Cognitive and affective architecture for social Human-Robot Interactions

Social Context
Most robots in use today have an industrial or military use. However, service robots for daily life now challenge this professional usage. In 2012, about 3 million service robots for personal and domestic usage were sold. These sales mainly include vacuum robots and lawn mowing robots. However, a new type of robots is emerging, aiming at assisting people during their daily life activities. One can think of assistive robots taking care of elderly people, or pedagogical robots for children. More generally these robots are called “companion robots” because their main mission is to support and assist people in their everyday life activities and to keep them company. One of the specificities of such robots is that they interact more and more closely with their human users, and their value is much more on social than physical interaction [1]. By close, we mean that robots must share not only the same physical space but also goals and beliefs to achieve a common task through their interactions.

Research challenges
During the past decades, research in robotics has mainly focused on fundamental skills such as robust perception, navigation and catching or moving things. One of the challenges is now to endow our companion robots with subtle and smart abilities such as understanding and reasoning, emotion detection and expression, empathetic behaviour,... They should also interact intuitively and easily through speech, gestures, and facial expressions.

In spite of the numerous contributions in the field of cognitive architectures, (see good reviews for example [11], [12]), most of them are generic and few can really deal with the complexity of human-robot interactions (HRI). They are not tailored to meet the specific needs of social HRI, such as handling emotions, language, social norms...

That is why developing a cognitive architecture for social robots able to take into account the complexity of interactions with humans still remains a real challenge. Such an architecture requires various features: emotions, non-verbal aspects of interaction, reactive and deliberative levels (fast emotional answer versus slower and more deliberate answer), explicit manipulation of mental states (enabling self-explanation)...

PHD research objectives
This PHD thesis follows our previous work in three research projects funded by the French national research Agency (ANR): ANR CECIL project, ANR MOCA project and ANR SOMBRERO project. These projects have contributed to the ongoing development of our Cognitive and Affective Interaction-Oriented architecture called CAIO (see Best Late Breaking Report Nomination paper [10]).
The goals of this PhD thesis are threefold:

- to fully implement this architecture and experimentation scenarios, using a lightweight humanoid robot (for instance a Nao robot)
- to propose an evaluation method and criteria, and apply this to experimentally evaluate the architecture at all stages of development
- to identify from these experimentations the necessary additions to improve the social capabilities of robots endowed with this architecture, and to realise some of these, for instance:
  - automatic activity analysis to learn socially acceptable interaction models;
  - multimodal perception of the user, including their emotions;
  - impact of emotions on various cognitive processes (memory, planning...).

**University, laboratory, team**

- Grenoble Informatics Laboratory : [https://www.liglab.fr](https://www.liglab.fr)
- MAGMA team : [http://magma.imag.fr/](http://magma.imag.fr/)

**Supervisors**

- Sylvie Pesty ([sylvie.pesty@imag.fr](mailto:sylvie.pesty@imag.fr)) Grenoble Informatics de Grenoble [http://magma.imag.fr/content/sylvie-pesty](http://magma.imag.fr/content/sylvie-pesty)

**Co-Supervisors**

- Carole Adam ([carole.adam@imag.fr](mailto:carole.adam@imag.fr)) Laboratoire d'Informatique de Grenoble [http://magma.imag.fr/content/carole-adam](http://magma.imag.fr/content/carole-adam)
- Damien Pellier ([damien.pellier@imag.fr](mailto:damien.pellier@imag.fr)) Laboratoire d'Informatique de Grenoble [http://magma.imag.fr/content/damien-pellier](http://magma.imag.fr/content/damien-pellier)

**Bibliography**


