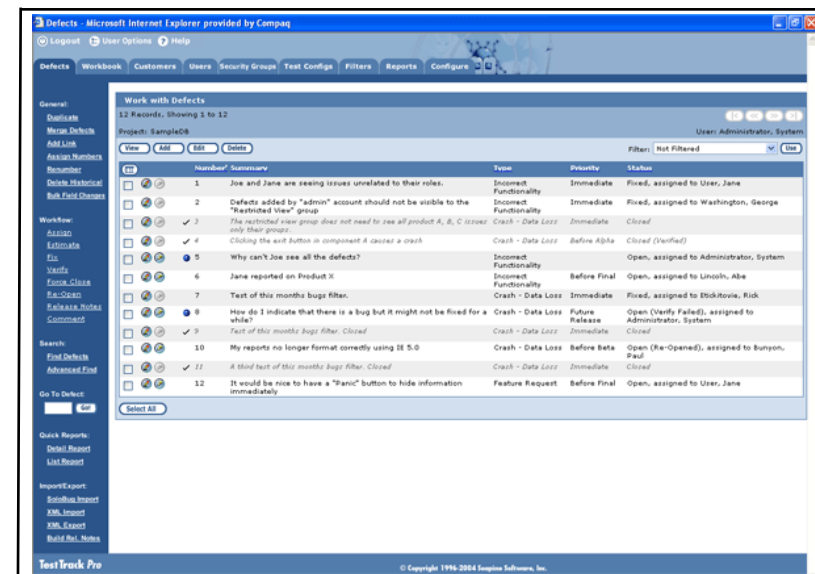


Problem Identification

- Single POC at AMSAA to coordinate submissions and filter redundant requests
- Type of issue identified (Incorrect Functionality, Feature Enhancement)
- Severity and priority of issue determined

Problem Reporting Process

- AMSAA/Natick identify and document issues
- Issues entered through web-based product (Test Track Pro)
- Contractor reviews and assigns issues for correction
- Contractor completes fixes and logs status
- New software drop received and installed by AMSAA/Natick
- AMSAA/Natick retest fixed entries and either close or re-open issues for further work





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V&V Review Areas



- Review addressed required capabilities delivered in v1.0
 - Review depends on nature of required capability:
 - Methodology: numerical results of IWARS compared to stand-alone model or equation results
 - Behavior: skill must alter data structures, be reflected in viewers, and be correctly represented in the database of output events
 - Documentation: rated on clarity, accuracy, usability
 - Architecture: analysis of software structure, flexibility, maintainability
- Usability - input/execution/output assessed for setup time, runtime, ease of access, audit capability

Reviews Determine Degree to Which Requirements Have Been Met



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V&V Effort



- Number of scenarios developed: ~130 (does not include pilot study scenarios)
- Number of test cases run: ~600 (does not include pilot study runs)
 - Parameters varied from run to run to test performance over wide range of inputs/conditions
 - A particular run was often used for multiple tests
- Number of items reported: 117 (only significant outstanding problems were highlighted during the final presentation)
- Specific examples of results presented are representative of tests performed in that V&V area
- Results present summary of findings based on numerous runs, test cases, varying inputs/conditions etc.



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V&V Results



- IWARS V&V Results organized by Soldier functionality:
 - Mobility
 - Lethality
 - Search and Target Acquisition
 - Communications
 - Suppression
- Integrated approach combines results from the major capability areas:
 - Methodology
 - Behaviors
 - Data

IWARS Results Organized According to Soldier Functionality



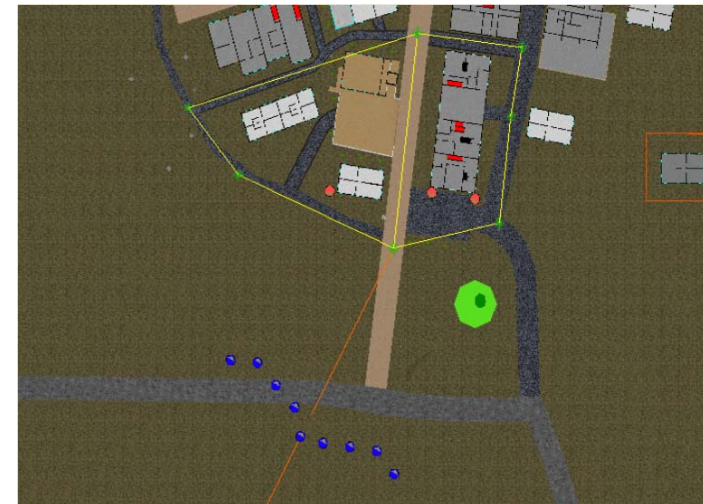
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IWARS Mobility Features



Agent Mobility capabilities in IWARS:

