LLNL-PRES648472
26 Jan 2018

JOINT CONFLICT AND TACTICAL SIMULATION

(JCATS)

CAPABILITIES BRIEF

DISCLAIMER

JOINT CONFLICT AND TACTICAL SIMULATION (JCATS)

Capabilities Brief

The purpose of this document is to provide a brief description of the Joint Conflict and Tactical Simulation (JCATS) model. This paper describes the background, usage, and major capabilities of JCATS.

Overview

The DOD and Homeland Security need a consistent and immersive training environment that reflects the growing complexity of the military environment. To be effective, the training environment must adapt to the changing threat, tactics, and equipment. It must support training of all levels, all services, coalition partners, and non-governmental agencies. No one system today satisfies all these needs. However, networking a collection of simulations (i.e., a federation) is a logical and cost effective training environment. Lawrence Livermore National Laboratory's (LLNL) Joint Conflict and Tactical Simulation (JCATS) system has become the de facto entity level ground maneuver simulation used in these federations.

JCATS is sponsored by the Department of Defense's (DOD) Joint Staff, J7. It is currently the most widely used tactical simulation in the world. The model is installed at over 350 sites throughout the Department of Defense (DOD) and other U.S. Federal agencies. JCATS is also used by NATO and is currently installed in 30 allied nations through the U.S. State Department's Foreign Military Sales program. Other users include the Department of Energy, RAND Corp., Boeing, and General Dynamics.

JCATS provides joint multi-service interoperability with integrated ground, air, water functions, and real world C4I links. Additional features and capabilities include the ability to conduct simulation exercises from playing a single entity (First Person) up through the Joint Task Force level and across the entire spectrum of conflict, to include Stability Assistance Security Operations in both lethal and non-lethal open, urban, and subterranean environments. JCATS is a low cost, low maintenance simulation which has a small foot print (PC laptops at a minimum) and self-contained editors that make it ideal for many uses. As such, JCATS provides an effective tool for supporting training, analyses, experimentation, mission planning, rehearsal activities, school house/academic use, exercises, Course of Action analysis, synchronizations, evaluations, and as a supporting system driver. The simulation can be run in real-time and started and paused on demand. Users can run a Replay for a given run to review player actions. Finally, users are able to run the JCATS application in a Batch mode for the purposes of conducting statistical analysis.

JCATS is also able to federate with other simulations and simulators by using High Language Architecture (HLA) and Distributive Interactive Simulation (DIS) bridges. The current HLA Bridge supports 1516 Evolved and HLA 1.3 federations with the JLVC 2017 FOM and RPR2 based FOMs and has been tested with NG-PRO v8.0, Pitch v5.3, MAK v4 and RTIS 35F.

The HLA Bridge supports connectionless and time managed federate play. This allows JCATS to be federated with large numbers of other simulations for specific purposes, for example, linking with an Air Force high resolution air-to-air combat simulator and first person 3D models. It can link to real players in a training area and show their locations and actions as a part of the game play on the JCATS screen. As a result of JCATS capabilities, it has operated in a combined live/virtual/constructive environment for large military exercises for all branches of military services. JCATS is routinely used for federated exercises running the simulation on one server and launching client workstations locally or to multiple locations around the world. This stable and proven simulation has been chosen by U.S. Joint Staff J7, Marines Corps, and the U.S. Army as their primary ground constructive high resolution entity level model for the following federations:

- Joint Live Virtual Constructive (JLVC) for U.S. JS J7
- The U.S. Army's Entity Resolution Federation (ERF), Joint Land Component Constructive Training Capability (JLCCTC**)**
- The U.S. Army's Live, Virtual, Constructive – Integrating Architecture (LVC-IA)

JCATS is an effects based simulation that accurately replicates entity-level operations. It employs the same terrain data used in the military command, control and mapping systems. It accurately represents all services' observation and sensor systems, weapons, munitions, and vehicles (including ground, sea, and air systems). It is a man-on-man simulation with live opponents employing friendly and enemy tactics and responses. Small unit leaders control their forces on individual client workstations and use their actual battlefield command and control systems to report to higher commanders and staffs. Thus, JCATS portrays the ground truth that occurs in response to friendly and enemy decisions.

JCATS is a client-server system which runs on networked PCs using the Linux operating system. JCATS V13.1 currently runs on Red Hat Linux Enterprise 6.9 as its supported operating system. JCATS does not support any other versions of Linux. JCATS is most commonly configured to run on a single network. However, the model does have the capability to run a simulation on multiple LANs. These LANs can be separated geographically or within the same location. Again, this makes JCATS an excellent tool for conducting business by enabling users to reduce cost and save resources for training, exercises, etc.

