COMPARISON OF UPPERLIMB KINEMATICS COLLECTED BY ELECTROMAGNETIC TRACKING VERSUS DIGITAL CAMERA SYSTEMS IN A GAIT ANALYSIS LAB

[1,2] Elizabeth Hassan, [1,2]Thomas Jenkyn, PhD, PEng and [1]Cynthia E. Dunning, PhD, PEng
[1]Department of Mechanical and Materials Engineering, University of Western Ontario, London Ontario, Canada,
[2]Wolf Orthopaedic Biomechanics Lab, Fowler-Kennedy Sports Medicine Clinic, London, Ontario, Canada

INTRODUCTION

The purpose of this study is to dynamically quantify the accuracy of kinematics measured by an electromagnetic tracking device compared to a digital optical motion analysis system for applications in the upper limb. Unlike lower limb motion, there is currently no standardized marker set for collecting upper limb kinematic data. [1] Complicating upper limb kinematic are joint motion pathways with fewer biomechanical constraints, smaller segments, and larger skin movement errors. These factors make collecting accurate and reliable in vivo data of the upper limb difficult. [2] However, innovations in motion analysis technology combined with optimized marker set design and placement could allow investigators to study upper limb kinematics in a gait analysis lab as an alternative to electromagnetic tracking systems.

METHODS

All of experiments were performed in the Wolf Orthopaedic Biomechanics Lab (WOBL) at the University of Western Ontario, which is equipped with an 8 camera Eagle Digital Motion Capture System (Motion Analysis Corp., Santa Monica, CA, USA). Rigid clusters of spherical reflective markers and electromagnetic sensors were attached to a mechanical articulator that mimicked elbow motion (Fig. 1).[3] Kinematic data were collected simultaneously using the camera system and an electromagnetic tracking system (Flock of Birds, Ascension Technologies, Burlington VT, USA) while the mechanical 'elbow' was moved through known ranges of flexion (i.e. 1, 2, 3, 5, 20, 110°), with and without coupled varus-valgus and/or internal-external rotations.

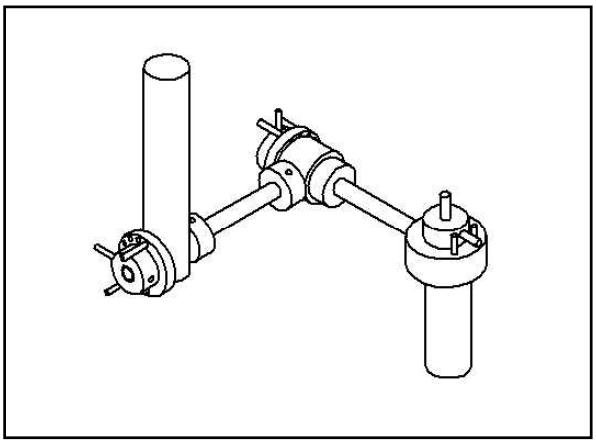

Figure 1 – Mechanical Articulator

RESULTS AND DISCUSSION

Compared to the known magnitudes, both the electromagnetic system and the optical system tended to overestimate the motion with mean differences of 0.96° and 3.28°, respectively (confidence intervals from 0.67°-1.24° and 2.55°- 4.06°, respectively). Two-way ANOVA analysis showed that for large (110°) flexion arcs, there is no effect of adding coupled motions (p=0.53) and no significant difference between systems (p=0.09). Both systems are able to accurately describe upper limb motion (Fig. 2), although they tended to over-estimate the magnitude of the motion. This appeared to be more pronounced for the optical system, but optimization of the marker cluster design may improve these results.

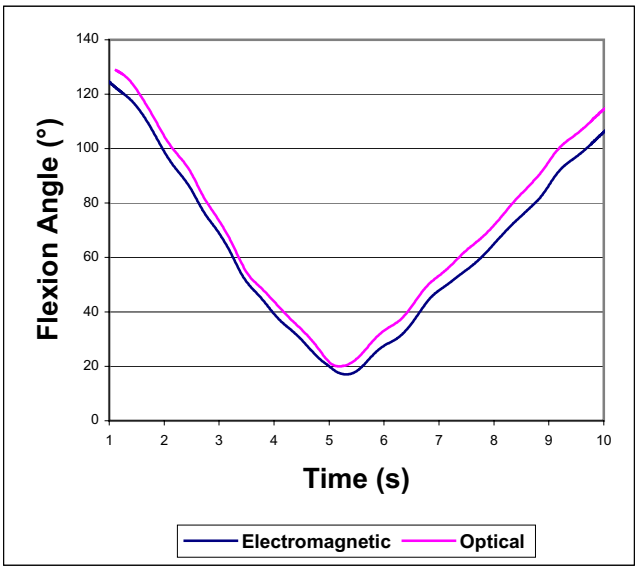

Figure2 – Reported Flexion Angle for Both Systems as a Function of Time.

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