robotics Swiss National Centre of Competence in Research
NEWS BULLETIN
Issue 33

Exoskeleton prevents seniors from falling

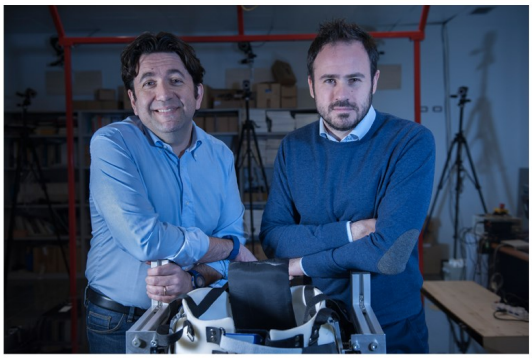
VIDEO

The first smart exoskeleton that recognizes the loss of balance – and prevents falling – has been developed by researchers in at Scuola Sant'Anna in Italy, EPFL and NCCR Robotics in Switzerland, and tested at the Rehabilitation Center "Fondazione Don Carlo Gnocchi" in Florence.

A powered exoskeleton helps the elderly from falling

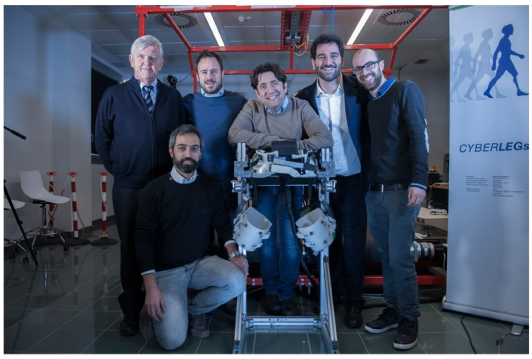
Wearable machines that enhance your movement and endurance no longer belong to the realm of science fiction. They are being developed today in the laboratory, and in this controlled setting, already prevent the elderly from falling.

Scientists at Scuola Sant'Anna in Italy, NCCR Robotics and EPFL (Ecole polytechnique fédérale de Lausanne) in Switzerland have built a prototype of a smart, light-weight and easy-to-personalize exoskeleton that counteracts the loss of balance and promotes balance recovery after an accidental slip. This is a first in wearable machines, which are normally used to assist or enhance regular movement, instead of preventing an unexpected event like falling. The results are published today in Scientific Reports.



The exoskeleton was designed to help the elderly by preventing fall-related injuries, since seniors are involved in 40% of fatal injuries related to falling in Europe. But the exoskeleton could also be used as an aid for the physically impaired, amputees and those suffering from neurological disorders. It's technology that will actually help people with their daily activities.

The exoskeleton is wearable from the waist down, and is vastly different from the armored stuff you see in today's science fiction movies.



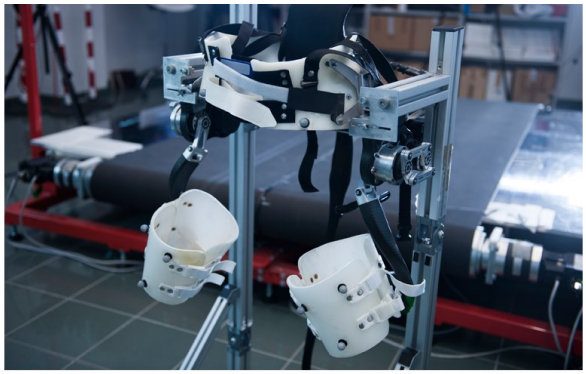
"*Our smart exoskeleton is light-weight and extremely easy to personalize*," says Silvestro Micera, professor at EPFL and Scuola Sant'Anna and holds the Bertarelli Foundation Chair in Translational Neuroengineering. For this first prototype, the exoskeleton requires only a few minutes to adapt to a given patient, which involves adjusting the size for a particular user and learning the user's gait.