Terrain Capabilités

JCATS supports a 24 by 24-degree Lat/Lon play box with no distortion in elevation or location data. However, the model does support larger terrain play boxes if users are willing to tolerate some distortion in the accuracy in elevation and location data. To assist users in playing on larger terrain files without losing fidelity in elevation or location data JCATS support the use of Multi-Resolution maps. A Multi-Resolution map is a single terrain file that has multiple high resolution areas of interest overlaid on the base low resolution map, which reduces both the files size and CPU usage during a game. For example, one can build a low resolution base map of 40 degrees Lat/Lon and have smaller high resolution maps overlaid in those particular areas of interest for exercise play.

A user can zoom in and out during exercise play, from a view of the entire terrain box down to a specific room on a specific floor in a building at 1m accuracy.

Though JCATS displays a simple 2D view that replicates a commander's map view, the simulation uses 3D terrain internally. It employs the same digital terrain data used by military command and control systems from the National Geospatial-Intelligence Agency (NGA), which can then be modified using the JCATS integral terrain editor.

The basic terrain framework is a set of Digital Topographic Elevation Data (DTED) posts which produce a grid of elevation points. The resolution of the grid is based solely on the available data (posts every 100 meters, 30 meters, etc.) JCATS then uses a round-earth algorithm to "tilt" the posts producing an elevation based on the center of a sphere and thus produces a horizon.

Polygons representing soil types, vegetation, and bodies of water are then overlaid over the DTED posts forming the terrain (Figure 4). These polygons (which can be manually drawn, scanned in from a map, or brought in as shape files) have characteristics that affect how an entity can move, see, or shoot. An urban area can be portrayed as a terrain polygon if there is no interest in actually operating within it and it is simply there to block observation and weapons fire. Man-made structures, such as roads, airfields, buildings, subsurface structures are then added to the terrain through the terrain editor.

Buildings can be simple 3D shells or can be enhanced with interiors including multiple stories, walls, windows, stairs, and doorways that can also have locks & keys. Regardless of source, enhanced buildings can be multi-floor. The player can look into any floor or the roof of the building during game play.

JCATS also supports the importing of Compressed Arc Digitized Raster Graphics (CADRG), Geo-referencing Tagged Image File Format (GeoTIFF), and Controlled Image Base (CIB) data. CADRG data has been produced from paper maps in the various scales. When raster graphics are displayed the user may control how the graphics are displayed relevant to the JCATS terrain. Graphics may be displayed on top of or behind the JCATS terrain. The opacity of the graphics may also be set by the user for better viewing. Other advantages of using the raster graphics superimposed on the JCATS terrain file is to match up features that exist in both files but may not line up correctly. If for example a road on the JCATS terrain doesn't line up with the raster graphics road the user can move the JCATS road to line up.

Terrain also includes lighting. In a scenario, there can be overcast conditions, day or night, moon or no moon, and artificial lighting. Player controlled lights can be added (for example, in a building).

The simulation model also has the ability to display various types of grids in order to determine absolute locations and relative distances. The selected grid can be in latitude-longitude, military UTM/MGRS, or a special JCATS grid in meters that relates only to the scenario's terrain box. Regardless of the grid type, as the player zooms in and out during play, the grid changes to reflect the current scale.

The player can also select any point on the map and determine the type of terrain, the location (latitude and longitude) and the elevation during game play. Users can also click on any two points and determine the distance between them (in nautical miles or kilometers) and the azimuth.

Additionally, JCATS allows users to play water with different depths, which supports naval and amphibious operations. Weather effects can be created and dynamically changed during a game that affects movement and visibility along with other parameters. JCATS also supports the play of tunnels with the ability to specify the light levels in those tunnels they wish to play.

