# HYBRID MECHATRONIC SYSTEM - NEUROPROSTHESIS FOR ARM RECOVERY IN PATIENTS WITH NEUROMOTOR IMPAIRMENT- PATENT RO130961/30.08.2021

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## Introduction

Designing upper limb exoskeletons requires attention in order to account for adaptation to arm anatomy, as well as to obtain a lightweight device with enough actuation power in the joints. A hybrid exoskeleton&FES system for the entire arm will usually advance the arm recovery until the moment that finesse movement at hand level is required to be trained. The combination between exoskeleton and FES, as well as, the balanced control between these two main sub-systems is the main novelty of the proposed approach (Patent RO130961/30.08.2021) [1].

## Motivation and Description of Work

The actual market shows many attempts to restore hand and upper limb functionality in stroke people, by means of different wearable devices aiming for active motor training . Functional electrical stimulation has proven its effectiveness in a number of clinical applications, e.g. as active orthosis to improve walking pattern in stroke people (e.g. ODFS PACE device [2]). Recently, it has been proven that “electromechanical-assisted gait training in association with Functional Electrical Stimulations produced more benefits than the only robotic treatment” [3].

This is why, it will be of interest to combine mechatronics and FES to design rehabilitative devices for the upper limb. Our proposed hybrid exoskeleton&FES device supports combined motions at the entire arm level and works towards recovering main control at the arm level, for stroke patients.

## Results

Based on a kinematic model of the upper limb and the planned electrode placement (left picture) over the upper limb the exoskeleton (right picture) has been configured for easiness in donning and doffing, anatomic adaptation and actuation system to satisfy the required torques. The control strategy is based on the kinematic model of the exoskeleton.

## Conclusions

The first experimental trials envisaged daily life actions (e.g. picking-up a cup) performed at a reduced speed mimicking an action where a stroke patient has to concentrate and perform a cognitive effort to accomplish such a task. The proposed prototype has been tested in a clinical environment with only two patients by now, with very promising results. The main advantage is the combination of electrical stimulation of muscles with exoskeleton promising a better recovery of arm movements in stroke patients.

## References

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