

## Title

Interaction control in humans and with robots

## Abstract

My talk will present some of our attempts to i) understand how humans skilfully interact with their environment, and ii) endow robots with similarly successful control behaviours. Twenty years ago, we discovered how humans constantly adapt their muscle activations to identify and adapt to the dynamic environment they are working with. I will first present this discovery and how it lead to novel adaptive control behaviours for robots, which will enable them to interact with rigid and soft environments, with perspective in fields such as manufacturing and medical robotics. In recent years, we studied how humans physically interact with each other, e.g. during physical neurorehabilitation after a stroke or while dancing. By examining the behaviours of individuals when their right hands are physically connected, we could show how haptic information enables humans to estimate partners' motor plan and use it to improve one own performance. Embodied as a robot partner, this model was verified as it induced the same improvements in motor performance as a human partner. These results elucidate the haptic communication taking place between physically interacting humans and promise collaborative robot systems with human-like assistance.

## Related publications

- Burdet et al. (2013), Human Robotics - neuromechanics and motor control. MIT Press.
- Y Li et al. (2018), Force, impedance, and trajectory learning for contact tooling and haptic identification. IEEE Transactions on Robotics 34(5): 1170-82.
- A Takagi et al. (2017), Physically interacting individuals estimate the partners goal to enhance their movements. Nature Human Behaviour 1: 0054.
- Y Li et al (2019), Differential game theory for versatile physical human–robot interaction. Nature Machine Intelligence 1(1): 36.

## Biography

Dr. Etienne Burdet is Chair of Human Robotics at the Imperial College of Science, Technology and Medicine in UK. He is also a visiting Professor at University College London. He holds an MSc in Mathematics (1990), an MSc in Physics (1991), and a PhD in Robotics (1996), all from ETH-Zurich. He was a postdoctoral fellow with TE Milner from McGill University, Canada, JE Colgate from Northwestern University, USA and Mitsuo Kawato of ATR in Japan. Professor Burdet's group uses an integrative approach of neuroscience and robotics to: i) investigate human motor control, and ii) design efficient systems for training and rehabilitation, which are tested in clinical trials.