Human Interaction with Autonomous Systems in Complex Environments

Autonomous systems can greatly reduce human workload in complex environments by handling routine or cognitively challenging operations. Such autonomous systems, however change the nature of human tasks and can introduce new risks. Thus, a key question for this symposium was: How do we make people more effective and safe in performing tasks in cooperation with an autonomous system? If the autonomous system is distributed the tasks become even more challenging, as the human may not have an integrated view of the underlying environmental state and the associated task responsibilities. It is our view that effective human interaction with autonomous systems requires more than just good user interface design. It involves substantial challenges in the design of the autonomous systems themselves and in the representation and use of the cognitive models underpinning human interaction with autonomous systems.

Some of the key problems that were addressed in this workshop are:

- The circumstances and methods by which the autonomous system notifies humans of environmental events (nominal or off-nominal) and accepts task inputs from humans.

- The mismatch between the knowledge modeling in the autonomous software and mental modeling of operational tasks that can result in unpredictable autonomous action and human error.

- The dissociation of the human from routine operations that can result in a naive understanding of the autonomous system and inappropriate or erroneous response to anomalies.

- The failure to consider human task priorities and preferences that can result in intrusive or distracting autonomous actions.

- The potential for conflicting or confounding actions when multiple humans interact simultaneously with distributed autonomous systems.

- The circumstances and support for a human to adjust the level of autonomy and/or change the distribution of roles and responsibilities between the autonomous system and humans.

- The allocation and control of initiative among human and intelligent software agents.

- The roles that cognitive aiding software can fulfill (such as assisting human tasks, standing in for the human, augmenting human capabilities, or critiquing human actions) and the associated representation and reasoning challenges (such as dynamic allocation of task responsibility and authority).

- Models and software architectures supporting groups of multiple humans and multiple software agents

Human interaction with autonomous systems can fall into several different categories: 1) human as a supervisor; 2) human as a bystander; 3) human as a collaborator; and 4) human as a user of assistive agents. Each of these categories has its own challenges and they are all represented in the papers in this report.

Organizing Committee:

David Kortenkamp, NASA Johnson Space Center/Metrica Inc. (co-chair)
Mike Freed, NASA Ames Research Center (co-chair)
Michael Cleary, Draper Laboratory
Debra Schreckenghost, NASA JSC/Metrica Inc.
Reid Simmons, Carnegie Mellon University
David Woods, Ohio State University