Title: **Agentization of the Battlefield**

Author's:
Name: Dr. Philip J Emmerman
Organization: Army Research Laboratory
Address: Army Research Laboratory
ATTN: AMSRL-IS (Philip Emmerman)
2800 Powder Mill Road
Adelphi, Md. 20783
Telephone: (301) 3941956
FAX (310) 3945420
E-mail **emmerman@arl.mil**

Name: Mr. John Grills
Organization: Army Research Laboratory
Address: Army Research Laboratory
ATTN: AMSRL-IS (John Grills)
2800 Powder Mill Road
Adelphi, Md. 20783
Telephone: (301) 3943978
FAX (310) 3945420
E-mail **jgrills@arl.mil**

Agentization of the Battlefield

There are several significant and related trends in the evolution of the tactical battlefield. One relates to the increased automation of the nerve center or tactical operation center. The second relates to the digitization of current battlefield platforms. The third is the rapid development of robotic or physical agents for numerous battlefield tasks such as clearing buildings, or acting as wingmen for a future combat vehicle. This paper attempts to illustrate the potential synergy between these disparate developments, particularly related to battlefield visualization and software agents.

There is a strong sense of dissatisfaction in the design and functionality of current tactical operation centers (TOC). Much of this concern is caused by the lack of mobility, inefficiency and high complexity of these centers. The extensive hardware, software, and manpower resources needed to operate a current TOC severely limit the mobility needed for the future battlefield. The TOC exists to support the tactical commander in understanding the state of the battlefield and being able to predict its future state. This comprehension enables rapid and effective decision making and leadership in the battlefield. Although the TOC is the information and control center of the tactical battlefield, it must also be able to project its critical information to a remote commander who is frequently in a platform such as a tank or helicopter observing the battlefield. Therefore the TOC is an essential part of a highly distributed and mobile force. A scalable, extensible, and adaptable visualization and software agent architecture and rich application set are required to achieve the efficiency envisioned. Visualization and software agent thrusts are closely linked because of the need to visualize both the Agent State as well as the results of their analysis. To reach the efficiency needed, most low level information retrieval, dissemination, and analysis will be performed or controlled by these agents. A generalized multi-resolution approach to visualization as well as analysis is introduced and demonstrated. Most of the current emphasis of the battlefield visualization program is on providing a global infrastructure with the ability to visualize the battlefield (terrain, weather, entities, features, communications, etc.) at whatever resolution data is available. This enables the commander to have a custom global view of the battlefield as well as any high-resolution local view to support critical decisions. This same infrastructure supports high fidelity local views for the platform commanders as well as the ability to jump to any other local view in the world to support training or preparation for deployment. This scalability provides a single visualization approach for both TOC's and platforms including robotic platforms.

The digitization of the lower echelons of the army strongly enhances the coupling of the TOC and the tactical platforms. It enables the automated exchange of data and information as well as more advanced applications by means of an agent environment. This paper illustrates several key examples, (in logistics, maneuver, and intelligence) of these agent applications that tie the TOC and platform worlds together. This automated information exchange will greatly reduce the latency of information and enable a more real time control system approach in the battlefield.

Physical agents are another type of platform, albeit without humans onboard. It is anticipated that physical agents or robots will be ubiquitous on the battlefield of the 21st century, and will exhibit a range of sizes and capabilities. Currently there are several military programs that are developing small robots for a variety of applications in urban and cross country terrain. Several applications apply to the TOC itself such as remote sentries and remote communications relay. Software agents may be used as the high level control of these physical agents as well as the automated information transfer mechanism similar to the human centered platforms. The scalable visualization approach applies well to these automated platforms. Military planners currently utilize digital terrain and elevation data along with digital feature data to plan maneuvers. Because the currently available elevation data is so coarsely sampled (100m post spacing), these planned routes may contain numerous significant obstacles. In order to traverse these routes the manned or unmanned vehicles must sense and react to these obstacles. As the number of reactions increases the time to complete the mission also increases. Fortunately, under the battlefield visualization umbrella, there are programs, which are developing the technology to both rapidly generate and visualize much higher resolution data. Most of the current emphasis of the battlefield visualization program is on allowing an operator the ability to visualize the battlefield (terrain, weather, entities, features, etc.) at whatever resolution data is available. This would enable an operator to visualize the planned routes and manually detect obstacles. If the planning and execution analysis could utilize the high-resolution data then many of the obstacles that fall within the 1-100m range would be detected and avoided in the plan. However, the cost for this high-resolution analysis is increased response time, since the route planning algorithms would be using much more data. A multi-resolution analysis approach would greatly assuage this cost for most areas. Because the cost for reactive planning is high, particularly in robotic platforms, significant mission time savings are expected.

The army must take advantage of the synergy between its visualization, software agent, and physical agent technology development. Without this holistic approach, multiple competing visualization and software agent designs will proliferate.