

# **A New Active Body Weight Support System Capable of Virtually Offloading Partial Body Mass**

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## **Abstract**

Passive Body Weight Support (BWS) devices have been widely used to assist treadmill-based physiological or neurological rehabilitation of patients with walking impairment caused by stroke, brain or spinal cord injuries or other disorders. A passive BWS device can statically offload partial body weight of a patient but it may exert undesirable inertia load or other constraints on the patient body due to the inertial and other dynamic properties of its associated counterweight and/or cable-pulley system. Active BWS techniques developed a few years ago can reduce the inertia load caused by the BWS hardware but it cannot offload the inertia force caused by the patient himself or herself. The new active BWS system to be presented in the seminar is capable of (virtually) offloading full or partial body mass for potentially enhancing treadmill-based rehabilitation. The mass offloading capability is realized by actively compensating a specified amount of body weight and the corresponding inertia force using an acceleration feedback scheme. The method was studied by dynamics simulations and a specially designed experiment. In the simulation study, the human and the BWS device were modeled as a multibody dynamical system interacting dynamically with the treadmill. The ground reaction forces were recorded as the dynamic load on the person. A cam-slider based experiment system was designed and conducted to test the engineering feasibility of the mass offloading capability. Both the simulation and experiment results demonstrated that the BWS system can compensate any desired amount of gravity force and inertia force, and therefore, has the effect of virtually reducing the mass of a person attached to the system. A patient will feel less mass (usually called "weight loss") when he/she walks on a treadmill with the new BWS system. Therefore, the device can better assist the patient with weak legs to do leg exercising for neurological rehabilitation.