- Movement to waypoints and along paths
- Movement into and within buildings
- Ability to choose path within nodal networks (based on user selected criteria)
- Take correct position in formations (according to soldier role) and maintain that position while moving
- Maintain correct speed as a function of posture, terrain and fatigue
- Avoid collisions





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Mobility Testing



Navigation

Monitor Speed

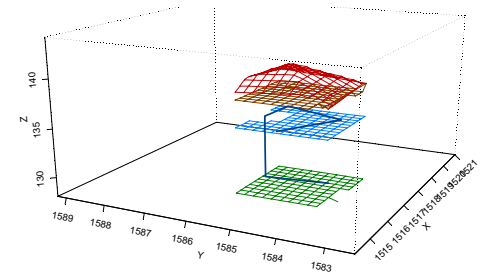
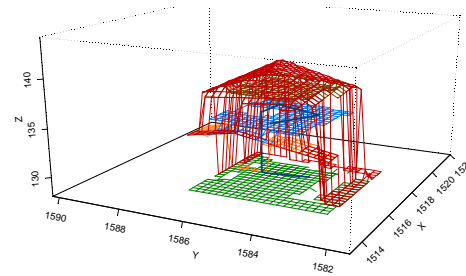
Avoid Collisions

Align with Unit

Move in Formation

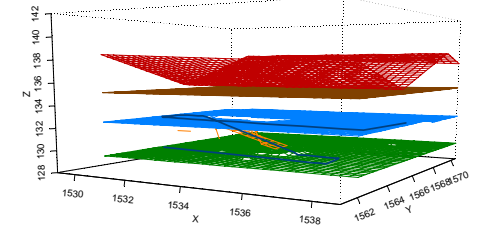
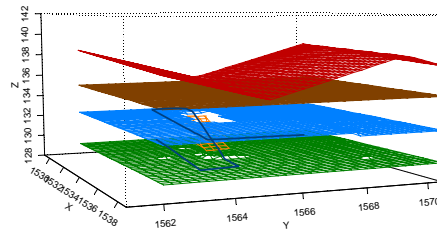
Navigation

- Verify agents can navigate to points, along paths, and along node networks
- Ensure navigation can be done in open terrain as well as interior structures
- Verify agents can determine and maneuver across terrain
- Make maneuver decisions based on force strength



Results

- Agents successfully navigate to points, along paths, and along node networks
- Navigation successfully done in open terrain as well as in rooms, stairwells, towers
- Agents maintain contact with terrain skin during movements
- Agents also have ability to traverse tunnels and ladders
- “Dead force counts and percentages” not working - force strength decisions cannot be used





Mobility Testing



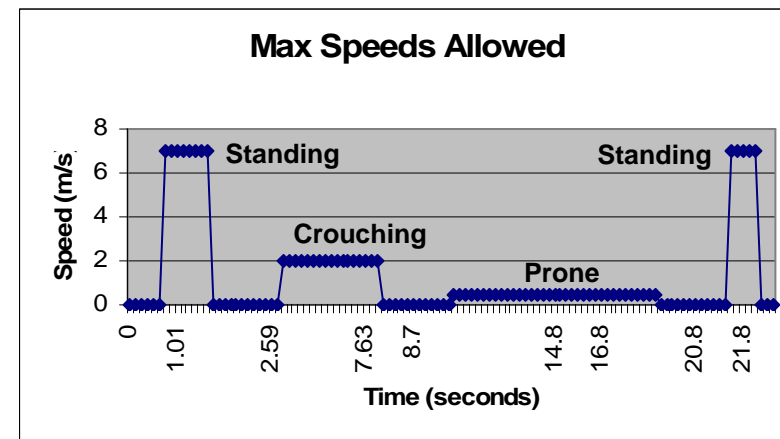
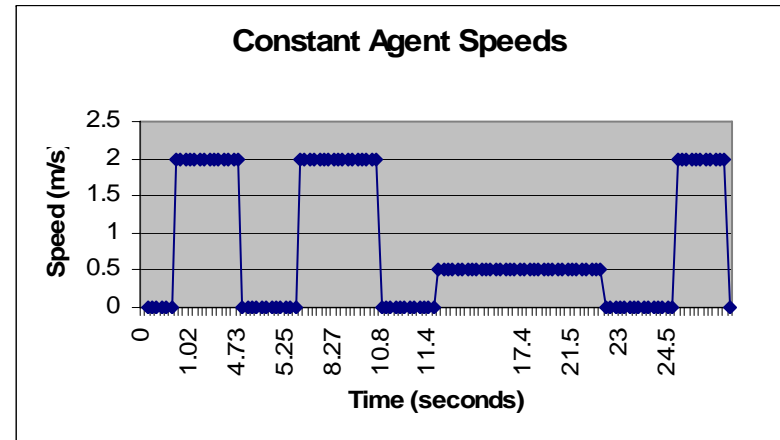
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| Navigation | Monitor Speed | Avoid Collisions | Align with Unit | Move in Formation |
|------------|----------------------|------------------|-----------------|-------------------|

