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Social cobots: Anticipatory decision-making for collaborative robots incorporating unexpected human behaviors

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ABSTRACT:

We propose an architecture as a robot’s decision-making mechanism to anticipate a human’s state of mind, and so plan accordingly during a human-robot collaboration task. At the core of the architecture lies a novel stochastic decision-making mechanism that implements a partially observable Markov decision process anticipating a human’s state of mind in two-stages. In the first stage it anticipates the human’s task related availability, intent (motivation), and capability during the collaboration. In the second, it further reasons about these states to anticipate the human’s true need for help. Our contribution lies in the ability of our model to handle these unexpected conditions: 1) when the human’s intention is estimated to be irrelevant to the assigned task and may be unknown to the robot, e.g., motivation is lost, another assignment is received, onset of tiredness, and 2) when the human’s intention is relevant but the human doesn’t want the robot’s assistance in the given context, e.g., because of the human’s changing emotional states or the human’s task-relevant distrust for the robot. Our results show that integrating this model into a robot’s decision-making process increases the efficiency and naturalness of the collaboration.