CENTER OF MASS MOVEMENT ESTIMATION USING AN AMBULATORY MEASUREMENT SYSTEM

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Abstract

Center of Mass (CoM) displacement, an important variable to characterize human walking, was estimated in this study using an ambulatory measurement system. The ambulatory system was compared to an optical reference system. Root-mean-square differences between the magnitudes of the CoM appeared to be comparable to those described in literature.

1 Introduction

Traditionally, human body movement analysis is done in so-called 'gait laboratories', where several gait variables are estimated by measurement systems such as optical position measurement systems, EMG or force plates. A major drawback of these systems is their restriction to the laboratory environment. Therefore research is required for the development of measurement systems to perform these measurements in an ambulatory environment.

An important variable to characterize human walking is the Center of Mass (CoM), an imaginary point at which the total body mass can be assumed to be concentrated. Several methods exist for CoM estimation, of which the segmental kinematics method and the double integration of ground reaction force method are the most important ones.

The objective of this study is to estimate the CoM trajectory using an ambulatory measurement system which fuses Center of Pressure (CoP) trajectory with double integrated acceleration obtained from Ground Reaction Force (GRF) data. The accuracy of the ambulatory system is verified by comparing it to an optical reference system based on the segmental kinematics method.

Figure 1: Picture of the instrumented shoe [2].

2 Methods

A picture of the instrumented shoe is shown in Fig. 1. Two six-degrees-of-freedom force/moment sensors are mounted beneath the heel and the forefoot with two inertial sensors rigidly attached to them. Fusion of CoP with double integrated GRF data is based on a frequency domain method. A detailed description of the method can be found in [2].

3 Results

Fig. 2 shows the CoM trajectory of a stroke patient estimated by the ambulatory (solid) and reference system (dashed). The root-mean-square difference between the CoM magnitudes estimated by both measurement systems averaged over 100 trials was 0.025 ± 0.007 m (mean ± standard deviation).

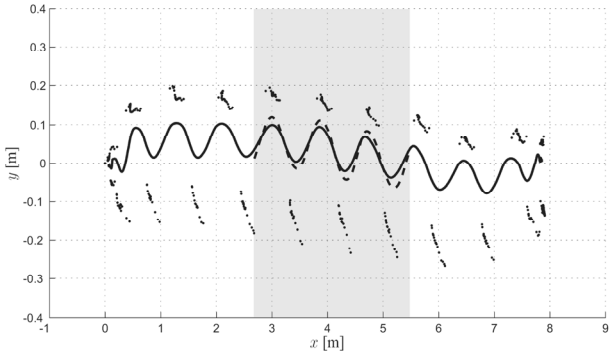

Figure 2: CoM trajectory of stroke patient estimated by ambulatory (solid) and reference system (dotted). Moreover, the CoP on either side of the CoM is indicated by the dots [2].

4 Discussion

This study has shown the possibility to estimate CoM movement using an ambulatory measurement system. The accuracy was verified by a comparison with an optical reference system. The results are comparable to those described in literature [1].

5 Acknowledgment

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References

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