WINDSURFING BIOMECHANICS: FROM A SINGLE GOPRO TO MARKERLESS MOTION TRACKING AND PERFORMANCE ASSESMENT

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Introduction

IQFoil windsurfing is a new type of Olympic windsurfing sport. Interestingly, there are limited publications that focus on the biomechanics of windsurfing in general and specifically in IQFoil windsurfing [1]. In this study, we will collect data in real-life conditions of windsurfing training sessions with the use of action cameras and wearables and develop an algorithmic flow to automatically synchronize, process, and analyze both sensor data and videos (markerless motion tracking). Thus, comparisons in speed, body, and board movement between multiple athletes will be possible. Therefore, the aim of this study is to quantify important data driven sports performance metrics for multiple athletes at the same time in real-life scenario trainings under the same surfing conditions.

Methods

Eight Olympic level athletes (4 M (male) and 4 F (female)) completed two windsurfing training sessions that lasted for about an hour each. The athletes performed various speed tests in a specific setup given by the coach and repeated the setup multiple times with a 4-minute break between each race. A GoPro camera was placed and mounted on the front of each IQfoil board, and the IMU data were extracted from the action camera videos using gpmf-parser [2].

An algorithmic flow was designed and implemented to synchronize, denoise, and analyze the data. Data analysis included estimation of wind direction, labeling of GPS segments as “upwind” or “downwind” accordingly, and calculating board rotation features such as roll and pitch per segment. Markerless motion tracking motion of the athletes on the segmented data was carried using an automatic pipeline, that merges all the training videos and extracts the body key-points using the OpenPose [3]. Subsequently, each type of motion (pumping, turning, high speed moments etc.) was tagged automatically in the video and used for post processing and visual purposes.

Results

Average downwind and upwind speeds of the male and female groups are shown in Figure 1 (A). Downwind presented higher speeds compared to the upwind condition (P=0.0009). Average knee flexion angles are presented in Figure 1 (B). The average KFA were significantly (P=0.036) higher (33.56 ± 5.75) under downwind compared to upwind (26.45 ± 6.47).

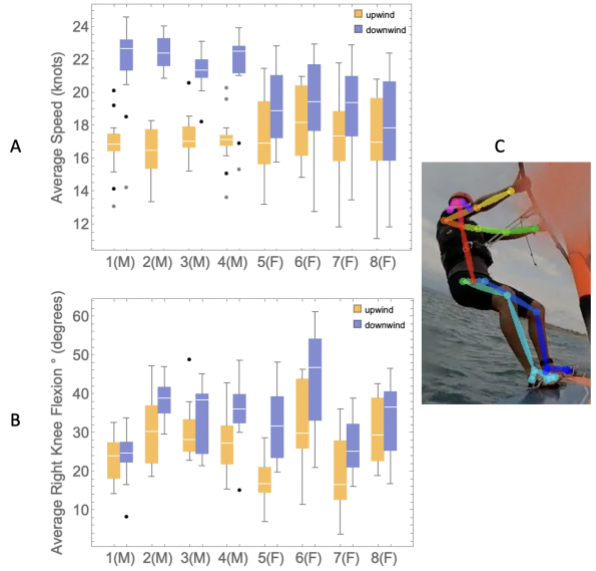

Figure 1: (A) Average GPS speed (knots) from each sailing segment for two different sailing directions (upwind/downwind) for each athlete (M-Male, F-Female). (B) Right knee flexion (degrees) for the same configuration as the (A). (C) Snapshot frame from the video markerless tracking.

Discussion

Action cameras and wearable sensors were used to collect data in real life environments, enabling us to leave from the laboratory to collect motion data. An algorithmic flow has been presented to synchronize all the data sources together and extract features related to the athlete’s and board movement. This is the first study, known to the authors, that collected and analyzed real life windsurfing (IQfoil) data from elite level athletes using wearable sensors. Future directions include further investigation of different kinds of motion movements (pumping, maneuvers etc.), heartbeat smartwatch data analysis and IMU sensor placement on the athletes for more accurate biomechanical and biomarker analysis.

References

1. Chun, Sabin, et al. J Performance Analysis in Sport (2022) 332-342.
2. https://github.com/gopro/gpmf-parser
3. Cao, Zhe, et al. IEEE conf. on comp. vis. and pattern rec., 7291-7299, 2017.