Category: Application and clinical integration

Workshop Title: Robot-Mediated Physical Human-Human Interaction in Neurorehabilitation

Organizer(s): Lorenzo Vianello

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Workshop Time: 16:00 - 17:30

Attendee Engagement: In the first part of the workshop (45 minutes), experts in the field will provide an overview of robot-mediated physical interaction and its applications in rehabilitation, followed by a brief Q&A session.
The second part of the workshop (last 45 minutes) will be a hands-on activity where participants will be divided into four groups. Each group will have a computer connected to two robots (eight robots and four computers in total) and will complete a controller for their two robots. The robots in each group will physically interact and collaborate to compete against the other three teams in a virtual game (similar to ping-pong) displayed on a screen.

Abstract: Humans often perform motor tasks in pairs or groups to enhance performance through teamwork or to share knowledge and learn from each other. While some tasks, like limb rehabilitation, can be done alone, outcomes improve significantly with assistance. For example, a single therapist may guide a patient's impaired limb, but more complex cases might require multiple therapists to coordinate efforts to move a more impaired patient. In all these scenarios, interaction can involve audiovisual communication, physical interaction, or both. Using robots to mediate physical interaction can enhance the outcomes of conventional physical rehabilitation while promoting measurability. Studies on robot-mediated physical interaction between humans have shown that haptic training with a partner improves task performance and motor learning [1, 2, 3]. These benefits are attributed to (1) increased motivation and engagement, (2) the ability to infer strategies from a partner's movement, and (3) the summing of physical effort or adopting specialized roles to complete a task. A network of robots can regulate interaction dynamics and simulate virtual environments. While the simplest setup involves two humans interacting through two machines, more complex networks—such as a therapist coordinating with multiple patients—are also possible. In this workshop, we will explore how robot-mediated interaction can benefit rehabilitation. The first part will showcase practical examples of robot-mediated physical interaction for the upper and lower extremities from experts in the field. In the second part, participants will engage in a hands-on activity, designing a controller for multiple robots (eight 1-degree-of-freedom robots) to mediate interactions during a therapy-oriented game involving both collaboration and competition tasks.