

# Active exoskeleton for the neuro-rehabilitation of lower limbs - P.I.G.R.O.

## Abstract

The first stage of lower limbs neuro-rehabilitation after a traumatic injury or a stroke is one of the most complex step of brain recovery. This active orthosis was thought in order to be easily transportable and inexpensive. Its structure offers the possibility to carry on different rehabilitation cycles in suspension and over-ground also without treadmill, to perform exercises not allowed by traditional machineries, with useful results in the medical and aerospace fields.

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## Description

During post-operative and post-traumatic rehabilitation, in case of severe injuries or lower extremities strokes, the recovery procedure is difficult and long. In particular, the first phase of motor neuro-recovery prove to be demanding, given the inability to begin from the outset with muscles and cerebral cortex stimulating exercises. Accordingly, the presented system is designed for lower limb rehabilitation in patients with stroke or traumatic brain injury. Systems of this kind are already commercially available, but they are bulky,

linked to fixed stations, rigid and heavy, that block some physiologic motions of the human walk, allow treatments in general only on treadmill, and cannot accommodate different pathologies or specific clinic protocols of various nature. On the contrary, the invented orthosis is easily transportable, lightweight, do not require a fixed station and it is less expensive with reference to those currently in use. Thanks to its structure, it allows a number of exercises to be performed, which are not executable otherwise.

## Applications

The presented active orthosis can be used to accommodate different lower extremity pathologies: hemiplegia, tetraparesis, hemiparesis, including ictus, ischemia, cerebral haemorrhages, partial lesion of the spinal cord with extension, muscular dystrophy and motion degenerative diseases. Also, the orthosis offers the possibility of ankle actuation during treatment and to perform various physiological motions of the human walk, which are not allowed by machineries currently in use.

## Advantages

With reference to traditional machinery, this orthosis allows joint ankle activation and simulate different physiological motions during the human gait cycle. P.I.G.R.O. can be easily transported, since it has two robotics legs with slides for anthropometric regulations and a rear handle for pelvis dimension adjustment. Actuation is made by means of pneumatic actuators and a real-time control. Its structure allows for pelvis motion also outside the sagittal plane, in order to obtain a more physiological gait. It makes possible the

execution of exercises both in suspension and over-ground, during which the machine can be set up in order to get weight discharge for the orthosis and a partial or total weight discharge for the patient. There is the possibility to carry on different rehabilitation cycles in suspension and over-ground also without treadmill and to register all session parameters for a subsequent analysis of the patient performance. In this way, the gait imposed to the patient is more natural and the overall effectiveness of treatment improves.