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A proposed test to support the clinical movement analysis laboratory accreditation process

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Abstract

This paper describes a testing methodology and resultant set of four variables that can be used to quickly and easily document the correct installation, configuration, and combined working status of force platform (FP) and three-dimensional (3D) motion capture components of a clinical movement analysis (CMA) laboratory. Using a rigid, rod-shaped testing device, CMA laboratory data are collected simultaneously from the FP and motion capture components (typically, video-based kinematic measurements) as the device is manually loaded while being pivoted broadly about a point on the FP. Using a computational method based on static equilibrium, it is possible to independently measure the rod's orientation and tip position during the moving trial, using FP derived data exclusively, and to compare these estimates to rod orientation and tip position estimates derived exclusively from the motion capture component. The motion laboratory accreditation test (MLAT) variables include: the difference (angle) between the orientation of the long axis of the testing device as independently determined from kinematic measures (motion capture component) and the FP derived data; and the difference (x, y, z) between the center of pressure position (FP derived) and the position of the testing device tip (motion capture derived) that loads the FP. A numerical dynamics model was explored to evaluate the appropriateness of the static equilibrium-based FP data model and to determine guidelines for testing device movement frequency and FP loading. The MLAT technique provides a simple means of detecting the combined presence of errors from many sources, several of which are explored in this paper. The MLAT has been developed to help meet one criteria of the CMA laboratory accreditation process, and to serve as a routine quality assessment tool.

Keywords: Movement analysis; Gait; Laboratory accreditation; Accuracy; Kinematics; Kinetics; Force platform

1. Introduction

Criteria for clinical movement analysis (CMA) laboratory accreditation in the United States and Europe are being developed in several areas, including measurement instrumentation, data collection, and data reduction [1]. One of the challenges in developing specific criteria in these areas is the need for a relatively simple, standardized method to assess and report the combined performance of the force platform (FP) and the system components dedicated to measuring movement (motion capture component). Several approaches for checking and/or comparing system performance have been reported in recent years [2–19], but many of these methods have tended to be time-consuming and/or focused on a specific measurement system or application. For example, a method similar to that proposed for rapidly 'spot checking' for stereophotogrammetric errors [18] utilizes a tipped rod that is manually moved in a circular pattern, but does not include an evaluation of FP measures. More recently, a method for 'spot checking' FP location estimates that simultaneously measures and compares FP and kinematic data from a double tipped rigid rod [19] has been proposed. However, this method: (1) requires that the rod be kept almost vertical during each data set collection (minimally loading the FP shear components), (2) needs data

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