

Inertial sensor-based instrumented cane for real-time walking cane kinematics estimation

ABSTRACT

Falls are among the main causes of injuries in elderly individuals. Balance and mobility impairment are major indicators of fall risk in this group. The objective of this research was to develop a fall risk feedback system that operates in real time using an inertial sensor-based instrumented cane. Based on inertial sensor data, the proposed system estimates the kinematics (contact phase and orientation) of the cane. First, the contact phase of the cane was estimated by a convolutional neural network. Next, various algorithms for the cane orientation estimation were compared and validated using an optical motion capture system. The proposed cane contact phase prediction model achieved higher accuracy than the previous models. In the cane orientation estimation, the Madgwick filter yielded the best results overall. Finally, the proposed system was able to estimate both the contact phase and orientation in real time in a single-board computer.

Keyword: Instrumented cane; Inertial measurement unit; Gait; Falls; Deep learning; Edge computing