

Mechanical Engineering Thesis Defense

Indicators of Anticipated Walking Surface Transitions for Powered Prosthetic Control

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abstract

Human locomotion is an essential function that enables individuals to lead healthy, independent lives. One important feature of natural walking is the capacity to transition across varying surfaces, enabling an individual to traverse complex terrains while maintaining balance. There has been extensive work regarding improving prostheses' performance in changing walking conditions. However, previous studies have largely focused primarily on the transition between level, rigid surfaces to other rigid surfaces with various complexities, such as uneven topologies or changing surface grades, which is only representative of a subset of walking surfaces. There is still a need to address the transition from rigid to compliant or dynamic surfaces, such as the transition from pavement to long grass or soft sand. This research aims to investigate the mechanisms involved in transitioning from rigid ground to a compliant surface and identify potential indicators of the anticipated change that can be applied to the control of a powered ankle prosthetic to reduce falls and improve stability in lower-limb amputees in a wider range of walking environments. A series of human subject experiments were conducted using the Variable Stiffness Treadmill (VST) to control walking surface compliance while gait kinematics and muscular activation data were collected from three healthy, nondisabled subjects. Specifically, the kinematics and electromyography (EMG) profiles of the gait cycles immediately preceding and following an expected change in surface compliance were compared to that of normal, rigid surface walking.

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