VALIDITY OF TWO DIMENSIONAL VICON MOTUS MOTION SOFTWARE AT VARYING CAMERA ANGLES

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INTRODUCTION

Two dimensional (2D) VICON Motus Software (VMS) is commonly used for motion analysis in research laboratories and in clinical settings (Kuo, Tully, & Galea, 2008). The 2D analysis can be used for measuring joint angles, angular velocity and angular acceleration. In 2D analysis, before measurement of joint motion is taken, a rectangular frame of known size is placed in the plane of the movement to calibrate the camera field. According to the VMS operating manual, the use of a rectangular frame for calibration allows the camera to be placed at any angle from the plane of motion (Discovering Peak Motus, 2003). This has allowed clinicians and researchers to use VMS even if it is not possible to place a camera perpendicular to the plane of motion. The present study aims to validate the accuracy of measurement of angles by VMS at multiple camera angles.

METHODS

A rectangular piece of black construction paper (57.80 cm X 47.30 cm) affixed with four reflective markers was applied to the wall and used to calibrate the camera field. A universal goniometer was applied over the construction paper so that both were affixed to the lab wall to ensure they were in same plane. A quarter circle was constructed on the floor, and marked at 5° intervals from 5° to 90°. The arm of the goniometer was moved in 20° increments from 20° to 340°

(Fig.1). A one second video of each angle of goniometer was recorded at 60 Hz, then digitized and processed by the VMS version 8.5 (Peak Performance Technologies, Inc. Colorado, USA) to calculate the angle.

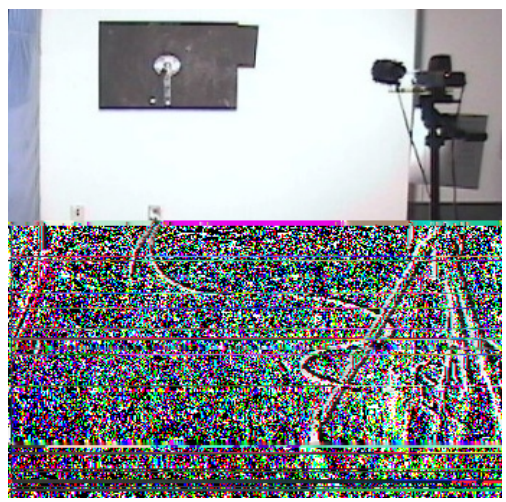

Figure1. Measurement of an angle on the universal goniometer by VMS.

RESULTS AND DISCUSSION

To calculate the error angle, the measured angle was deducted from the actual angle on the universal goniometer. The mean error at each camera position was calculated. A scatter graph was plotted between the camera position and mean error (Fig. 2). A logarithmic trendline was calculated to find out the error adjustment equation. The results indicated an increase in measurement error as the angle between the camera and the plane of motion of the goniometer decreased.

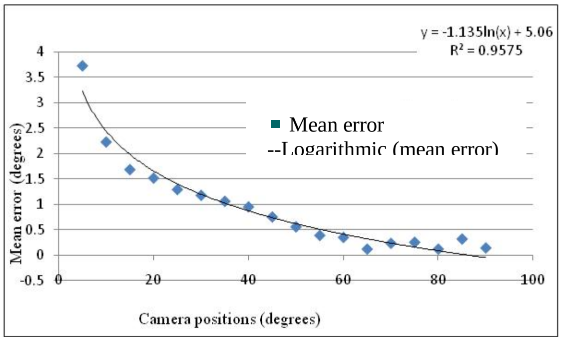

Figure 2. Camera position and angle mean error graph

The results of the study suggest that the angle of camera position is of vital importance in reducing error in measurement with 2D VICON Motus software (VMS). We found that the use of the rectangular calibration frame reduced the measurement error only up the 40° camera position (mean error <1.00°). Therefore, the camera should be placed as perpendicular to the plane of motion as possible to keep the measurement error to the minimum. However, the use of a rectangular frame instead of a one meter scaling rod for calibration appears to provide researchers some freedom to position the camera away from the perpendicular if needed. Calibration by a one meter scaling rod required the camera to be placed perpendicular to the plane of motion (Peak Motus 1996).

The maximum errors were noticed at the angles between 5° to 20° of camera position. The mean errors were more than 1.50°; therefore, researchers should avoid positioning the camera 20° or less from the plane of motion. However, if it is obligatory to place the camera as close as 5° to 20° to the plane of motion, the measurement error by VMS may be corrected by using a logarithmic trendline equation presented in Fig. 2.

We used the VMS to measure the static angle where the plane of motion was fixed all along the measurement. However, in actual research settings where human movement is being analyzed there is always a possibility of change in the plane of motion with respect to the camera position, thus more errors may be expected.

CONCLUSION

In 2D motion analysis, the camera should be placed as perpendicular to the plane of motion as possible.

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