28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

Validity of a wearable sensor for stroke detection in youth tennis players

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INTRODUCTION:
The practice of athlete monitoring in tennis used to be done via notational analysis, so that coaches or analysts manually count the stroke and empirically estimate the load player may experience. The advancement of in micro-sensors and intelligent algorithms allow for the automatic and more tennis-specific quantification of the load, which enables the monitoring of multiple players in real-time. The aim of the study was to validate a commercially available trunk-mounted wearable sensor in detecting the strokes of different techniques in youth tennis player.
METHODS:
Fifteen youth tennis male players (International Tennis Number: 3 to 8) were recruited in the study and wore a GNSS and IMU based wearable device (Catapult Vector S7) between the scapulae using specific harness to collect the data of each stroke. During the experiment, players were required to perform 30 strokes of the following stroke in sequence with an interval of rest: forehand stroke, backhand stroke, volley, smash, serve, and shadow swings. The device manufacturer has developed a prototype algorithm to classify the recorded stroke into one of the following category: Forehand, Backhand, Serve and Other stroke. The Kappa statistic was used to measure the consistency between detected strokes by the device and the actual strokes.
RESULTS:
For strokes with presence of the ball, a total of 1391 correct strokes were identified, 187 incorrect stroke numbers were identified, and 843 incorrect stroke types were identified. While during for shadow swings, a total of 1216 correct strokes were identified; 58 incorrect stroke numbers were identified, and 1049 incorrect stroke types were identified. Higher Kappa coefficients were shown for forehand and backhand strokes detection (0.919 & 0.910 for ball strokes; and 0.904 & 0.959 for shadow swings), followed by that of serves (0.533 and 0.361). The device turned out to have poor to fair agreement with the actual counts in volley and smash (0.104 & 0.390; and 0.066, 0.316).
CONCLUSION:
The wearable device tennis stroke detection algorithm presented good results with excellent consistency in detecting forehand and backhand strokes. However, younger players may not produce the aspects of stroke strength and turn amplitude that met the inclusion criteria of the algorithm, so that the smash and serve showed a fair to moderate consistency. Moreover, as the turn amplitude of the volley and stroke strength are comparatively slighter, and youth players showed more variance during stroke execution, it is possible that few strokes could be correctly classified using a single sensor placed between scapulae. The device should be applied with caution to quantify player's stroke load and adding wrist-mounted sensors could potentially improve detection accuracy.

Topic: Sport Technology

Presentation Oral

European Database of Sport Science (EDSS)

Supported by SporTools GmbH

24881