Smarter, lighter exoskeletons to provide better mobility therapy

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In health technology, wearable robots are programmable devices designed to mechanically interact with the body of the wearer. Sometimes referred to as exoskeletons, their purpose is to support motor

function for people with severe mobility impairments. But market adoption of exoskeletons has been limited due to factors such as the weight of the equipment and the sometimes inaccurate predictions of wearer's movements when walking on uneven ground or approaching an obstacle. However, recent advances in robotics, materials science and artificial intelligence could make these mobility assistance and rehabilitation tools more compact, lightweight and effective for the wearer.

The BioMot project, based at the Human Locomotion Laboratory in Madrid, advanced this emerging field by demonstrating that personalized computational models of the human body can be used to control wearable exoskeletons. Funded by the EU Future and Emerging Technologies (FET) program and completed in September 2016, the project developed robots with real-time adaptability and flexibility by increasing interactions between the robot and the user through dynamic sensorimotor interactions. Inspired by biology, the BioMot architecture design emulates multiple levels of sensory information processing, so researchers and developers could utilize relate specific movements to customize motor control recovery. In short, this means that an exoskeleton can be personalized to an individual user.

To allow this new human-robot interaction, a new type of stiffness actuator that uses springs to emulate the biomechanical properties of human muscles was developed. Building upon the knowledge gathered on actuators during the BIOMOT project, the Robotics and MultiBody Mechanics Research Group at the Free University of Brussels-VUB has sought to bring this technology closer to market through various spin-out initiatives.

An example of such a spin-out initiative is the Smart Wearable project, which is further developing a smart robot system for lower limb rehabilitation. It uses the previous actuator technology with a control and

monitoring system linked to a user interface in the form of a video game. The integrated system aims to better personalize the equipment to the movements and needs of the user.

"Smart Wearable takes advantage of part of the knowledge generated within the European BioMot Project. Together with Technaid, a company with previous experience in the area of rehabilitation robotics, the CISC Neurorehabilitation Group is developing a robotic rehabilitation platform specifically for the ankle diseases," says project coordinator Professor Juan C. Moreno. "This platform will allow the programming of both active and passive exercises, as well as allowing free movement and assessment of the patient's capabilities. Within the project, the whole system will be controlled by a software of data collection, exercise programming and games execution to make the platform more pleasant to the patient."

The Smart Wearable prototype should be ready by the end of 2019, with commercialization of the product expected in early 2020. In future, lighter and more efficient wearable robots have the potential to not only modernize health technologies, but could advance a whole new European robotics ecosystem. Where extra strength coupled with human agility are required, it is not hard to imagine how a smart "power suit" could benefit sectors like construction, security and the emergency services.

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