

Unpowered Knee Exoskeleton with Compliant Joints for Stair Descent Assistance

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Abstract : This paper introduces the design of an unpowered knee exoskeleton to assist human walking by redistributing the moment of the knee joint during stair descent (SD). Considering the knee moment varying with the knee joint angle and the work of the knee joint is all negative, the custom-built spring was used to convert negative work into the potential energy of the spring during flexion, and the obtained energy work as assistance during extension to reduce the consumption of lower limb muscles. The human-machine adaptability problem was left by traditional rigid wearable due to the knee involves sliding and rotating without a fixed-axis rotation, and this paper designed the two-direction grooves to follow the human-knee kinematics, and the wire spring provides a certain resistance to the pin in the groove to prevent extra degrees of freedom. The experiment was performed on a normal stair by healthy young wearing the device on both legs with the surface electromyography recorded. The results show that the quadriceps (knee extensor) were reduced significantly.

Keywords : unpowered exoskeleton, stair descent, knee compliant joint, energy redistribution

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