Category: Neuromodulation

Workshop Title: Barriers and Facilitators in FES Cycling: Bridging Clinical Insights and Technological Advances

Organizer(s): Tania Olmo Fajardo, Clara B. Sanz-Morere, Juan C. Moreno and Ines Bersch

Speaker(s):
Speaker: Emilia Ambrosini
Title: “Cycling induced by Functional Electrical Stimulation: Insights and Innovations from the Cybathlon 2024”
Brief description: In my talk, I will share my experience as the Team Manager of the POLIMI team, which competed in the FES-bike discipline at Cybathlon 2024. I will provide an overview of the devices used and the results achieved by the participating teams, with a particular focus on POLIMI's journey to securing third place.

Speakers: Juan C. Moreno, Clara B. Sanz-Morere and Tania Olmo Fajardo
Title: "Lessons from a Pilot Study on FES Cycling: Exploring Feedback, EMG-Based Strategies, and Usability Challenges"
Brief description: In this talk, we share our experience designing and conducting a pilot usability study on FES cycling, incorporating visual and auditory feedback to guide exercise intensity in healthy individuals and patients with incomplete spinal cord injury. By analyzing and comparing EMG characteristics across populations, we aim to explore how stimulation strategies may be improved. We also discuss usability findings, as well as the challenges and strengths of this approach in neurological rehabilitation.

Speaker: Ines Bersch
Title: "Key Drivers and Obstacles in Implementing FES Cycling"
Brief description: FES cycling offers physical and psychological benefits for individuals with spinal cord injuries, supported by intrinsic motivation, prior physical activity, and social environments like wheelchair clubs. However, barriers such as limited knowledge, accessibility challenges, funding issues, and psychological hurdles hinder its widespread adoption. Addressing these obstacles through targeted education, better resources, and peer support is essential to enhance participation and optimize outcomes.

Speakers: Christine Azevedo Coste and François Bailly
Title: "Towards Model Predictive Control of FES-Cycling to Delay Fatigue Onset"
Brief description: This talk presents a novel approach to mitigate early muscle fatigue in FES-assisted cycling—one of the key barriers to its broader adoption. Using an adapted physiological muscle model compatible with gradient-based optimization, we personalize musculoskeletal models with experimental torque data. We demonstrate how refined control strategies enhance cycling performance and explore the implications for improving rehabilitation outcomes.

Workshop Time: 13:45 - 15:15

Attendee Engagement: Through an interactive format, using tools such as Mentimeter, attendees will share their experiences, challenges, and knowledge related to FES cycling. This will foster discussions between clinicians and engineers, with the goal of identifying the motivating factors and obstacles that influence participation rates and outcomes. Together, we will generate ideas to address current barriers and promote future participation.

Abstract: Functional Electrical Stimulation (FES) cycling has emerged as a promising therapeutic intervention for individuals with spinal cord injuries and stroke. Facilitators of FES cycling include pre-existing physical activity habits, long-term commitment and motivation, and its potential role as a preventive health measure. As an effective sport-therapy that also enables outdoor activities, FES cycling appeals as both a therapeutic and recreational tool, well-suited for social environments like wheelchair clubs, which help maintain engagement. However, several barriers hinder widespread adoption. These include a lack of knowledge and inadequate education, challenges with accessibility and funding, and the substantial time commitment required. Additionally, the psychological challenge of starting FES cycling can often deter participation. From a technological perspective, FES cycling has benefited from advances in kinematic data measurement, enabling real-time monitoring and performance optimization. Personalized feedback systems and FES adjustments allow interventions to be tailored to individual needs, improving overall outcomes. The development of user-friendly interfaces has further simplified the integration of FES cycling into rehabilitation routines, but challenges remain.
This workshop will explore these factors from both clinical and technological perspectives, emphasizing the importance of multidisciplinary collaboration to overcome existing barriers and fully exploit FES cycling's potential in neurorehabilitation and sport-therapy. Through an interactive format, using tools such as Mentimeter, attendees will share their experiences, challenges, and knowledge related to FES cycling. This will foster discussions between clinicians and engineers, with the goal of identifying the motivating factors and obstacles that influence participation rates and outcomes. Together, we will generate ideas to address current barriers and promote future participation.