2007 CCRTS
THE STATE OF THE ART AND THE STATE OF PRACTICE

Title of Paper: Modeling and Agent-Based Simulation of Organization in a Stochastic Environment

Student Paper Submission
(Suggested Track: Modeling and Simulation)

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This work is supported by the Office of Naval Research under Contract #N00014-00-1-0101

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Abstract

This paper presents a computational model of organizations operating in stochastic mission environments, and its implementation in a discrete event simulator. The model depicts an organization as consisting of information processing and command/communication structures. The organization is structured to achieve a specific set of goals, and is comprised of individuals with limited information processing capabilities. The mission is composed of a set of interdependent tasks. Each task has two phases, i.e., task identification phase and task execution phase. In the identification phase, surveillance resources are used to collect information on tasks; this information is used to infer the hidden attributes of a task. Once the attributes of a task are inferred through information analysis, its execution requirements can be determined with a higher degree of certainty. The execution phase consists of allocating the resources necessary to schedule and complete the task.

To simulate the behavior of an organization working on a command and control mission environment with a concrete objective, we implement the mission environment and organization model in a discrete event simulator. We illustrate how the model implementation can be used to provide organization designers insights into organizational behavior and performance.

- **Organizational Model**

We extend the models of mission environment and an organizational model described in our earlier research [4], as follows:

1) Resources can be utilized to gather information to infer the attributes of tasks as well as to execute tasks.

2) Tasks

Each task has a list of attributes, which determine the nature of a task (e.g., threat, neutral, friendly) and its processing requirements. These characteristics include:

- Resources required to execute the task,
- Baseline processing time
- Baseline workload required per unit time

The resources, time and workload requirements to identify a task are assumed to be known by each decision maker.

4) Agents and Organizational structure

Agents, or decision makers, engage in the activities of an organization, by virtue of their task assignment and their position in the organization. Agents own a set of resources for task identification and/or execution. Agents are characterized by self-goals and individual's performance expectation in the mission, as well as organizational goal and the performance expectation of the entire team in the mission.

Organizational structure incorporates the assignment of decision makers/agents to groups and the hierarchy of the groups establishing clear lines of responsibility. In this paper, we consider the impact of command and communication structures on organizational performance. An example of a typical activity in the command structure is that a commander, i.e., an agent in a higher position in the command structure, has control on his subordinate agents' resources. An example of a typical activity in the communication structure is that agents having direct communication link can coordinate their resources directly in executing their assigned tasks. The identification and execution activities associated with tasks, as well as activities associated with command control, communication and coordination all contribute to the agents' workload. Agents have workload constraints due to their information processing and task execution limitations.

The metrics used to evaluate the performance of an organization include: mission completion time, task identification rate, task completion rate, resource utilization rate, and task accuracy. The model is being applied for pre-experimental evaluation of organizational performance in the A2C2 experiment [5,6] to be conducted in spring 2007.

References

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