Data management in gait analysis using autonomous system for control and monitoring

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Abstract

In this study we describe an autonomous system for estimation of spatio-temporal parameters during walking. Based on a biomechanical model, the medio-lateral ankle rotation during stance and swing phase of walking, the stride length and velocity are estimated. Measurements for each gait parameter was obtained using the information provided by tactile sensors between each heel strike and toe-off as well as the signal obtained from a rotational potentiometer in the ankle hinge joint. The system can operate in two modes during walking: data collection mode and assistive mode with active ankle-foot orthosis in cases of impaired ankle-foot complex. During each gait cycle, by measuring the total time when the foot remains in contact with the ground, the microcontroller estimates the forward speed and modulates the swing phase flexion and extension in order to achieve quite normal lower limb dynamics.

The system is portable, and can be carried for long periods of time, thus providing new longitudinal information such as stride-to-stride variability of gait. Graphical interface for representation and analysis of the data acquired during human motion is developed as well. Several clinical applications can be proposed such as outcome evaluation after total knee or hip replacement, external prosthesis adjustment for amputees, monitoring of rehabilitation progress, gait analysis in neurological diseases, and fall risk estimation in elderly.

Keywords: Gait analysis, Control, Active ankle-foot orthosis