

Detection of gait events using an F-Scan in-shoe pressure measurement system

Paola Catalfamo^{a,*}, David Moser^a, Salim Ghousayni^{a,1}, David Ewins^{a,b,2}

^a Centre for Biomedical Engineering, School of Engineering, Duke of Kent Building, 12DK03, University of Surrey, Guildford, Surrey GU2 7TE, UK

^b Gait Laboratory, Queen Mary's Hospital, Roehampton, London SW15 5PN, UK

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Abstract

A portable system capable of accurate detection of initial contact (IC) and foot off (FO) without adding encumbrance to the subject would be extremely useful in many gait analysis applications. Force platforms represent the gold standard method for determining these events and other methods including foot switches and kinematic data have also been proposed. These approaches, however, present limitations in terms of the number of steps that can be analysed per trial, the portability for outdoor measurements or the information needed beforehand. The purpose of this study was to evaluate the F-Scan[®] Mobile pressure measurement system when detecting IC and FO. Two methods were used, one was the force detection (FD) in-built algorithm used by F-Scan software and a new area detection (AD) method using the loaded area during the gait cycle. Both methods were tested in ten healthy adults and compared with the detection provided by a kinetic detection (KT) algorithm. The absolute mean differences between KT and FD were (mean \pm standard deviation) 42 ± 11 ms for IC and 37 ± 11 ms for FO. The absolute mean differences between KT and AD were 22 ± 9 ms for IC and 10 ± 4 ms for FO. The AD method remained closer to KT detection for all subjects providing sufficiently accurate detection of both events and presenting advantages in terms of portability, number of steps analysed per trial and practicality as to make it a system of choice for gait event detection.

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1. Introduction

The detection of gait events is an important part of gait analysis. The initial foot contact (IC) and the end of foot contact or foot off (FO) represent the start of stance and swing, respectively. They are commonly used in the analysis of temporal gait parameters and for the time normalization of data (for example, kinetic, kinematic or EMG) per gait cycle. This information, in turn, may be used for the characterization of gait as well as for the development and

evaluation of gait assist devices and sensors, for example, alternative sensors used in functional electrical stimulation orthoses applied to foot drop [1–3] or cerebral palsy toe walking [4,5].

Force platforms represent the gold standard method for determining these gait events. However, despite their recognized accuracy, the method is usually restricted to gait laboratory environments and the number of force platforms available (often two or three) limits the number of steps per trial that can be recorded. The use of foot switches represents an alternative method but normally requires previous knowledge about the appropriate position of the foot switches to obtain reliable detection for different subjects, especially for pathological gait [6].

The investigation of alternative methods that could provide portable and reliable measurements is an ongoing area of research. Kinematic methods have been suggested

* Corresponding author. Tel.: +44 1483 684575.

E-mail addresses: pcatalfamo@hotmail.com, p.catalfamo@surrey.ac.uk (P. Catalfamo), d.moser@surrey.ac.uk (D. Moser), s.ghousayni@surrey.ac.uk (S. Ghousayni), d.ewins@surrey.ac.uk (D. Ewins).

¹ Tel.: +44 1483 682971.

² Tel.: +44 1483 689670.