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Presentation title:

Computational joint action: from joint coordination to artificial partners

Abstract:

Many of our everyday activities take place in social settings and are coordinated with other persons. Even seemingly simple interactions, like a pair of workers sawing timber with back and forth movements, or a therapist providing physical therapy to a patient, require that two individual minds are somehow connected and their bodies coordinated. The characteristic feature of these interactions is that subjects influence each others' behavior through coupled sensorimotor exchanges within continuous action spaces, continuously in time and possibly over repeated trials. Previous joint action studies using sensorimotor games suggest that human dyads develop coordination strategies that can be interpreted as Nash equilibria. Uncertainty about the intended opponent actions may shape the resulting coordination. However, the mechanisms underlying the development of a joint coordination over repeated trials are poorly understood. I will review experimental studies on how two players that are mechanically connected develop a joint coordination. I will then present a general computational framework – based on game theory and Bayesian estimation – to understand the underlying mechanisms. I will focus on two

applications. First, models can be used to implement artificial 'partners' with an inherent ability to establish such coordination. Human-artificial dyads develop forms of joint coordinations that are similar to those observed in human-human dyads. Second, models can be used to characterize the behavior of individual participants in joint coordination experiments. Very much like dynamical models of sensorimotor adaptation, they capture the temporal evolution of performance, and the estimated parameters provide a comprehensive characterization of the individual capability to coordinate with a partner. Finally, I will discuss the implications of these studies for the development of artificial robotic 'therapists', with an 'optimal' capability to understand patient impairment and to facilitate their recovery.

Short CV:

Vittorio Sanguineti is Professor of Bioengineering at the University of Genoa (Italy) and head of the local undergraduate/graduate program in Biomedical Engineering. After his PhD degree in robotics (Univ. Genoa, 1994) he has been working as post-doctoral fellow at the Institut National Polytechnique de Grenoble (1995-1996), McGill University (1996) and Northwestern University Medical School (1997-1998). Since 1999 he has been a faculty at the University of Genoa. In 2009-2013 he has been team leader at the Italian Institute of Technology. His main area of interest is neural control of movement. In particular, he has been investigating sensorimotor control in individuals and dyads (joint action), using a combination of behavioral experiments and computational models, in healthy subjects and in persons with neurological and cogntive disorders. He also studies the application of robots as aids for neuromotor rehabilitation. He is authors of 150+ journal articles and conference papers and is editor of two books. He has been PI or co-PI in a number of national and international research grants (NEUROBIT, HUMOUR among others). Current research is funded by NextGeneration EU programs on biomedical robotics (RAISE, FIT4MEDROB), neuroscience (MNESYS) and digital health (DHEAL-COM).