



# Invited Talks

## **Deploying Robust Autonomous Systems— Lessons from the Remote Agent Experiment**

*Nicola Muscettola, Autonomy and Robotics Area, Computational Sciences Division,  
NASA Ames Research Center, USA*

The need to reduce cost and the desire to tackle ambitious exploration goals pushes NASA toward adopting ever more sophisticated and autonomous software systems for its missions. The techniques of artificial intelligence promise to solve several key problems in the design and implementation of such software. However, the increase in complexity produces legitimate concerns on system correctness, robustness and reliability. While AI has typically strived to demonstrate sophisticated capabilities, not much attention has been given until now to the problems of verification and validation. This talk discusses these issues from the vantage point of our experience in the Remote Agent Experiment. Remote Agent was the first autonomy architecture to operate in inter-planetary space, controlling the *Deep Space One* spacecraft for a total of 2 days in May 1999. Remote Agent demonstrated the ability of being commanded by high-level goals and generating plans that achieved them, and the ability to fix the plan after device faults while continuing to keep control of the spacecraft. We will discuss some of the lessons learned from the experiment on how to increase the acceptability of autonomous AI systems by the operational community.

## **The Computer's Role in the Cognitive Revolution**

*Subrata Dasgupta, Eminent Scholar Chair in Computer Science, Director of Institute of  
Cognitive Science, and Professor of History, University of Louisiana at Lafayette, USA*

The complex relationship between technology and science — between humanity's attempt to understand the natural world, and its desire to harness and manipulate nature for practical human purpose — is one of the enduring and fascinat-

ing themes in the history of human culture. The appeal to technological artifacts and their operations as a *model* or *metaphor* for the workings of nature is one facet of this relationship. The use of technology to built *physical instruments* that help perceive the natural world is another. Both uses serve a common purpose: as *amplifiers of the human ability to comprehend the natural world*. My focus in this talk is on a very recent technological artifact — the computer — and the role it has played as an amplifier for comprehending one kind of natural phenomenon, one we call mind. Using an historical perspective, I will review how the computer has served to make and shape the scientific movement often called the *cognitive revolution*. I will try to explain how the computer has served roles in effecting this revolution, both as a powerful metaphor for explanation and description, and as a physical instrument for amplifying our sensory and cognitive capabilities for following mental phenomena.

### **AI and the Web: The Next Generation**

*James Hendler, University of Maryland and DARPA/ISO, USA*

It is clear to most Web watchers that the “next big thing” is a web in which far more of the information is produced by and for machines. Instead of a web of information for human presentation, the web will enable new applications and environments enhanced by computational “agents” that perform many low level tasks, freeing humans to use the web without many of today’s hardships and headaches. The overwhelming amount of information available out there, however, makes this a daunting task and a challenge to the AI community: this is our revolution to win! Unfortunately, accepting this challenge may completely revise how we view the field of AI, and the methodologies we use. In this talk I look at the web through an AI filter — what is the web, why is it hard for us, and how can we take advantage of the opportunities it may offer if we accept the challenges. In passing, I also point out that this may be the best thing ever to happen to AI — freeing us from the rut we are in now to explore the really hard science of how humans think and interact!

### **Promoting Transfer the Case-Based Reasoning Way**

*Janet L. Kolodner, Professor of Computing and Cognitive Science,  
Georgia Institute of Technology, USA*

Studies in cognitive science and cognitive psychology tell us much about the ins and outs of promoting transfer — the ability to apply what one has learned in new situations. They tell us just how hard it is to promote transfer, some conditions that are better than others, some of the characteristics of learning environments that promote transfer, and some exemplary classroom practices. Nonetheless, those accounts are far from complete enough to use in designing classroom ac-

tivities that promote transfer, as they are weak in telling us exactly what's going on cognitively in the learner. Case-based reasoning, originally developed as a way for computers to reason like experts, begins to address that issue by providing a model of the processes involved in integrating experiences into memory, retrieving them when needed, and applying them — the basic processes required for good transfer. CBR's model makes suggestions about the kinds of reasoning that promote turning one's experiences into easily-accessible cases, and the kinds of interpretations and variety of experiences that promote extraction of and iteration towards deep understanding of concepts and acquisition of skills. Understanding the implications of that model has allowed us to extract principles and cycles of classroom activities that should promote transfer and an approach to learning science called *Learning by Design* (LBD). We've implemented LBD's principles in a variety of curriculum units aimed at middle school students and in software called SMILE. Evidence of transfer and of development of the kinds of understanding that will allow later transfer is abundant.