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PRECISION BIOMECHANICAL MOTION TRACKING AND THROW CHARACTERISATION IN PROFESSIONAL DARTS

Walsh, M.[1], Tyndyk, M.[2], Barton, J.[1], O'Flynn, B.[1],

[1] Clarity Centre for Web Technologies, Tyndall National Institute, Microsystems Centre, University College Cork

[2] Medical Engineering Design and Innovation Centre, Department of Manufacturing, Biomedical and Facilities Engineering, Cork Institute of Technology

(email:michael.walsh@tyndall.ie)

INTRODUCTION

In professional sports there are in general three steps required to improve performance namely task definition, training and performance assessment. This process is iteratively repeated and feedback generated from quantitative performance measurement is in turn used for task redefinition. Task definition can be achieved in a number of ways including via video streaming or indeed and as is more common, by listening to coaching staff. However non-subjective performance evaluation is difficult due to the complexity of the movements involved. When considering the subset of sports where precision accuracy and repeatability are a necessity this problem becomes inherently more difficult to solve. Until recently sports such as martial arts, fencing and darts, where the smallest deviation from a prescribed movement goal can result in large outcome error, were deemed too difficult to characterise fully. Advances in technology, as illustrated by this study, now make this type of physiometry possible.

METHODS

This work performs an extensive measurement and characterisation study of biomechanical movement in professional darts, currently one of the fastest growing sports in the world. A multi-technology approach is adopted as illustrated by Figure 1 whereby a number of physiological and inertial measurement systems are applied in tandem, each extracting a useful subset of information.

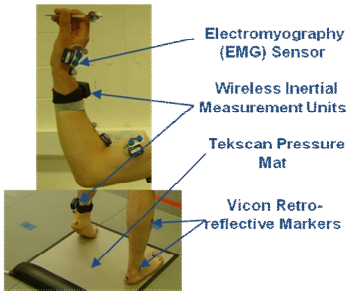

Figure 1 Experimental setup.

In this regard the VICON 3D motion capture system, with eight high speed, infrared video cameras (VICON, UK) provides a complete kinematic model of the subject as well as projectile ballistics, electromyography (EMG) sensors (Aurion, Italy) monitor muscle activation patterns, a force plate (AMTI, US) and a high resolution plantar pressure mapping system (Tekscan, US) capture tactile pressure and force measurements, wireless inertial measurement devices monitor tilt, force and fine grain movements and a high speed camera monitor's form. In addition the study will enable concurrent benchmarking of 'gold standard' inertial measurement systems with more affordable and proactive wireless inertial measurement solutions developed as part of this work.

BENCHMARK COMPARISON

Many inertial measurement systems utilize photonic technologies including high-speed video, motion capture cameras, or stroboscopic photography. These technologies generate quantitative measurements of movement dynamics. They also possess one or more major limitations including (1) extensive set-up and alignment, (2) restriction to indoor use, (3) high cost, (4) lack of portability and (5) time consuming data processing and analysis. This work seeks to overcome some of these limitations, employing Tyndall's low cost, miniature, wearable 6 degree of freedom Wireless Inertial Measurement Unit (WIMU) as a mobile and minimal infrastructure, drop in alternative to a photonic solution.

RESULTS

Initial results gathered from a professional darts player ranked within the top 100 in the world are shown in Figure 2. The WIMU technology exhibits performance close to that of the VICON motion capture system.

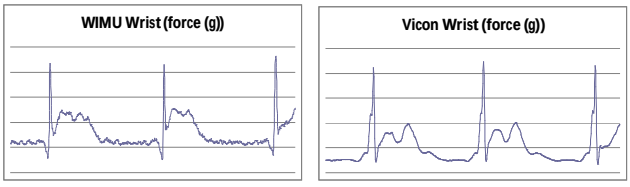

Figure 2 Benchmark comparison between VICON and Tyndall Wireless Inertial Measurement technologies.

DISCUSSION

This study will enable sports scientists to more fully understand the attributes required to perform at a higher level in sports involving highly complex inertial movement. Subsequent work will attempt to determine whether these qualities develop naturally or can be transferred with well defined training tailored to the individual.