

Human augmentation in multiple activities with a versatile portable knee exoskeleton

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Augmenting human capabilities with assistive robots to accomplish “superhuman” performances is a long-standing ambition in science. Recent exoskeleton studies have mostly focused on reducing human energy expenditure during walking. However, beyond lowering the energy cost of walking, a primary goal of augmentative devices is to enhance human productivity, in particular for physically demanding tasks. Achieving this objective presents significant multifaceted challenges, including providing wearers with powerful assistance, a compliant design, and intelligent versatile control. We developed an untethered versatile exoskeleton capable of providing useful assistance for endurance augmentation in multiple activities. Results demonstrated that the exoskeleton reduced human energy expenditure and significantly enhanced productivity. Specifically, participants were able to squat, climb stairs, and carry a load on an incline for 52.3%, 39.8%, and 21.5% longer time, respectively, before reaching the same exertion level experienced without the device. This work provides new solutions for the creation of the next-generation exoskeletons that possess augmentative capabilities and expands the frontiers of physical human-robot interaction to enhance human productivity.

Video: <https://youtu.be/YLUMiqJDfqE>

