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Upper limb assistive devices for muscular dystrophy patients: Proposed approaches

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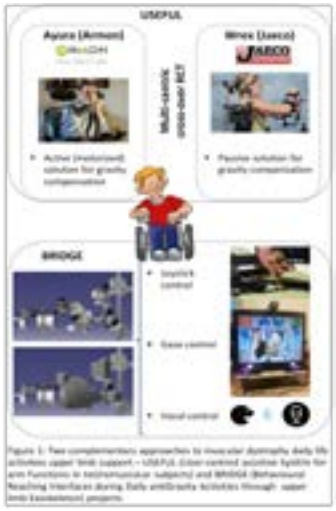
Statement of the Problem: People with neuromuscular diseases, such as muscular dystrophies experience a distributed and evolutive weakness in the whole body. Much effort has been invested to fight this disease from its genetic origin. Recent technological developments have improved the quality of life of many disabled people. In particular, upper limb assistance for muscular dystrophic patients is nowadays not investigated. A two-folded approach has been adopted – investigated already existing commercial solutions to be used by our target patients, and develop a dedicated device.

Methodology: First approach: USEFUL (User-centred assistive SystEm for arm Functions in neUromuscuLar subjects) selected two commercial solutions for upper limbs gravity compensation: ARMON AYURA (motorized) and JEACO WREX (passive) to be tested at home in a crossover RCT study. PUL, TAM, SUS scales are used to assess whether the systems are usable, acceptable and efficient for the target pathology. The clinical trial has been registered to the Italian Ministry of Health (013/16-CE), and on clinicaltrials.gov (GUP15021). Preliminary tests demonstrated that both devices are only suited for patients in the early stage of the disease. Second approach: BRIDGE (Behavioural Reaching Interfaces during Daily antiGravity Activities through upper limb Exoskeleton) is a light, wearable and powered five degrees of freedom exoskeleton (i.e., shoulder flexion/extension, abduction/adduction, internal/external rotation; elbow flexion/extension; wrist pronation/supination) under the direct control of the user through joystick, gaze or vocal control. An inverse kinematic model allows to track patient desired hand position. BRIDGE prototype has been developed, and successfully tested in simulation environment, and by a group of healthy volunteers with good tracking performance.

Conclusion & Significance: For both proposed complementary approaches preliminary results are encouraging towards keeping muscular dystrophy patients upper limbs as functional and autonomous as possible.



Biography

Marta Gandolla (MSc in Biomedical Engineering in 2009 and European PhD *cum laude* in Bioengineering in 2013 from Politecnico di Milano) is a Post-Doc Research Fellow at the Neuroengineering and Medical Robotics Laboratory since 2013. In 2011 she was a visiting PhD student at the Sobell Department of Motor Neuroscience of the UCL Institute of Neurology (London, UK), under the supervision of Dr. N Ward, co-supervisor of her PhD thesis. Her research interest is about the design, and on-field evaluation of innovative methods based on electrical stimulation and/or robotic systems for the rehabilitation and assistance of neurological patients. Moreover, she is interested in central mechanisms of neurological rehabilitation and re-learning investigated through fMRI images. She is currently Lecturer Assistant for Biomedical Signal Processing and Biomedical Images, and Bioelectromagnetism and Biomedical Instrumentation at Politecnico di Milano.

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