How the exoskeleton works

At Hospital Fondazione Don Carlo Gnocchi in Florence, 69 year old Fulvio Bertelli puts on the wearable machine, a device equipped with motors at the hip, and braces made out of carbon fiber. The scientists adjust a few nuts and bolts, and Bertelli is ready to test his new gear. It is not yet the attire that can be discretely worn outside of the laboratory. But it works.

"*I feel more confident when I wear the exoskeleton,*" says Bertelli after having worn the machine on a special treadmill that can artificially make him lose his balance and slip.

The personalized exoskeleton first detects the particularities of Bertelli's walk: the patterns of his stride known as the gait. Once this pattern is established, the system's algorithm is able to detect deviations from his normal gait i.e. the onset of a fall. When this happens, the motors push both of the thighs down, reestablishing Bertelli's stability at the hip.



From neuroprosthetics to exoskeletons

"*I was very lucky to have the opportunity to work with Prof. Nicola Vitiello from Scuola Sant'Anna, an expert in exoskeleton development, and with Dr. Vito Monaco, expert in locomotion biomechanics*," says Micera. "*Together, we came up with the idea of using an exoskeleton to prevent falls*."

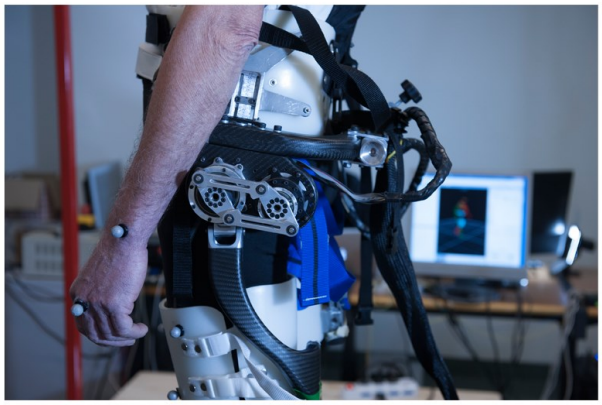
Micera engineers prosthetics that allow amputees to feel again. His interest in prosthetics broadened when he saw the first exoskeleton for lower-limb function restoration many years ago during a robotics conference, and was impressed by the potential of these devices to help people.

An important aspect of their system is to ensure that the exoskeleton is non-intrusive. It should not unnecessarily disturb the user, particularly when the user is not falling. The next steps involve making the exoskeleton more discrete and portable for the outside world, and to test its usability with end users in real-life environments.

Science-based innovation: from human biomechanics to human-robot symbiosis

The variable nature of human behavior represents the main challenge for researchers dealing with the design of wearable robotics. Monaco plans to generalize the results of this study requiring the development of novel solutions so that humans and robots can seamlessly work as a single system.

"*Our study revealed that a wearable robotic platform can effectively interact with humans during reactive motor responses, such as accidental slipping. These results open new perspectives for researchers who are expected to develop robotic platforms for enhancing human capabilities all day long*," says Monaco.



Exoskeletons and society

"*This work paves the way for imagining a completely new generation of exoskeletons that will actually be effective outside of research laboratories thanks to their ability to augment users' movement and make their mobility more stable and safe," says Vitiello, who believes that wearable robots will be the next wave of information and communication technology that will pervade society, and will assist people in domains ranging from healthcare to industry. He continues, "To reach these goals, exoskeletons must be endowed with features, like the one proved in this study, that really take into account what users can experience in real-life unstructured environments*."

Reference

V. Monaco, et al., An ecologically-controlled exoskeleton can improve balance recovery after slippage. Sci. Rep., 7, 46721, 2017; doi: 10.1038/srep46721.

For Further Information please refer to:

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NCCR Robotics

The Swiss National Center of Competence in Robotics (NCCR Robotics) is a federally funded programme bringing together robotics laboratories from EPFL, ETH Zurich, University of Zurich and IDSIA to work on wearable, rescue and educational robots.

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