To appear in *Computer Methods in Biomechanics and Biomedical Engineering*
Vol. 00, No. 00, Month 20XX, 1–11

Research Article

A Kinect-Based Movement Assessment System: Marker Position Comparison to Vicon

Julia K. Nichols,[a,b*] Mark P. Sena,[b] Jennifer L. Hu,[b] Oliver M. O'Reilly,[c] Brian T. Feeley,[b] and Jeffrey C. Lotz[b]

[a] *Department of Mechanical and Aerospace Engineering, University of California at Los Angeles, Los Angeles, CA 90095, USA*;
[b] *Department of Orthopaedic Surgery, University of California at San Francisco, San Francisco, CA 94143, USA*;
[c] *Department of Mechanical Engineering, University of California at Berkeley, Berkeley CA 94720, USA*

(*November 2016*)

Accurate movement analysis systems are prohibitive in cost and size to be accessible to the general population while commercially available, affordable systems lack the accuracy needed for clinical relevance. To address these limitations, we have developed a Depth Camera Movement Assessment System (DCMAS) that features an affordable, widely available depth camera, such as the Microsoft Kinect. After examining position data for markers adhered to participants and a flat surface captured both with the DCMAS and the industry standard Vicon system, we then demonstrate that the DCMAS can be used to obtain 3D marker position measurements that are comparable, within soft tissue artifact, to the Vicon system. Our results pave the way for a breakthrough technology in preventative medicine.

Keywords: clinical assessments; Kinect; depth camera; Vicon.

1. Introduction

Performance-based clinical assessment exercises, such as the double leg squat, single leg squat, and drop vertical jump (DVJ), are used to measure functionality and disability in patients. During these maneuvers, trained clinicians can visualize certain lower extremity movements that suggest neuromuscular deficits and increased injury potential. Joint kinematics, kinetics, and muscular activation can be quantified by using laboratory-based screening tools such as motion capture and electromyographic (EMG) systems. Several studies, e.g., Goerger et al. (2014); Hewett et al. (2005); Yamazaki et al. (2010) and Zeller et al. (2003), have used these assessment exercises and tools for evaluating movement deviations.

Presently, several of the aforementioned exercises and tools have major limitations. Clinical tests are subjective, difficult to implement, and lack normative data for interpreting test results. Laboratory-based screening tools require dedicated facilities, trained personnel, and expensive equipment (Myer et al. (2011)). Performance-based tests may also be sensitive to neuromuscular deficits that create risk, but are difficult to implement routinely in the clinical setting. In addition to laboratory-based functional assessment tools, other products, such as Wii Fit, Your Shape, and Kinect Sports, are highly accessible but lack the accuracy needed to reliably measure improvements in function and performance. Recently, affordable ($150), commercially available depth cameras

*Corresponding author. Email: julia.k.nichols@engineering.ucla.edu