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Title : BIOMECHANICAL CHARACTERISATION OF SENI SILAT CEKAK USING A NOVEL 3D MOTION CAPTURE-ANALYSIS SYSTEM

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Characterisation of Kaedah A is important to ensure its efficacy as one of defensive techniques emphasised in Seni Silat Cekak Malaysia (SSCM). This is because the ability to fend off an attack with bare hands is questionable since the estimated ordinary human reaction time is 0.18s. In addition, achieving this is also challenging as past research related to characterising martial arts technique suggested the use of motion capture system; which is complex (consisting multiple high-speed cameras), expensive, difficult to handle, devoted to the expert use and only available in certain institutions (sports institute, university laboratory). Thus, the main objective of this study is to biomechanically characterise Kaedah A. Furthermore, the objective also include developing a reliable and low cost motion capture-analysis system; which can be used to capture the SSCM movement in quasi-training environment for characterisation purposes. The motion capture-analysis system was developed using the integration of MATLAB GUIs and Kinect™ Sensor. The accuracy and reliability (validity) of the system was then statistically observed in comparison with Virtual Sensei Lite and VICON® (gold standard) system to ensure its validity as an alternative motion capture-analysis system. Then, the system was used to capture the Kaedah A (fend off technique) execution performed by 20 experienced Seni Silat Cekak Malaysia (SSCM) practitioners. The

time of execution (ToE) and kinematic parameter of practitioner's hand movement during Kaedah A execution were determined. As a result, an alternative system named Cekak Visual 3D (CV3D) v1.0 was developed. It is a markerless motion capture-analysis system which is capable to track dual martial art practitioner's skeleton motion in a single frame view. The results for the validity test show that CV3D is reliable and in good agreement with VICON® systems ($ICC \geq 0.6$, $r \geq 0.800$ and $\% SEM \leq 2\%$). A similar trend between CV3D and VICON® at providing elbow angular changes during Kedah A executions, has also confirmed the capability of CV3D in assessing rapid movements. The characterisation results show that the maximum impact velocity (Vimpact ave) was 5.02 m/s, determined from the root mean square (RMS) velocity profile. The time of execution for Kaedah A was identified to be below 0.1s. The velocity profile also demonstrates that the hand motion reaches its target, just before the left hand reaches the maximum velocity. The results presented are important not only for improving the performance of practitioners but also to demonstrate the efficacy of Kaedah A. Therefore, it could be concluded that this study has significantly contributed towards enhancing knowledge about Martial Art Biomechanics and motion capture-analysis system.