

Preface

Autonomous systems are needed to reduce human workload, to increase efficiency, and to perform routine, monotonous, challenging, or dangerous operations for which humans are not cognitively or physically well suited. The persistent or continuous nature of these needs in many applications requires deploying autonomous systems that can endure changing circumstances over extended operation. A key challenge for fielding such systems is supporting effective interaction between humans and the autonomous systems as situations and objectives change. Designs for short-term or one-shot deployment need not accommodate such changes. Over extended operations, equipment will degrade, human preferences and needs will change, environmental context will drift (e.g. weather changes), novel influences and obstacles will appear for which an autonomous system has not been explicitly prepared, and even high level goals and missions may shift. To be effective over extended operation, autonomous systems must be designed for appropriate interaction with humans to realize and respond to these changes.

Some of the key issues that were addressed in this symposium are:

- What is the state of the art for autonomous systems that operate over extended operation? What are the characteristics of today's autonomous systems that operate over extended operation in an environment that allows or requires human interaction?
- What does "extended operation" mean in terms of the capabilities of current systems? How do we foresee the evolution of the capabilities for extended operation in the future?
- By examining different applications for autonomous systems (e.g., aerospace, elder care, military, industry), what can we learn about the requirements and possible solutions for interaction between humans and autonomous systems? What lessons have we already learned from existing applications? What are the biggest technical challenges and possible solutions for running these systems over extended periods of time?
- What are the current barriers to fielding autonomous systems that must interact with humans over extended operation? Are these barriers due to a lack of knowledge about how to create such systems, a lack of appropriate implementation technology, or a social/cultural resistance to embracing such systems?
- Is adaptation a requirement for autonomous systems in this context? How should autonomous systems deal with unpredictable and previously unknowable situations?
- How should humans and autonomous systems work together? When do teamwork models work best as opposed to (or in conjunction with) traded control or adjustable autonomy, for example?
- What models should autonomous systems have of people and vice versa? How can we help each to track and understand what the other is doing?
- How should humans and autonomous systems communicate, e.g., when is a natural language interface necessary for effective interaction?

This symposium explored applications in which humans and autonomous systems interact across changing circumstances over extended operation. We examined the changing role of humans in these applications as automation, agents, and robots become more prevalent in the future. Overall, the symposium

participants gained insights into design challenges for future autonomous systems by exploring the synergy on this topic among research areas such as control automation, robotics, agent-based systems, human-computer interaction, psychology, sociology, and cognitive science. This report contains papers addressing each of these key areas.

James Gunderson and Cheryl Martin,
Symposium Chairs