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Applications in HHI: Physical Cooperation

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Abstract

Humans critically depend on permanent verbal and nonverbal interaction – for aligning their mental states, for synchronizing their intentions and goals, and also for performing joint tasks, such as carrying a heavy object together, manipulating of objects in a common workspace, or handing over components and building or assembling larger structures in teams. Typically, physical interaction is initiated by a short joint planning dialog and then further accompanied by a stream of verbal utterances. For obtaining a smooth interaction flow in a given situation, humans typically use all their communication modalities and senses, and this often happens even unconsciously. As we move

toward the introduction of robotic co-workers that serve humans – some of them will be humanoids; others will be of a different shape – humans will expect them to be integrated into the execution of the task at hand, just as well as if a human co-worker was involved. Such a flawless replacement will only be possible if these robots provide a number of basic action primitives, for example, handover from human to robot and vice versa. The robots must also recognize and anticipate the intention of the human by analyzing and understanding the scene as far as necessary for jointly working on the task. Most importantly, the robotic co-worker must be able to carry on a verbal and nonverbal dialog with the human partner, in parallel with and relating to the physical interaction process. In this chapter, we give an overview of the ingredients of an integrated physical interaction scenario. This includes methods to plan activities, to produce safe and human-interpretable motion, to interact through multimodal communication, to schedule actions for a joint task, and to align and synchronize the interaction by understanding human intentions. We summarize the state of the art in physical human-humanoid interaction systems and conclude by presenting three humanoid systems as case studies.

Keywords

Physical Cooperation

Human-humanoid Interaction Handover