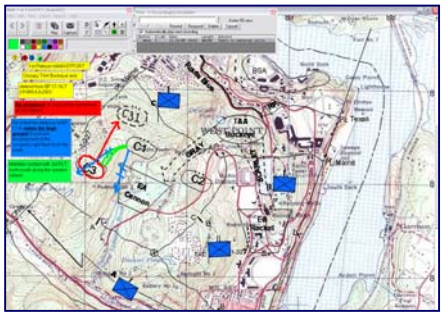
Military Planning Research

Project 1



Title: *Continuous Adaptive Planning in the U.S. Army*
Principal Investigator: Philip J. Smith (Co-PI: Jodi Heintz Obradovich)
Funding Source: Army Research Laboratory
Funding Period: 06/01/01 - 09/30/04
Award Amount: $550,000

Description

A critical challenge for the Military is supporting distributed work in the development of robust operations plans. Especially challenging is the continuous and dynamic planning that occurs during the execution phase of operations when revisions of these plans may be required in the face of unanticipated events. In previous research, we have identified alternative architectures for supporting such distributed work, as well as a number of different technologies and processes that can be used to significantly enhance continuous distributed planning in military operations. The relevant technologies include:

- Tools to support rich synchronous and asynchronous communication.
- Advanced displays to support visualization.
- Artificial intelligence approaches to support planning and plan adaptation.

Such tools support the development of a common frame of reference by all of the participating agents, and allow them to more effectively communicate and coordinate during continuous planning activities. They also use active decision support technologies to allow mixed initiative interactions among human and computer agents.

This work for the Army Research Laboratory focuses on the following questions:

- How do different architectures for distributing work affect performance on tasks involving initial plan development and continuous and dynamic planning during the execution phase of operations?
- Can tools be developed to effectively support the distributed plan development and adaptation process?

To date, several observational studies have been conducted at Army Warfighter exercises. In addition, a prototype tool to support asynchronous communication of rich multimedia messages, the Collaborative SLide ANnotation Tool, has been developed and tested, demonstrating improvements in situation awareness in the communication of battle operations orders of 47-65%.

Project 2

Title: *Intelligent Propulsion System Foundation Technology*
Principal Investigator: Nadine B. Sarter
Funding Source: Glenn Research Center
Funding Period: 08/01/03 - 04/30/04
Award Amount: $148,125

Description

The overall goal of this research project is to contribute to enhanced aviation safety by developing a human-machine interface that helps prevent incidents and accidents involving malfunctions of future intelligent propulsion systems. The specific objective of this task is to develop the conceptual design for a use-centered cockpit interface that: a) informs flight crews about predicted and actual malfunctions of the propulsion system in a timely and effective manner. and b) supports them in their fault management activities, which include prognosis, detection, diagnosis, and compensation. To this end, a review of the design of, and difficulties with, existing glass cockpit engine indications and display systems was conducted, and potential new functions (including improved prognostic capabilities) and associated failure modes of future propulsion systems are being identified.

Based on the findings from these activities, candidate designs for components of the fault management interface will be designed, evaluated, and iteratively refined, through heuristic evaluations and cognitive walkthroughs with pilots.

Project 3

Title: *Advanced Decision Architectures: Building Information Superiority in the Army through User-Centered Decision Support*
Principal Investigator: David D. Woods (Co-PIs: Philip J. Smith, B Chandrasekaran, Wayne E. Carlson, Nadine B. Sarter, Emily S. Patterson, W. Gary Allread)
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $361,898

Description
This research contains two sub-projects.

The first involves *Event Patterns as the Basic Unit of Communication in Human-Computer and Distributed Teams*. The objective of this project is to understand and overcome challenges in making event patterns a basic building block of visualization and collaboration. The primary benefit of this project is shifting the unit of display from data elements to events is a critical part of information fusion from dispersed sensor nets in surveillance and personnel detection, to control a mix of assets (soldiers, robots, UAVs), and for horizontal fusion of data to C2 commanders as they coordinate forces in complex and urban terrain. Examples include:

- The *hierarchical event template structure* integrates data from distributed sensors and algorithms to reveal events which deviate from typical behavior and threat behavior for surveillance and personnel detection.
- Point-of-view becomes a central variable in human-machine interaction, fusing information from and simplifying interaction with a suite of autonomous resources that monitor activities in a scene.
- *Visual narrative* organizes diverse data about mission plans and contingencies.

The second sub-project relates to *Dimensions of Human-Robot Control*. Its objective is to develop new forms of coordination between human and robotic resources. The results can be used to help design future soldier-robot teams. The new concepts for remote perception are particularly relevant to Military Operations in Urban Terrain (MOUT), search and rescue, and using robots in confined spaces.

Project 4

Title: *Human-Robot Coordination and Advanced Decision Architecture*
Principal Investigator: David D. Woods
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $120,000

Project 5

Title: *Event Patterns and Advanced Decision Architectures*
Principal Investigator: David D. Woods
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $244,669

Project 6

Title: *Multi-Modal Interaction and Advanced Decision Architectures*
Principal Investigator: Nadine B. Sarter
Funding Source: Micro Analysis and Design
Funding Period: 06/01/01 - 09/30/04
Award Amount: $270,000

Description
The battlefield of the future will be characterized by high levels of complexity and dynamism. It will involve a large number of human and machine agents in various locations, needing to collaborate on planning and problem-solving tasks, sometimes under considerable time pressure and risk. This implies that effective information systems and information operations, i.e., the ability to collect, store, distribute, fuse, and share information, will become increasingly important for the success of every U.S. Army operation.

The goal of this research project is to support timely and effective information sharing through multi-modal information presentation and exchange. In particular, we are developing a framework and guidance for the integrated and adaptive use of various modalities (which will ultimately include visual, auditory, tactile, and olfactory cues) in support of synchronous distributed coordinative functions, especially in highly dynamic high-tempo military operations.