Ubiquitous Semantics: Representing and Exploiting Knowledge, Geometry, and Language for Cognitive Robot Systems

In this paper, we present an integrated approach to knowledge representation for cognitive robots. We combine knowledge about robot tasks, interaction objects including their geometric shapes, the environment, and natural language in a common ontological description. This description is based on the Web Ontology Language (OWL) and allows to automatically link and interpret these different kinds of information. Semantic descriptions are shared between object detection and pose estimation, task-level manipulation skills, and human-friendly interfaces. Through lifting the level of communication between the human operator and the robot system to an abstract level, we achieve more human-suitable interaction and thus a higher level of acceptance by the user. Furthermore, it increases the efficiency of communication. The benefits of our approach are highlighted by examples from the domains of industrial assembly and service robotics.