The Control of a Lower Limb Exoskeleton for Gait Rehabilitation: 
A Hybrid Active Force Control Approach

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Abstract

This paper focuses on the modelling and control of a three-link lower limb exoskeleton for gait rehabilitation. The exoskeleton that is restricted to the sagittal plane is modelled together with a human lower limb model. In this case study, a harmonic disturbance is excited at the joints of the exoskeleton whilst it is carrying out a joint space trajectory tracking. The disturbance is introduced to examine the compensating efficacy of the proposed controller. A particle swarm optimised active force control strategy is proposed to augment the disturbance regulation of a conventional proportional-derivative (PD) control law. The simulation study suggests that the proposed control approach mitigates well the disturbance effect whilst maintaining its tracking performance which is seemingly in stark contrast with its traditional PD counterpart.

Keywords: active force control; particle swarm optimisation; three-link manipulator; robust, gait rehabilitation; trajectory tracking control.

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