Development of a hand exoskeleton for sensorimotor training

Background:

Research on neurorehabilitation has emphasized that patient's effort and sensory information (i.e., the information about the interaction with the environment) during physical training are crucial to provoke brain plasticity. However, most of the research in robot-assisted hand training has focused on designing rigid exoskeletons to guide the limbs of patients with neurological injuries in a "correct" pattern.

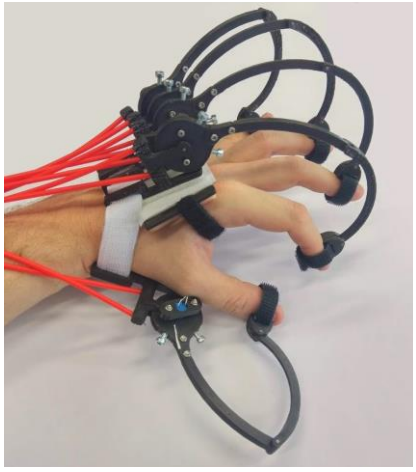

Figure 1: Prototype of hand orthosis for assistance/haptic rendering. Picture: BFH.

In order to target not only the motor but also the sensory side of the rehabilitation, we propose to develop a wearable hand exoskeleton, which can train the somatosensory system through haptic rendering of virtual objects for kinesthetic and cutaneous feedback. The modular device shall allow natural finger motion and assist common hand gestures, such as grasping a virtual object or tapping the fingers on a surface. Force feedback shall be applied to the fingers to render haptic interaction with virtual objects. The hand module shall be designed to track finger position with enough precision and accuracy to virtually render the hand in an immersive Virtual Reality (VR) environment. Furthermore, the device shall be designed to be electrically noise-proof, since it may be used in combination with electrical stimulation. The weight and volume of the device shall be minimized to provide a seamless experience to the patient. Finally, in order to increase clinical acceptance, the hand module shall be designed to be affordable, simple, effective and quick to equip and remove.

Aims:

1. Literature research: Review relevant exoskeleton and haptic gloves in clinics, research, and market, their methods, inconveniences, and results.
2. Exoskeleton design and development: Design, manufacturing, and assembly of the device.
3. Testing: A feasibility study with healthy participants shall be conducted.
4. Scientific reporting: The methods and results of the study findings shall be reported in a scientific report.

Requirements:

Good mechanical design skills are strongly required. Knowledge in mechatronics, motion control and robotics is recommended.

Supervisor:

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