S. Roccella, E. Cattin, N. Vitiello, F. Giovacchini, A. Chiri, F. Veccchi, M.C. Carrozza. Design of a hand exoskeleton (handexos) for the rehabilitation of the hand. Gerontechnology 2008; 7(2):197. Stroke is the leading cause of permanent impairment and disability, in fact more than 15 million people in the world suffer a stroke every year[1]. The paretic upper limb is a common and undesirable consequence of stroke which limits performances and consequently decreases abilities in Activity of Daily Living (ADL). Conventional hand therapy has a number of disadvantages: subjective and irreproducible measurement, impossibility to quantitatively monitor the progresses, no remote monitoring or re-evaluation of progress for a patient practising at home, and patients are forced to go to the rehabilitative centres[2]. Robot-assisted rehabilitation is a recent approach to stroke therapy which promises to redefine clinical strategies[1,3] overcoming conventional therapy problems. **Methods** HANDEXOS is a novel exoskeleton device for the rehabilitation of the hand for post-stroke patients developed and designed at the ARTS Lab of the Scuola Superiore Sant'Anna. An exoskeleton device allows the accurate and repeatable finger motion as well as force and hand parameters measurements. The limits of such solutions are the high level of complexity of the structure and mechanisms, the weight, the unsafe coupling with the human hand, and the low aesthetic acceptability. For these reasons, the HANDEXOS has been designed to combine a good usability, aesthetics, safety and comfort with innovative technologies. HANDEXOS is characterised by 5-fingers independent modules, good wearability, comfort, low encumbrance, light weight, low inertia and a remote actuation and control system. HANDEXOS is composed of orthotic shell structures connected by translational and rotational joints. Passive translational joints are used in phalange joints for auto-fitting and kinematics compatibility with the human fingers. Rotational joints are used for flexion/extension in DIP (distal interphalangeal) and PIP (proximal interphalangeal) joints and in MP (metacarpophalangeal) joints for abduction/adduction and flexion/extension. In DIP and PIP joints, the joint axes correspondence is obtained through compliant material inside the shell. The adopted actuation solution is the underactuation of each finger through Bowden cables transmission, so only one DC motor is used to extend the DIP, PIP and MP joints. Each finger is actuated by a cable running across idle pulleys placed in each finger joints and fixed to the distal phalanx. This configuration is similar to that of the *Extensor Digitorum* in the human hand. The cable converges at an extrinsic DC motor which pulls a cable through a linear slider whose displacement causes the finger extension. The flexion of the finger is passively obtained by means of an antagonist cable system running across idle pulleys placed on the other side of each finger connecting to three remote compression springs (one for each joint) whose elastic torques cause the finger to flex. An additional mechanisms on the dorsum is used to control the thumb opposition. **Results and discussion** The HANDEXOS is under fabrication. The first prototype will be tested with post-stroke patients. An intensive, active and repetitive practice by using HANDEXOS could maximize motor recovery and could reduce the muscular spasticity.

References

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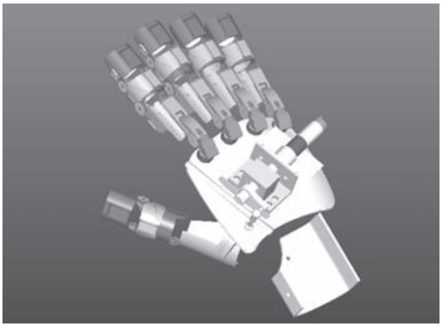

Figure 1 Design of the HANDEXOS