Example of Some Major Simulation Capabilities

- ☑ Integrated Joint, multi-service, air-land-sea entity-level operations using common tools on server/client stand-alone and/or expanded multi-client LANS
- ☑ Stand-alone platform or large configurations support (tested using 300 workstation clients with a single server)
- ☑ Comprehensive data editor of systems and aggregated entities reduce database redundancies and facilitates changes/modifications and reuse
- ☑ Unlimited multi-sided force capability with dynamically controlled balanced side relationships and Rules of Engagement (ROE) controlling side interactions
- ☑ User-friendly, mouse-activated, adjustable GUI with multi-menu selectable language system providing interactive player interface to input tactics for immediate or timed execution (languages supported are defined by the Linux operating system and keyboard)
- ☑ The ability for a Client player workstation to switch from a 2D view to a 3D view
- ☑ Multiple ways of issuing orders to entities in a game by selecting the entity icon or double clicking on the entity in a Command Tree
- ☑ Easy access self-contained editors for Scenario/PH-PK, Terrain, Symbols, Behavior, all mountable on a single server/client workstation
- ☑ Dynamic post game analytical tools (Replay / Analyst Work Station (AWS))
- ☑ Real time Killer Victim Scoreboard, which runs simultaneously with the simulation, for monitoring who killed who with what munition
- ☑ Imported or manually designed digitized and scalable x-y-z terrain/cultural features displayed up to 24 x 24 degrees Lat/Lon or greater play box.
- ☑ Underwater obstacles, navigable rivers with currents and fording depths
- ☑ Water bodies with definable depths, ship drafts, sea-state changes
- ☑ Amphibious Assault landing and submarine play to include rubber raft insertions
- ☑ Multi-story urban operations in buildings with windows, doors, interior walls, above and below ground, with connecting tunnels, caves
- ☑ Dynamic global feature changes such as weather and force insertions
- ☑ Dynamically aggregated and de-aggregated, mounted and dismounted systems at various hierarchy levels
- ☑ Mount/dismount exterior/interior of vehicles, ships, airplanes, helicopters
- ☑ Entity adjustable Line-of-Sight/Field of Regard play at 4 levels of acquisition
- ☑ Ground-air-marine radar/sonar to include active/passive features Unattended linear/area sensors security warning features such as fence and door latch alarms, motion sensors,

can link with munitions to produce trip and pressure mines (directional claymores/car bombs)
- ☑ Night operations using star light, phases of moon light and artificial lighting
- ☑ Adverse weather and temperatures affecting movement, acquisition, and fires
- ☑ Automatic & manual direct fires based on ROE setting / side relationships

- ☑ Detailed movement model that includes formation assignments for aggregates, ability to move forward or in reverse, towing, trailing, following, convoys, movement path finding, routes, and numerous activities which can be performed as part of a movement order
- ☑ Movement and conflict in/around buildings, rubbling exterior, fire thru walls
- ☑ Breaching, penetration, clearing of barriers (wire, ditch, rubble, mines)
- ☑ Targetable Bridges that can be damaged, destroyed or take cover beneath
- ☑ Resupply (normal/magic) and leveling of fuel and ammunition
- ☑ Ammunition and weapons recovery/use from any side
- ☑ Capture, surrender, repatriation (added control/movement of captive entities)
- ☑ Lethality determined by user built Ph/Pk or Carlton/Cookie Cutter munitions
- ☑ Non-Lanchestrian combat model with database controlled lethality kills and mobility, firepower, mobility-fire power, and suppression damage
- ☑ Controller kill, partial kill, suppression, fix and resurrect capabilities
- ☑ Direct fire engagements include combat systems in buildings and fratricide
- ☑ Direct Fire Primary/Secondary suppression effects for related entities
- ☑ Precision guided munitions/indirect fires with direct support laser/observers
- ☑ Non-lethal weapons, effects (water cannons, stun grenades, rubber bullets)
- ☑ "Beam weapon" suppression of personnel and vehicles, and electronic kills
- ☑ Launching of Tactical Ballistic Missiles, Cruise Missiles, and Harpys with the ability to model a flyout of the munition so it can be acquired and engaged; basic representation of GPS guided munitions
- ☑ Capability to play chemical contamination (vapor and liquid) and their effects on personnel and equipment. Can play decontamination and chemical sensors
- ☑ High resolution minefield model to include MCLIC clearing capability
- ☑ Can track movement of personnel and/or equipment through the use of Radio Frequency Tags
- ☑ Can dynamically play creating Checkpoints, manning, searching, and changing threat levels based on the tactical situation
- ☑ Deploy & Recover tactical launched bridges
- ☑ Intelligent path finding movement planning
- ☑ Dynamically create & play Integrated Air Defense System (IADS) Networks
- ☑ Robust Air Mission capabilities and controls for fixed wing and helicopter play
- ☑ Overlay graphics drawing tool and internal email between player workstations
- ☑ Capable of importing, creating, and playing Air Tasking Orders (ATO) and Airspace Control Orders (ACO).
- ☑ Capable of dynamically injecting a new system or aggregate into a running game
- ☑ Direct stimulation of the Global Command and Control System (GCCS) & Networked Interoperable Real-time Information Services (NIRIS) without third party software
- ☑ Automated behavior for systems and aggregates using Tactical States & Missions, as well as, Tactical Movement Techniques (Bounding Overwatch, etc.).

Summary

This document has highlighted some of the major capabilities of JCATS. There are many more features and capabilities of this model. Questions into the details and acquisition of JCATS should be directed to the Conflict Simulations Laboratory at Lawrence Livermore National Laboratory at phone number (925) 424-5654 or (925) 422-2052. Users may also visit the Conflict Simulation Laboratory web page at: https://csl.llnl.gov.