2007-03

Team 2: Situation Awareness of an Infantry Unit in a Chemical Environment

Kent, W.

http://hdl.handle.net/10945/35616

Team 2: Situation Awareness of an Infantry Unit in a Chemical Environment

TEAM 2 MEMBERS

W. Kent, MAJ – Lead, Contact*
NPS, US

G. Pearman, LTC (Ret.)
Consultant, US

Z. Henscheid
Northrop Grumman, US

L. Calloway
General Dynamics, US

M. Ferguson, CPT
Air Force Research Labs, US

J. Roginski, MAJ
CNO SSG, US

M. Ugarte, MAJ
TRAC - Monterey, US

INTRODUCTION

The team's primary research goal was to test an agent-based simulation's capability to rapidly prototype a chemical environment and its affects on mobile forces. Specifically, the overall research effort studies levels of chemical situation awareness (SA) and their impact on combat effectiveness of a Future Force Warrior (FFW) platoon using the agent-based simulation Pythagoras.

Pythagoras is a low-resolution simulation that enables rapid model development using agents, such as individual soldiers or chemical clouds, with assigned simple behaviors. These simple behaviors tend to produce complex results when coupled with varying experimental factors and multiple agent interactions. To efficiently explore the effects of complex results across numerous factors requires advanced experimental designs, flexible modeling tools, high-performance computing, and advanced data analysis capabilities.

This research highlights findings regarding combat effectiveness at various levels of chemical SA and recommends whether Pythagoras is a viable tool to model chemical environments. Specifically, the following points will be used as guidelines of the research:

- Produce a reasonable non-persistent agent scenario, including the modeling of SA in Pythagoras.
- Consider a variety of diverse measures of performance and effectiveness.

Description of Scenario

The initial scenario stems from prior research completed by MAJ Jon Alt, a graduate of the Naval Postgraduate School. It simulates a FFW capable platoon conducting a movement to contact operation in an urban environment. To adapt his simulation for our use we needed to add additional sensors and agents to model the non-persistent chemical environment and its effects on the platoon.

The first modeling addition was the chemical agent. Two ways of modeling the agent were discussed. First, we would be able to model the chemical effects through the use of constant indirect fire and damage functions. Second, we could model the effects using actual model agents who would fire at the modeled human agents in the scenario. After discussion of the benefits of both modeling options, we decided to use the latter method.

Since there are different levels of dosage of chemical agents, we modeled two types of chemical entities. The lethal dose of the chemical agent was represented by agents who carried a weapon that "shot" chemicals at the human agents. The non-lethal dose was represented by agents who also carried a weapon to "shoot" chemicals at the human agents, but the non-lethals' weapon had no lethality (or effectiveness) so as not to actually kill a human agent.

* For more information contact: W. Kent, wekent@nps.edu

In order to trigger a reaction in the human agents from being shot by the chemical agents, we utilized Pythagoras' attributes. Three generic attributes are given to each model entity. As the human entities get shot, they receive damage in the form of an increase in their attributes. Once these attributes get to a threshold level, a state change is triggered. This, in effect, modeled a self-detection of the chemical. Once a detection occurred, the blue forces were directed to put on their chemical protective mask, move to a rally point, and, after a period of time to report the incident, to continue their mission to secure a certain piece of terrain.

Another addition to the initial simulation was the addition of mechanical chemical detectors. The detectors were modeled after the Joint Chemical Agent Detector (JCAD) by decreasing the threshold level at which they would make a self-detection. In other words, the JCAD is simply modeled by allowing the human agents with this device to make near-instantaneous self-detections instead of adding the JCAD as a separate sensor.

Modeling SA

In order to model situation awareness, we decided to script four plausible scenarios. The four scenarios branch from the combination of two levels of SA from their initial intelligence prior to the start of the mission and two possible distributions of the JCAD within the platoon. Therefore the four separate scenarios were as follows:

- No prior intelligence and the platoon leadership and unmanned ground vehicles carrying the JCAD
- No prior intelligence and only the platoon leadership carrying the JCAD
- Prior intelligence and the platoon leadership and unmanned ground vehicles carrying the JCAD
- Prior intelligence and only the platoon leadership carrying the JCAD

Figure 1 is a screen shot of the first scenario listed above. The green agents in the picture are the representation of the chemical IED after the explosion. It also shows the blue agents received some exposure from the chemical prior to masking.

Factor and MOE Selection

Eight factors and two MOEs were selected. We wanted to farm over blue speed, the obedience of the soldiers after they put on their protective mask, internal communication effectiveness, external communication effectiveness, the number of UAVs, the number of UGVs, JCAD sensitivity, and the marksmanship of the soldiers after they don their protective mask. The MOEs we decided on were mission accomplishment and time to accomplish the mission.

Additional data was needed to accurately depict mission accomplishment in addition to the Pythagoras MOE of arriving at the final way-point, or objective. So, we opted to collect data on the number of casualties from both chemical and kinetic weapons, the level of dosage for each blue agent, and the human agents' work output (modeled as fuel usage).

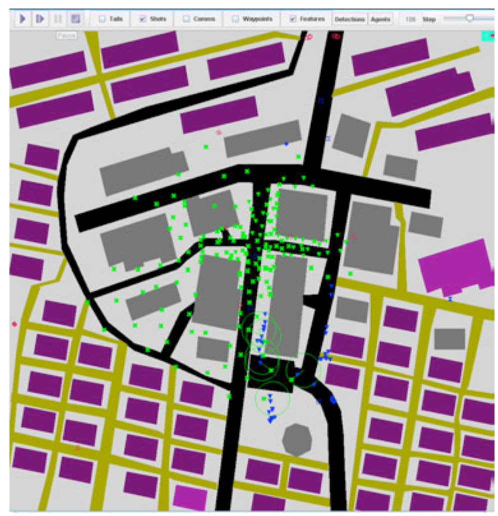

Figure 1: Model snapshot

Job Submission

We placed our factors into a NOLH spreadsheet that gave us our design. In conjunction, we placed our scenario file into the Tiller to interface with a computer cluster. The Tiller provided us with a study file that we manipulated our design of experiment into. At that point, time became a factor in actually receiving data back for our analysis and no model runs were conducted.

CONCLUSIONS

Team 2 set out with two goals in mind as stated earlier. We accomplished the goals with the building of our four scenarios and selecting the MOEs for use in ongoing research. We also concluded that an agent-based model is a feasible type of model for rapid modeling and analysis of chemical environments and SA.