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HKK Bionics empowers hand gripping functions

A spin-off from the Ulm University of Applied Sciences is aiming to provide people whose hands have been paralysed due to accident or illness with a new kind of orthopaedic aid. Dominik Hepp and Tobias Knobloch are currently starting serial production of a hand orthosis prototype. The two medical engineers from Ulm, who founded HKK Bionics GmbH in 2017, plan to commence final tests in 2019 and hope to get the "exomotion® hand one" orthosis approved for human application, thus closing a gap in the market.

Intelligent control by muscle signals

Dominik Hepp (left) and Tobias Knobloch - founders and managing directors of HKK Bionics

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Previous approaches aimed at improving the gripping function of paralysed hands, say the company founders, were restricted to gripping aids used for therapy only and were not suitable for everyday use.

The new orthosis, a battery-powered medical device, has been developed by Hepp and Knobloch for adults with distal hand paralysis resulting from strokes or nerve injuries. It is not suitable for people suffering from complete hemiplegia, because it works with sensors attached to the intact muscles of the corresponding side of the body. Together with intelligent software, it recognizes the user's intention to move and helps reinforce the hand with tiny drive motors. These microdrives deliberately introduce force into the actuation mechanisms, which then open and close the fingers, thus providing the necessary gripping force.

The exomotion® hand one orthosis consists of a weight-bearing arm splint, a drive package, modular and adaptable finger exomechanics, a silicone glove, a sensor and an operating unit. This equipment enables fingers to be controlled individually. The orthosis can thus take into account anatomical features, i.e. limited finger joint mobility after prolonged paralysis. Moreover, the design allows independent bending and stretching of single or multiple fingers.

Exomechanics instead of stimulation current

In contrast to conventional models, the HKK Bionics orthosis does not require stimulation current impulses, which is an advantage for hands without feeling that might, but not necessarily, be the result of paralysis. The innovative orthosis uses an exomechanical principle which enables the mechanical movement of the fingers in the glove. The glove is worn over the paralysed hand and is activated by the sensor and control mechanics.

The hand orthosis can perform six different types of grip, including a closed fist, a so-called check card grip, in which only the thumb moves, or the three-finger grip. The inventors expect that with these different types of grip, the paralysed hand will be able to carry out everyday tasks such as holding a bottle, opening it with the other hand, or carrying a laundry basket on both sides. The touch display on the control unit, which houses the orthosis' energy supply and logic, can be attached to clothes and unfolded for easier operation. The battery needs to be recharged on a daily basis.

The orthosis distinguishes between short and long muscle contractions. It can be used to generate control commands such as "open", "close" or "change grip". This makes it easier to use, as it allows the hand to open and close without having to use the touch display, and to move back and forth between two different types of grip. The control unit is similar to the operating modes of hand prostheses. As far as technology is concerned, the human-machine interface does not yet enable simultaneous control of all fingers, explains engineer Dominik Hepp.

Craftsmanship and industrial manufacturing

The special exomechanics and the supporting arm splint used in the HKK Bionics hand orthosis, can only be achieved with 3D scanning and printing that combines the reproducibility and accuracy of industrial production methods with the traditional

craftsmanship of orthopaedic technology.

The exomotion® prototype has a distinct modular design.

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An individualised medical device such as the bionic hand orthosis consists of different modules. In medical supply shops with orthopaedic workshops, the orthopaedic technician creates a glove based on a plaster cast of the hand and forearm. The glove is equipped with a different number of exomechanics parts. Once this is ready, a 3D scan is made and used by a professional 3D service provider to print the splint. The hand orthosis is assembled in medical supply stores with the required technical expertise.

The medical device will initially be sold by a range of medical supply stores in the so-called DACH (acronym for D — Germany, A — Austria, CH — Switzerland) region. A sustainable and close-knit network of doctors, therapists, medical supply stores and patients has already been established. In cooperation with patients, Hepp and Knochloch plan to check the usability and functionality of the medical device in 2019. Several doctors and hospitals have already signaled an interest in working with the company founders from Ulm.

An aid for everyday life

The hand orthosis is designed as an aid for paralysed people in their daily and professional lives. This requires the hand orthosis to be worn all day long. The young entrepreneurs know that being able to wear the orthosis for an entire day is an important feature when it comes to reimbursement by medical insurance companies.

The company first came about in 2011. Dominik Hepp was still a student at Ulm University of Applied Sciences working on a bachelor project to develop a hand prosthesis. The project was expanding and providing material for further bachelor theses, including Tobias Knochloch's. The two company founders have since discovered a better, relatively free market for hand prostheses. After their studies, they were awarded an EXIST start-up grant, and shifted their focus from prosthesis technology to orthosis technology. They built a prototype, developed a business plan and demonstrated the feasibility of the hand orthosis.

The young company has now hired a business professional and receives financial support from several investment companies. It has gained in visibility and achieved a number of successes. In 2018, HKK Bionics was one of two innovative founder teams to be awarded for achievements that pave the way towards an electrical and digital future. The HKK Bionics team is now looking forward to a one-week trip to the technology mecca of Silicon Valley. The young entrepreneurs will certainly return to Ulm with new ideas for further successful business models.

Article

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