

# Expectations, Intentions, and Actions in Human-Robot Interaction

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Human-robot interaction is becoming increasingly complex through the growing number of abilities, both cognitive and physical, available to today's robots. At the same time, interaction is still often difficult because the users do not understand the robots' internal states, expectations, intentions, and actions. Vice versa, robots lack understanding of the users' expectations, intentions, actions, and social signals.

Many studies have been conducted unveiling the importance of properly designed adaptive human-robot interaction strategies in general and appropriate feedback in particular. Robotic systems have been built that reflect the progress in the different fields in robotics with regard to learning, autonomous behaviours, safe navigation, and manipulation. However, integrated approaches to

- understanding the user and her expectations, intentions, and actions,
- transparently communicating to the user what the robot understood or expected,

– and designing appropriate robot behaviours based on its understanding of the world

are still in their infancy.

This special issue bundles recent advances in addressing these challenges. The key questions are how meeting or failing the user's expectations influences the efficiency and effectiveness of human-robot interaction; how more effective and efficient interaction with humans can be achieved using modalities available to a robot; how robots can be equipped with models enabling them to understand their users' state of mind; and similarly, how they can make their own expectations and states explicit through eligible communication channels.

Each of the seven articles in this issue highlights different aspects around the central theme of *expectations, intentions, and actions in human-robot interaction*. The topics covered range from recognition of verbal and non-verbal cues of intentions and expectations, to verbalisation and presentation techniques that make internal processing of the robot accessible to the human. In the following we give a brief overview of the contents of the articles.

Komatsu, Kurosowa, and Yamada ask “How does the Difference between Users' Expectations and Perceptions about a Robotic Agent Affect Their Behavior?” They call this difference the *adaption gap* and research how it affects the decisions of the users in a game. Their findings show that the participants with positive adaptation gap signs (i.e., the robot performed better than they expected) accepted the robot's suggestions more often than users with a negative adaptation gap sign (i.e., the robot performed worse than they expected). This work shows that expectations indeed play a major role in human-robot interaction.

The paper by Rosenthal, Veloso, and Dey deals with the problem of “Acquiring Accurate Human Responses to

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Robots' Questions." They identify and evaluate four different types of state information that a robot can use to ground non-supervisors in its state when requesting help. The authors describe what they believe to be the most appropriate combination of information to communicate the robot's intentions and to trigger the right actions by the users.

Two papers in this issue focus on the *analysis of human behaviour* to facilitate *contingency* in interaction with a robot. Contingency is inherently related to expectations in interaction, as contingency can only be achieved if the mutual expectations of the interactants are met. However, the objectives of this analysis of contingency in the two articles differ: While Lohan *et al.* propose a model to detect tutoring turns in an interactive learning setting informed by adult-infant interaction, Lee *et al.* investigate the potential of multimodal cues to help turn-taking in natural interaction.

Focusing on the perception of intention and emotions, Yohanan and MacLean define different categories of *intent* in the interaction with an affective artificial creature. Those intents are related to emotional states that are haptically conveyed to a robot. The contribution proposes patterns of gesture use for emotional expression as well as a touch dictionary used to convey those different intents.

The paper by Lemaignan *et al.* entitled "Grounding the Interaction: Anchoring Situated Discourse in Everyday Human-Robot Interaction" presents a robotic system that can engage in *situated dialogues* with a human about shared tabletop environments. The system comprises perceptual modalities that allow it to build symbolic representations of the environment. One of the key aspects of the approach is that the system is capable of *perspective taking* – effectively allowing the robot to take into account the human's perspective as well as its own when interpreting and generating utterances.

Finally, Salem *et al.* present work on the generation of behaviour by the robot to facilitate the understanding of robot's intentions and expectations. They propose a novel *gesture generation* mechanism evaluated on a humanoid platform to produce *co-verbal* hand and arm gestures.

Some of these papers are extended versions of work presented in two preceding workshops, others have been submitted to an open call for papers. This special issue appears as a follow-up to the workshops on *Interactive Communication for Autonomous Intelligent Robots (ICAIR)*, held at the ICRA 2010 conference in Anchorage, AK, USA, and on *the Role of Expectations in Intuitive Human-Robot Interaction*, held at the HRI 2011 conference in Lausanne, Switzerland.

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