Monitor Speed

- Determine if movement speeds are adjusted due to terrain or fatigue
- Verify maximum speeds per posture are not exceeded

Results

- Movement speeds are not adjusted due to terrain or fatigue
- Movement speeds remain constant to the next waypoint
- Agents do not exceed maximum speeds per posture





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Mobility Testing



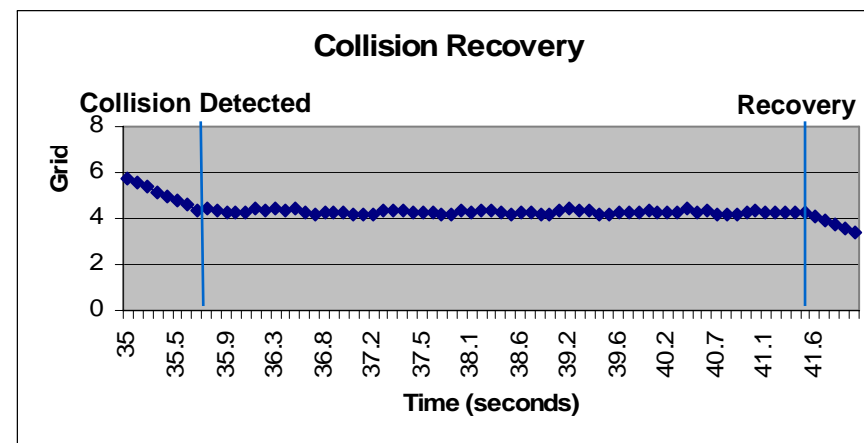
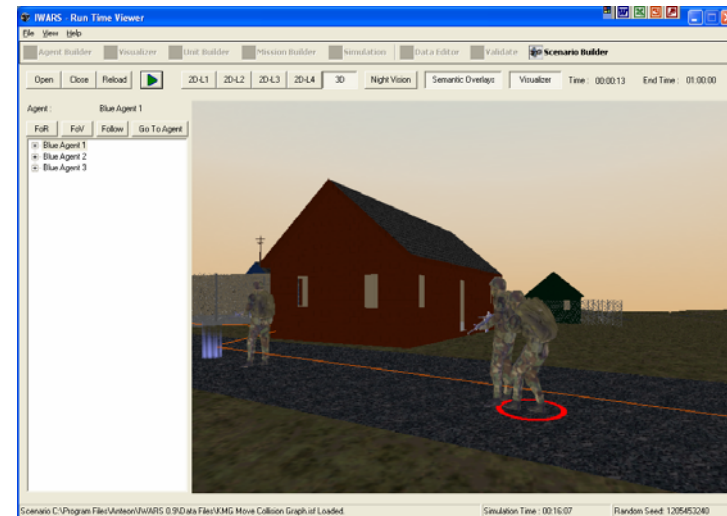
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| Navigation | Monitor Speed | Avoid Collisions | Align with Unit | Move in Formation |
|------------|---------------|-------------------------|-----------------|-------------------|

Avoid Collisions

- Determine agent ability to detect possible collision during movement
- Determine agent ability to avoid or recover from collisions

Results

- Agents successfully determine collisions with terrain features and other agents
- Agents use simplistic collision recovery methodology (move along random direction vector until past obstacle)





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Mobility Testing



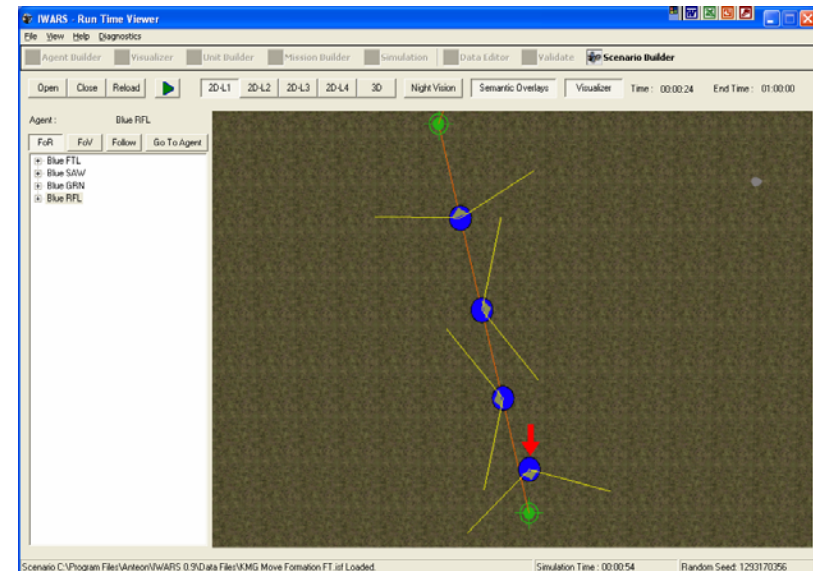
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|------------|---------------|------------------|------------------------|-------------------|
| Navigation | Monitor Speed | Avoid Collisions | Align with Unit | Move in Formation |
|------------|---------------|------------------|------------------------|-------------------|

