Analysing Elite Athletes' Movement Variations During Sports Games Through Broadcast Video

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Summary

This study utilised advanced computer vision techniques to perform 3D motion analysis with broadcast video of elite badminton matches. Pose variations over time were examined and analysed using a linear mixed-effects model. The results revealed no significant trend indicating changes in shoulder rotation among elite badminton players as time progressed.

Introduction

Performance outcomes in badminton are highly associated with shuttlecock speed and trajectory. These, in turn, are dependent on the player's movement and respective joint motions [1]. Previous studies using motion capture systems analysed badminton smash movements before and after fatigue-inducing exercises [2], revealing notable differences in player movements. However, in-game competitive performance presents diverse scenarios, including repetitive movements that can cause fatigue and dynamic adaptations highly dependent on specific game contexts. These factors may significantly impact players' strategies resulting in movement patterns that cannot be replicated in a lab setting. However, research on elite athletes' movements during actual in-game performance remains limited. It is unclear how interactions with other players and changing environmental conditions affect movement during gameplay. Recent advances in human mesh recovery (HMR), a computer vision technique powered by deep learning, enable 3D pose and shape estimation from standard video footage, making kinematic analysis feasible in real-world settings [3]. This study aims to leverage HMR to analyse broadcast footage of sports games, exploring whether elite players' movements change as gameplay progresses.

Methods

Manual annotations and labelled data from ShuttleSet [4] were used to extract male smash video clips, game timestamps, as well as the attacking player and their location. 366 video clips from 12 players (some of whom participated in multiple games) were extracted for movement analysis. The video clips were analysed using HMR (Figure 1) to extract the maximum shoulder external rotation during the smash movement, exhibiting significant changes under athlete fatigue [2]. A Linear Mixed Effects Model was used to determine whether in-game maximum shoulder external rotation during a badminton smash changed during a game (every 10 minutes).

Results and Discussion

This study leverages cutting-edge markerless motion analysis technology (HMR) to analyse players' movements using broadcast video datasets. By examining real-game scenarios rather than controlled simulations, the study aims to identify whether the pose of elite athletes will change during the sports game. The fix-effect estimate for game time was 0.283 ($P>0.05$), indicating that the players keep consistent shoulder rotation as game time progresses. Contrary to previous research indicating significant changes in fatigue before and after treadmill exercise [3], this finding suggests that elite athletes may not experience substantial fatigue during games.

Figure 1: Human mesh recovery for a badminton player. (Image resource: Badminton World Federation)

This research performed biomechanical analyses of badminton smash movements using a large dataset of competitive badminton broadcast videos, demonstrating the potential of deep learning techniques in advancing biomechanics research in real-world sports settings. However, the study highlights that current research heavily relies on manual annotation to identify relevant video clips. Therefore, it is recommended that computer vision researchers focus on developing sports event models to enable fully automated biomechanical analyses in the future.

Conclusions

The test results revealed no significant evidence of changes in shoulder rotation among elite badminton players over time during a game. Further research could explore whether sub-elite or junior players exhibit similar consistency or whether other biomechanical factors change over time during gameplay.

References

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