Anthropomorphism and Social Robots: A Discussion

BRIAN R. DUFFY

Media Lab Europe
Sugar House Lane, Bellevue, Dublin 8, Ireland
brd@media.mit.edu   http://www.medialabeurope.org/

***Abstract:* -** What is anthropomorphism? And specifically what role could anthropomorphism play in social interaction between robots and people in mutual physical spaces? This paper seeks to discuss the basic issues of how anthropomorphism could be employed in social robot research while considering the inherent advantages and disadvantages prevalent in anthropomorphic paradigms.

***Key-Words:* -** Social robots, anthropomorphism, communication

1 Introduction

Research to date in the robotics domain has primarily tended to address strong kinematic functionality (Honda Humanoid), specific sensor modalities (vision, sonar), or strongly theoretical control paradigms (neural networks, multi-agent systems) often inspired by human or animal capabilities. The argument for developing more complete systems is a difficult one when confronted by strong symbolic arguments and a requirement to provide robust empirical data to reinforce qualitative and/or quantitative justification. The robot "Shakey" [Nilsson, 1984] was the first to attempt a complete physical system and as such highlighted failings and fundamental issues with classical artificial intelligence approaches for real-world application domains.

The objective of Social Robot research is to build a robot that can engage humans in a familiar and compelling manner providing social communicative functionality that is natural and intuitive. From a scientific perspective, the use of such terms as "familiar", "compelling", "natural" and "intuitive" are about as difficult to deal with as the notion of "anthropomorphism".

This paper seeks to assess its possible contribution to such a particular problem domain as social interaction between machines and people and embrace those facets that are conducive to the social situation without becoming entrapped in resulting over expectations that anthropomorphism can promote.

2 The Social Robot

Being "social" implies the existence of interactive relationships. An agent capable of interactive, communicative behaviour is considered social. But, as the simple existence of two autonomous entities (human/robotic) in the same environment forces aspects of social contact, be it direct or indirect, the necessity for a robot to have social capabilities is clear. In order for multiple robots to exhibit and maintain robust behaviours in a mutual environment necessitates a degree of social functionality.

The current state of the art in the realisation of high-level social behaviour has only recently extended from a conceptual interpretation and understanding with Newell's *Social Level* [Newell, 1990], and Jennings *et al.*'s *Principle of Social Rationality* [Jennings and Campos, 1997]. The limitations of robotic hardware systems and their corresponding control architectures have generally dictated the extent to which complex control methodologies facilitating explicit social scenarios could be realised. A wealth of anthropomorphic social analogies in the pursuit of the intelligent robot has only begun to be exploited (Duffy, 2000; Breazeal, 2000).

The following subsections discuss how aspects of human-like features could be implemented on a social robot in order to augment the interactive functionality of the robot with people.

2.1 Deliberative Mechanisms

The existence of a robot in a social community promotes the use of such deliberative mechanisms conducive to the development of strong social interaction as found in Belief-Desire-Intention approaches (Rao & Georgeff, 1991) where the notions of beliefs, desires and intentions can be implemented in a social context. The use of a BDI control architecture facilitates the implementation of an artificial notion of intentionality (Searle, 1992) on robotic systems. Such high-level deliberative mechanisms have provided abstract reasoning mechanisms about the robot's physical and social environment (Duffy *et al.,* 1999). When such a system's social and environmental knowledge is stored in the form of beliefs, a degree of system observability is obtained. Limited decoding of this knowledge is required for interpretation by any human observer. This facilitates an understanding of the robot's data acquisition and learning processes for testing and analysis. The social and physical representations that each robot builds of its environment become more transparent. With the implementation of a speech recognition system and voice synthesiser enabling direct social communication with people, the intentional architecture could greatly facilitate the human-robot communication process when it already operates at an intentional level through its BDI functionality.

2.2 Social Mechanisms

In order to achieve co-operation for explicit social tasks, relationships of some form must be established between robots and people. This involves an important characteristic of the agent concept: social ability [Wooldridge and Jennings, 1995], which requires each agent to be aware of other agents that also interact in its environment and with whom it must negotiate. As language will