Align with Unit

- Verify agents align themselves properly in various unit configurations (Buddy Team, Fire Team, Squad, Platoon)
- Ensure agents know unit roles and movement responsibilities

Results

- Agents successfully aligned in various unit configurations (Buddy Team, Fire Team, Squad, Platoon)
- Agents know unit roles and take correct spot in formation
- Agents set FOR according to location in formation





Mobility Testing



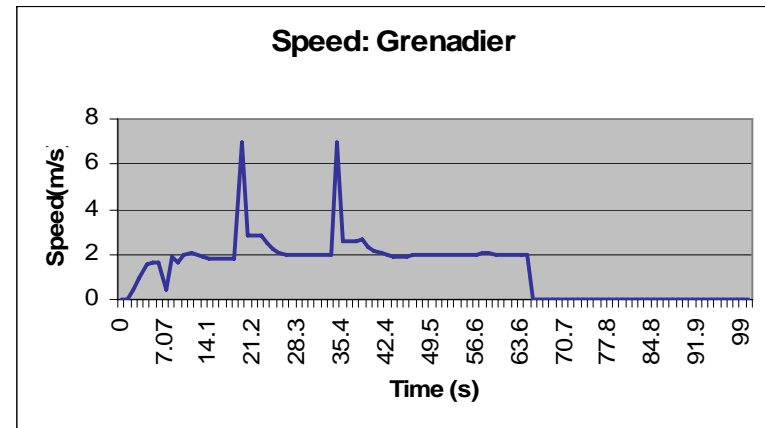
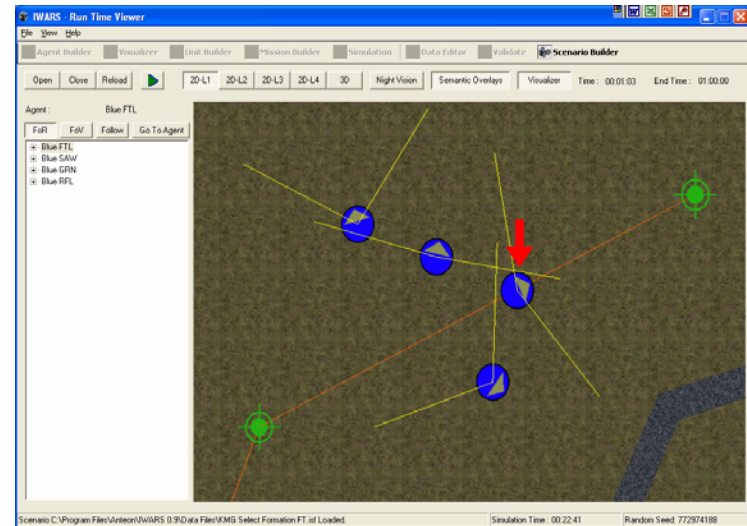
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|------------|---------------|------------------|-----------------|--------------------------|
| Navigation | Monitor Speed | Avoid Collisions | Align with Unit | Move in Formation |
|------------|---------------|------------------|-----------------|--------------------------|

Move in Formation

- Verify model supports correct infantry formations (Column, Diamond, File, Line, Wedge)
- Verify relative agent positioning and offsets during formation moves
- Verify agents maintain correct speeds
- Ensure agents execute correct Field of Regard searches according to role in formation

Results

- Model correctly represents infantry formations
- Relative agent positioning and offsets maintained during formation moves
- Individual agent speeds adjust to maintain relative position
- Agent spacing is static and cannot be altered dynamically
- Agents undertake correct Field of Regard searches according to role





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Release Approval



Based on the results of the current AMSAA IWARS V&V and Pilot Study, IWARS is suitable for use* in the following types of direct-fire, small-unit engagement analysis applications:

- Soldier Sensor Performance Analyses
- Soldier Small-Arms Lethality Analyses
- Soldier Survivability Analyses
- Limited Situational Awareness / Battle Command Analyses

IWARS is Ready to Start Aiding in Army Infantry Analyses

* Certain assumptions and limitations apply



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Current Status



Sample studies being performed

- Close Combat Armament System (CCAS) comparison study
- Two-sided engagement enhancement to CCAS study
- Joint Chemical Agent Detector (JCAD) utility study

Development for next release continuing

- Expanded capabilities list being finalized
- New missions, threats, environments being prioritized

Ongoing Development to Provide Additional Capabilities



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Questions?



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