

Titre : Affective Haptic Human-Robot Interaction

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Context:

Nonverbal expressions are often used to communicate emotions between people (including prosody, facial expressions, body movements and hand gestures). Unfortunately, research in embodied communication and human-robot interaction are not yet able to reproduce the full potential of human-human affective communication. The use of the haptic modality in human-computer interaction opens up new prospects. Interpersonal haptic interaction gives access to various pieces of information through complementary perception mechanisms such as tactile and kinesthetic channels. Psychological studies suggest that the haptic channel plays a very important role in social interactions (Poggi 03, Hertenstein et al. 06, Bailenson et al. 07). It can communicate positive / negative emotions and enhance the meaning of other verbal and nonverbal communication. Recent studies highlighted specific biological systems and perception mechanisms that are dedicated to the expression and perception of emotions through these haptic channels (Olausson et al. 08). Moreover, psychological theories of emotions suggest a strong link between emotions and the body. For example, the Component Process Model (Scherer 10) considers the following components of emotions: a neurophysiological component (bodily symptoms), a motor expression component, a motivational component (action tendencies), a cognitive component (appraisal), and a subjective feeling component (emotional experience).

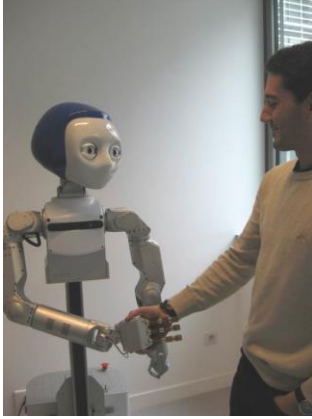
Haptics is therefore a relevant modality to investigate embodied cognition during human-robot affective interaction since it involves a physical contact and interaction between the user's body and the robot's body (Bergamasco et al. 11). In the field of mediated communication and Human-Computer Interaction, several works studied the potential of the haptic channels to support affective communication (Bickmore et al. 10, Gaffary et al. 13). They investigated different stimulation strategies (pneumatic, thermal, kinesthetic) according to different interaction configurations (handshaking, smartphone). They observed that haptics might correctly convey some emotions while providing a better social presence of the remote partner/autonomous virtual agent.

Issues, objectives, and methodology

Several robotic (including humanoid) platforms feature the possibility of haptic communication with the user. Surprisingly, haptics has been little studied in the field of Human-Robot Interaction where researchers mostly investigated facial and gestural interaction. But the physical contact could support additional information, which may influence the affective interaction with the user. The project proposes to address affective haptic interaction with robots by exploiting human's capacities to express and perceive emotions through the haptic channels. In order to explore this new field, it is necessary to investigate several issues going from the integration of new sensors to the psychological study of expression and perception of emotions via haptics and by a robot.

Based on the Robotic platform MEKA, we propose to integrate a series of tactile and physiological sensors on the robot's skin (arm, hand, etc.). These sensors will detect the physical behavior and the emotion state of the user. Thereafter, a series of experimental studies will be conducted to identify haptic expressions, physical invariants, and regions of the body of the robot and the user involved in the expression and perception of emotions. These results enable us to propose a model which aggregates affective haptic robot behaviors in interaction with a human user. Finally, the project will take place in the context of children social and educational activities. Several studies observed that the communication between a child and an adult (teacher, parents, etc.) is not only based on eye-contact and

speech but also is embodied through touch and haptics. This type of communication conveys various kinds of emotional information (Trevarthen 01), and develops into joint attention that helps the child to learn the meaning of various concepts in the world. This leads him to an easy acquisition of new knowledge (Tomasello 99). Different scenarios involving children-robot haptic interaction will be investigated: guidance of gestures in learning and educational tasks (robot that guides a child and vice versa), and educational games / riddle with physical contacts.



MEKA platform (ENSTA ParisTech): Humanoid robot with articulated arms and hands coupled with an

Prerequisite: Programming C++/Python. ROS, Control and automatic, Haptics (Psychology/Stimulation)