ACCURACY OF A PORTABLE (PTZ DIGITAL) CAMERA SYSTEM DESIGNED FOR AQUATIC THREE-DIMENSIONAL ANALYSIS

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INTRODUCTION: Three-dimensional (3D) motion analysis of aquatic activities such as swimming requires high accuracy throughout large volumes particularly when above and below water data are merged for full body analysis. The purpose of this study was to assess the accuracy of a recently developed portable camera system designed for 3D kinematic data collection of aquatic activities including swimming.

METHOD: Ten markers with known 3D coordinates in a 6.75 m^3 calibration frame were digitized from video clips recorded with 4 underwater cameras (Elmo PTC-450C, Elmo CO., Ltd, Nagoya, Japan) and the data input to a DLT programme. A different set of ten markers with known locations were digitized and their 3D coordinates were calculated using the DLT equations generated from the digitized data of the original set of markers. Concurrently the same procedure was conducted for data recorded by a second camera system for which high accuracy and reliability has been previously established (Psycharakis, Sanders and Mill, 2005).

RESULTS: The mean differences and the root mean square errors (RMS) in estimating the locations of the second set of markers relative to their known locations were quantified to assess reconstruction accuracy. Moreover, the accuracy of the new system was drawn based on the magnitude of the RMS errors with reference to the accuracy of the established system as shown in Table 1.

Table 1 Mean differences (mm) and RMS errors (mm)

Recording system	Mean differences (mm)			RMS errors (mm)		
	X	Y	Z	X	Y	Z
Assessed system	2.0	2.8	2.7	2.3	3.3	3.3
Established system	6.7	5.5	4.3	8.0	6.7	4.7

DISCUSSION: The results of this study showed that the mean differences were lower for the assessed system when compared to the established system. RMS errors represent 0.05% of the calibrated area for X axis, 0.2% for Y axis and 0.3% for Z axis. These results were considerably lower than the results of the second camera system used and other systems reported in the literature.

CONCLUSION: The camera system assessed in this study showed high accuracy when used for aquatic three-dimensional analysis. Considering the additional advantage of being portable, the tested camera system can be regarded a valuable research tool for swimming biomechanics.

REFERENCES:

Psycharakis S.G., Sanders R. & Mill F. (2005). A calibration frame for 3D swimming analysis. In: Wang Q (Ed.), *Proceedings of the XVII International Symposium on Biomechanics in Sports*. The China Institute of Sport Science, Beijing. Pp.: 901-904.