Involvement of the motor system in perceiving and understanding the external world: A computational account

Abstract : How do we understand the external world and how do we learn from other agents? To answer this question I will present –within a unified theoretical, computational and robotic framework– an embodied view of individual and social cognition, in which the understanding of the external environment and the social milieu is fully grounded in the sensorimotor processes of perception and action.

The point of departure is the "motor simulation theory" according to which the brain constructs internal models of the body and the external world for engaging in overt goal-directed actions; in turn, once established, these internal models support "motor understanding" of the external world in terms of possible action patterns. This theory reuses the concept of generative and predictive models, well established in computational motor control and neuroscience for the study of perceptual and motor processes, and is supported by the seminal discovery of mirror neurons in the monkey brain which linked –for the first time– two functions that were traditionally segregated: action planning and social understanding.

In this talk I will present some recent achievements in the field of social robotics that exploit the above idea of motor simulation: How can robots acquire models of –and from– the external world? How can they use those to understand others' actions and intentions? Can said models be deliberately modified at run-time to increase the likelihood of being understood by the others? How could robots engage in complex joint actions with humans? I will also present few ongoing international projects I am involved with and linked with the overall goals introduced above.

Short bio : I am Senior Researcher at the Department of Computer Science Engineering at the University of Palermo, Italy and Affiliated Researcher at the Icelandic Institute for Intelligent Machines (IIIM) in Reykjavik, Iceland. My main research interests are in the field of machine learning and robotics with emphasis on Bayesian learning, hierarchical/latent models, approximate inference, social robotics (action/intention recognition, learning from others, joint action) and big data. I am also generally interested in relations to neuroscience (e.g. neural learning patterns) and cognitive science (e.g. motor simulation view of social cognition). I have published more than 50 articles in international journals and peer-reviewed conference proceedings, and I am holder of one pending patent.

I served as team leader and scientific board member of the 2M EU-funded project "HUMANOBS: Humanoids that Learn Socio-Communicative Skills by Observation" (FP7-ICT-231453) from 2009 to mid 2012. I teach Robotics and Machine Learning (for graduates) and Operating Systems (for undergraduates). In my spare time I consult on Machine Learning, Big Data and NLP.