

# Italian researchers unveil new robotic exoskeleton for lower limbs

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Two features make TWIN unique in the world: it is made of lightweight materials, such as aluminum alloy, and it is composed of modular components, facilitating usability and transportation. Credit: IIT-Istituto Italiano di Tecnologia

TWIN is the name of the new robotic exoskeleton for lower limbs, designed and developed by Rehab Technologies IIT—INAIL, the joint laboratory between the Istituto Italiano di Tecnologia (IIT-Italian Institute of Technology) and the Prosthetic Center of INAIL (the

prosthetic unit of the National Institute for Insurance against Accidents at Work), which will allow patients to wear it more easily.

Presented today in Milan during a press conference held at the Museum of Science and Technology, TWIN was demonstrated by two patients who were involved in testing the system during its development. TWIN is currently a prototype, but researchers hope to bring it to industrialization soon.

The exoskeleton TWIN originates from the IIT's Rehab Technologies Lab, which is the joint laboratory between the IIT in Genoa and the Prosthetic Center of INAIL in Budrio (Bologna), coordinated by Matteo Laffranchi. The collaboration began at the end of 2013 with the goal of developing innovative, high-tech, cost-effective solutions for patients with physical impairments.

One of the patients who wore TWIN today is Alex Santucci, who accompanied technicians and researchers throughout the entire design period of the device, participating in clinical experimentations as a tester. The clinical experiments took place not only at the Prosthetic Center of INAIL in Vigorso di Budrio but also at the Montecatone Rehabilitation Institute in Imola and at Villa Beretta in Costa Masnaga (LC).

The motorized exoskeleton TWIN is an external structure capable of enhancing the physical abilities of the wearer. It has been designed to allow individuals with reduced or even absent motor abilities in the lower limbs, such as in cases of complete spinal cord injuries, to maintain an [upright position](#), walk with the assistance of crutches or walkers (as the exoskeleton is not self-balancing), and to stand up and sit down.

Two features make TWIN unique in the world: it is made of lightweight

materials, such as aluminum alloy, and it is composed of modular components, facilitating usability and transportation. Furthermore, the structure is adjustable based on the patient's physical characteristics through telescopic links placed at the level of the femur and tibia.

Ankles and foot support are available in various sizes to adapt to the ergonomics of the user, whether female or male, young or adult. TWIN's operating modes are also adaptable to the patient, evaluating the degree of motor deficit of the person wearing it, particularly their ability to perform autonomous walking.

TWIN can be controlled by an operator, such as a physiotherapist, using a specific Android application installed on the provided tablet. The graphical interface allows for controlling the exoskeleton in the execution of various programmed activities, setting the kinematic parameters of movement, and choosing between different step execution modes.



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The exoskeleton works in three operating modes: "Walk mode," designed for patients with absent motor function, in which the exoskeleton imposes a walking pattern according to programmed parameters; "Retrain mode," used for patients with a partial impairment of the lower limb motor function, capable of performing a more or less autonomous movement but with difficulty in some phases of the step—in this case, the [exoskeleton](#) supports the patient's movement with more or less intensity, directing them towards an optimal reference trajectory; and "TwinCare mode," designed for patients with partial and differentiated motor impairment between the two limbs, where one leg is healthy and can move autonomously, while the other requires assistance, more or less pronounced, in some phases of the step.

The TWIN motors activate the knee and hip joints, imposing a completely configurable movement pattern on the patient's limbs in terms of step length, step type, and walking speed. The battery has a lifespan of approximately four hours and requires an hour to recharge.

In addition to rehabilitation clinics during physiotherapy sessions, TWIN can be worn daily, even for just a few hours, as assuming the upright position brings significant benefits in terms of musculoskeletal, circulatory, psychological, and digestive system functionality for

wheelchair users.

TWIN's next goal is CE marking, which will occur in partnership with an industrial partner, followed by the industrialization process. Once TWIN is on the market, it can be used by patients in need, reintegrating severely injured workers into social and work environments.

Provided by Italian Institute of Technology

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