4th World Physical Medicine and Rehabilitation Conference

February 22, 2021 | Webinar

Neuromusculoskeletal system based assist-as-needed control of a lower limb soft robot for repetitive and double support task

Iram Muñoz-Pepi

Research Center for Advanced Studies (CINVESTAV), Mexico

Introduction: Human movement science integrates knowledge from different research areas, such as neuroscience, kinesiology, biomechanics and robotics. The field of robotics contributes in the modelling and analysis of rehabilitation and assistance (RRA) devices by addressing holistic studies of movement physiology. It pursues the development of smart devices inspired by the neuromusculoskeletal system (NMS) to improve qualities of human-robot interaction. In addition, evidence in biosignal-based neurorehabilitation suggests that building closed-loops at hierarchical anatomy level leads to human motion improvement. In the last half decade, we have been addressing some components on the RRA field to synthesize assist-as-needed schemes driven by biosignals to show evidence of NMS rehabilitation. In this realm, we are conducting a four-years research project involving analysis and characterization of NMS models, from the perspective of dynamical systems using robotic tools, to assess repetitive and double support tasks (such as stationary cycling, postural balance and sit-to-stand). This project is conducted with the participation of Dr. Raul Diaz Santibañez medical director of the CRIT (Children's Rehabilitation Center Teleton) in Saltillo.

Methods: Under the assumption that NMS system is driven by central pattern generators (CPGs) and reflexes, satisfying the principle of minimal action (essential for modeling and control of all sort of efficient robots), we resort on design and control of an assistive soft device using motion, reaction forces and EMG biosignals. Full nonlinear time-varying robotic models feed with data-driven and optimal assist-as-needed control methods are proposed to command a soft-robotic device and exergames for rehabilitation and assistance in repetitive and double support tasks.

Preliminary Results: Based on recent schemes we have proposed on muscle and kinematic synergy, exergames for force strength, as well contact-based exergames, we are going to develop assist-as-needed robot control using energy-based efficient trajectories and more precise NMS models substantiated with respect to the task,. Furthermore, we are identifying performance criteria that individuals satisfy in repetitive and double support tasks, through experimentation involving healthy humans. Inspired by the identified NMS system, we aim to develop the biomechatronics of an exosuit capable of assisting in custom-made physiotherapy exergames with human-in-the-loop.

Biography

Iram Munoz is a Ph.D. Candidate at Cinvestav carrying out a thesis entitled “Neuromusculoskeletal System based Assist-as-needed Control of a Lower Limb Soft Robot for Repetitive and Double Support Tasks”. He received a B.S. degree in Mechatronics Engineering from Technological Institute of Saltillo (Mexico) and a M.S. degree in Robotics and Advanced Manufacturing Dept of Cinvestav-Mexico with the thesis: “Development of a platform to measure 3D ground reaction forces and plantar position for gait analysis”.

iram.munoz@cinvestav.edu.mx

Notes: