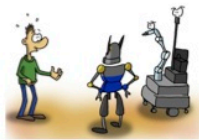


On robot decisional abilities for human-robot joint action

Aurélie Clodic, Séverin Lemaignan, Amit Kumar Pandey, Lavindra de Silva, Mathieu Warnier, Rachid Alami
LAAS-CNRS, Toulouse



Questions for a robot which collaborates with humans:
What, who, where, when, how ?



Integrative approach for a robot that acts in interaction with humans

Work on Collaborative / Interactive task achievement

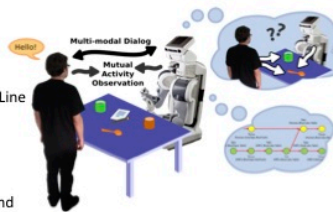
- based on a study of human-robot interaction
- inspired from Joint activity / Teamwork
- concretized as a set of robot decisional abilities

is progressively producing a coherent basis for **Joint Human-Robot Activity**

A Task Oriented Architecture

- **Task-Oriented:** How to perform a task, in presence or in interaction with humans, in the best possible way
 - Efficiency
 - Safety
 - Acceptability
 - Intentionality
- **Plan-Based:** Planning and On-Line Deliberation
 - Reasoning
 - Anticipation
 - Pro-active behaviour
- **Theory of Mind** – Predicting and reasoning about human activity and mental state

H&R Sharing Task and Space

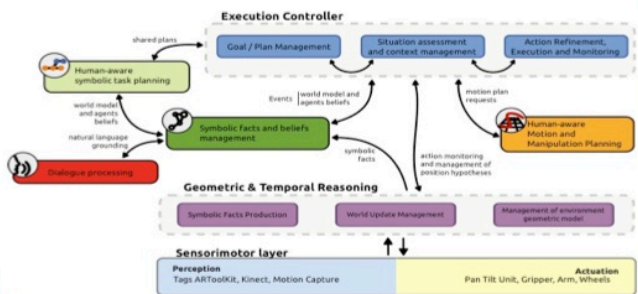


Building a « good » plan

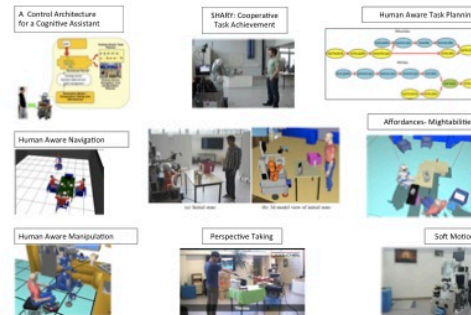
- Managing Joint task achievement
- Legibility of robot actions and intentions (intentionality)
- Acceptability of robot actions
- Compliance with “conventions”
- Coherent attitudes and behaviours

=> Constraints on robot plans

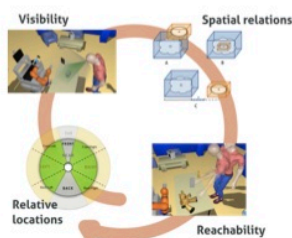
Robot Decisional Architecture



Decisional Ingredients



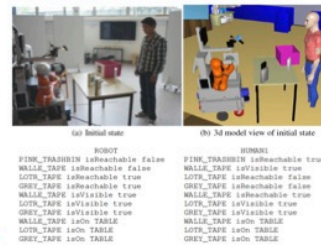
Perspective-taking and geometric reasoning



Real Video Recording Motion Planner 3d Display



Facts related to objects, robot and human (from the robot perspective)



S. Lemaignan, R. Alami, A.K. Pandey, M. Warnier, J. Guillon. **Towards Grounding Human-Robot Interaction**, in Bridges between the Methodological and Practical Work of the Robotics and Cognitive Systems Communities – From Sensors to Concepts, Springer Publishing, 2012.

S. Allii, V. Montreuil, and R. Alami. **HATP task planner for social behavior control in autonomous robotic systems for HRI**. In The 9th International Symposium on Distributed Autonomous Robotic Systems, 2008.

A. Clodic, H. Cao, S. Allii, V. Montreuil, R. Alami, R. Chatila. **SHARY: A Supervision System Adapted to Human-Robot Interaction** in Springer Tracts in Advanced Robotics, Experimental Robotics, 2009, ed.Khatib, Kumar, Pappas vol.54.

S. Lemaignan, R. Ros, L. Mosenlechner, R. Alami, and M. Beetz. **Oro, a knowledge management module for cognitive architectures in robotics**. In Proceedings of the 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems, 2010.

E.A Sisbot, L.F. Marin-Urias, X. Broquere, D. Sidobre, R. Alami **Synthesizing Robot Motions Adapted to Human Presence. A Planning and Control Framework for Safe and Socially Acceptable Robot Motions** International Journal of Social Robotics Volume 2, Issue 3, 2010

F. Dehais, E Akin Sisbot, Rachid Alami, Mickael Causse **Physiological and subjective evaluation of a human-robot object hand-over task** Applied Ergonomics , Vol 42, Nr 6, pp 785-791, 2011

Emrah Akin Sisbot, and Rachid Alami **A Human-Aware Manipulation Planner** IEEE Transactions on Robotics, Volume:28 , Issue: 5, 2012