Augmented Cognition and Human-Robot Interaction

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The theme of this minitrack is how people use robots or computer systems to facilitate their performance. We sought papers that concern problems in augmented cognition and human-robot interaction. A goal of augmented cognition is to reduce the complexity of tasks. Suggested ways of accomplishing this goal include utilizing technology to adapt either the task or the way the task is represented. We encouraged papers related to all facets of augmented cognition and human-robot interaction and are pleased to present papers that not only describe systems designed to augment cognition but also provide empirical studies, field studies and case studies that evaluate these systems.

Scholtz introduces the human-robot interaction portion of this minitrack by describing the rationale behind the theory and evaluation of these interactions. In describing their version of embedded interfaces for human-robot interaction, Daly, Cho, Martin and Payton show how they use techniques from augmented reality to communicate information from large numbers of small scale robots operating as a coordinated swarm. In their paper on human-robot interaction for intelligent assisted viewing during teleoperation, McKee and Brooks report finding a simpler reactive algorithm to replace their visual acts algorithm. Experimental evidence showed the newer algorithm performed as well as the previous algorithm as well as encouraging the operator to be more aware of depth information. Nicolescu and Mataric linked perception and action in a unique architecture for representation of robots' behaviors. Kawamura, Nilas, Muguruma and Johnson describe efforts to develop an adaptive graphical user interface for mixed-initiative interaction between a human and robot. In a practical application, Bruemmer, Marble, Dudenhoeffer, Anderson, and McKay present a case study that examines the human-robot dynamic of a teleoperated task. They outline a mixed-initiative command and control architecture for hazardous environments. Biagioni and Sasaki propose and analyze efficient wireless sensor placement to satisfy communication and data collection requirements. Several of the papers employ either user models or physiological measurements to assess skills or mental processes. For example, Brezillon, focuses on making the context explicit for users and gives examples of context based representations. Pavel, Wang, and Li use a model of attentional processes and perform an experiment to test their framework for optimum attention allocation processes. Feng describes an integrated multimedia environment for speech recognition using handwriting and written gestures. Damianos, Loehr, Burke, Hansen and Viszmed performed an experiment to examine the effects of speech enabled input on cognition experiments. Vick and Ikehara describe methodological issues of real time data acquisition from multiple sources of physiological data while Izzetoglu, Yurtsever, Bozkurt, Yazici Bunce, Pourrezaei and Onaral use near infrared (NIR) spectroscopy measurements as a tool to understand cognitive ability. As part of larger data collection effort, Ikehara and Crosby describe experiments related to user identification based on the analysis of the forces applied to a computer mouse. Marshall, Pleydell-Pearce and Dickson integrate psychophysiological measures of cognitive workload and eye movements to detect the users' strategy shifts. Pleydell-Pearce, Whitecross and Dickson provide insights into the importance of individual differences for accurate prediction of the users' state by using a multivariate analysis of EEG for predicting cognition on the basis of frequency decomposition, inter-electrode correlation, coherence, cross phase and cross power. Aschwanden and Stelovsky discuss their software architecture for measuring cognitive load with an event stream framework using data collected from a variety of physiological measurements or events. In order to provide a framework for the papers presented in this minitrack, Crosby, Iding and Chin review research on task complexity as a foundation for augmented cognition. Task complexity is a construct that has been used in many areas such as user models, human computer interaction, human factors and instructional design. Hopefully, recommendations and guidelines that emerge from these presented papers will give teams of educators, computer scientists, and curriculum designers additional perspectives on how to first assess cognitive capabilities of individuals and then tailor human computer or human robot applications with an ability to augment cognition.

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