Abstract

Human–Robot Interaction challenges Artificial Intelligence in many regards: dynamic, partially unknown environments that were not originally designed for robots; a broad variety of situations with rich semantics to understand and interpret; physical interactions with humans that requires fine, low-latency yet socially acceptable control strategies; natural and multi-modal communication which mandates common-sense knowledge and the representation of possibly divergent mental models. This article is an attempt to characterise these challenges and to exhibit a set of key decisional issues that need to be addressed for a cognitive robot to successfully share space and tasks with a human.

We identify first the needed individual and collaborative cognitive skills: geometric reasoning and situation assessment based on perspective-taking and affordance analysis; acquisition and representation of knowledge models for multiple agents (humans and robots, with their specificities); situated, natural and multi-modal dialogue; human-aware task planning; human–robot joint task achievement. The article discusses each of these abilities, presents working implementations, and shows how they combine in a coherent and original deliberative architecture for human–robot interaction. Supported by experimental results, we eventually show how explicit knowledge management, both symbolic and geometric, proves to be instrumental to richer and more natural human–robot interactions by pushing for pervasive, human-level semantics within the robot's deliberative system.