A SOFTWARE MODULE FOR CARDIOVASCULAR REHABILITATION IN ROBOTICS-ASSISTED TREADMILL EXERCISE.

Schindelholz M, Stoller O, Hunta KJ.
Institute for Rehabilitation and Performance Technology, Division of Mechanical Engineering, Department of Engineering and Information Technology, Bern University of Applied Sciences, CH-3400 Burgdorf, Switzerland.

ABSTRACT

A new software module for cardiovascular rehabilitation in robotics-assisted treadmill exercise is described; it is designed to evaluate and improve aerobic capacity for individuals with different neurological diseases. The Lokomat device was used in conjunction with a breath-by-breath cardiopulmonary monitoring system and a heart rate monitoring module to quantify the subjects’ exercise intensity and capacity, managed by the new software module. The intensity of the individuals’ exercise participation was estimated by a novel method which respects passive stiffness of the lower limbs and was guided by a custom human-in-the-loop feedback control system. Severely affected individuals’ participation was controlled by modifying body weight support or guidance force of the Lokomat system. Standard assessment and testing protocols were implemented and adapted to the target populations for cardiovascular rehabilitation tasks. Further intensity-control mechanisms provided by the software are feedback control of heart rate, oxygen uptake and metabolic work rate. The results demonstrated the technical feasibility of the software module for cardiovascular assessment and training in robotics-assisted treadmill exercise. Using one of the intensity control methods, cardiovascular responses were activated and controlled in healthy people, moderately to severely affected individuals early after stroke and also in individuals with spinal cord injury.