

Special Issue Themes: Markerless Motion Analysis in Sport and Exercise

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Introduction

This special issue will cover the application of markerless motion analysis in sport and exercise science research. Traditional methods for the analysis of human movement involve the use of cameras designed to assist with the identification of markers attached to specific anatomical landmarks. The use of markers requires training to ensure that equipment is configured and used properly. The correct identification of anatomical landmarks also requires extensive training and increases the preparation time for participants before data collection. Recent developments in artificial intelligence have enabled training of neural networks to automatically identify key points in the body that could serve as surrogate locations for anatomical landmarks. However, further research is required to explore their validity, reliability and application to sport and exercise. This special issue aims to capture papers that demonstrate one or more of these components and to inform practitioners. We understand that this theme aligns with the *Journal of Sports Sciences*' aims and scope around applied sport and exercise. The relevance is clear in the area of Sports Medicine and Biomechanics, but application to Sport Performance is also evident through movement optimisation and performance implications.

Significance and rationale

Robust data collection methods are important to assist with the prescription of exercise and training programmes. Measuring human movement to optimise performance and reduce the risk of injuries is a key goal for applied biomechanics research. However, biomechanical assessment is traditionally time-consuming, particularly when using 3D motion capture systems. In applied settings, these systems are normally available in high performance sport facilities and in a limited number of clinical settings due to the high cost of the specialist equipment and requirements for staff trained in conducting these assessments. The use of artificial intelligence, that is trained to automatically identify body segments and anatomical landmarks, can assist with scaling the use of markerless technology to motion analysis in any setting. We understand that the rapid expansion of markerless methods, particularly through commercial systems, deserves attention from the scientific community. The large number of new methods to conduct markerless motion analysis requires appraisal to ensure that validity and reliability are at appropriate levels for cutting-edge sport and exercise research.

Scope of the themed collection

This special issue will accept high quality research involving the validity and reliability of markerless methods for the analysis of human movement. In addition, studies demonstrating the application of markerless methods to sport and exercise will be a key element of this issue. Preference will be given to studies illustrating a clear application beyond the development of new methods, to ensure that readers for the *Journal of Sports Sciences* can appraise the potential use of these methods in practice.

Topics include but are not limited to the following:

- 3D/2D pose validation and assessment of different markerless motion analysis in sport and exercise
- Development of novel machine learning and deep learning methods for markerless motion analysis in sport and exercise
- Best practices, common pitfalls, and new opportunities for markerless motion analysis in sport and exercise
- Prediction and classification of sport/exercise performance analysis from markerless motion analysis, including retraining and transfer learning
- Classification, detection, segmentation, tracking and/or pose estimation solutions for sport and exercise from markerless systems
- Data augmentation and evaluation for markerless systems improvement, including the use of synthetic data

We will invite key investigators, with strong track records on the topic, to contribute two review papers. We will also reach out to colleagues in Latin America, Africa and Asia to ensure that there is representation from their regions.

Keywords: Markerless, human motion, artificial intelligence, machine learning, deep learning, sport performance, pose estimation

Proposed timeline:

Advertisement of the special issue: Mar 2024

Due date for submission of abstracts to the editors: Jul 2024

Due date for submission of full papers for review: Oct 2024

Expected completion of review: May 2025

Suggested Themes for Articles

To enhance the special issue on "Markerless Motion Analysis in Sport and Exercise" with additional topics, while maintaining the original parts, here are some new themes that can be included:

1 Impact of Markerless Motion Analysis on Coaching Techniques and Strategies:

- Investigate how coaches in various sports can utilize markerless motion analysis to refine training techniques and strategies.

2 Application of Markerless Motion Analysis in Dance and Artistic Performance:

- Explore the use of markerless motion analysis in the context of dance and other artistic performances, focusing on movement optimization and injury prevention.

3 Wearable Technology Integration with Markerless Systems for Enhanced Athlete Monitoring:

- Discuss the synergy between wearable technologies and markerless systems, and how this integration can provide comprehensive monitoring of athletes.

4 Markerless Motion Analysis in Pediatric Sports Medicine:

- Examine the application and challenges of using markerless motion analysis for assessing and improving movement in young athletes.

5 Use of Markerless Motion Analysis in Extreme Sports:

- Explore the unique applications and challenges of implementing markerless motion analysis in extreme sports like rock climbing, skateboarding, or snowboarding.

6 Advancements in Real-Time Markerless Motion Analysis for Immediate Feedback:

- Discuss the development of real-time markerless motion analysis systems that provide immediate feedback to athletes and coaches during training sessions.

7 Ethical Considerations and Data Privacy in Markerless Motion Analysis:

- Address the ethical implications and data privacy concerns associated with the collection and use of human movement data in sports, exercise and clinical settings.

8 Cross-Comparative Studies of Markerless Systems Across Different Sports:

- Present studies that compare the effectiveness and applicability of markerless motion analysis systems across various sports disciplines.

9 Machine Learning Innovations in Markerless Motion Analysis for Injury Prediction

Explore how machine learning algorithms integrated into markerless motion analysis systems can predict potential injuries in athletes.

10 Markerless Motion Analysis in Rehabilitation and Recovery Processes:

- Investigate the role of markerless motion analysis in the rehabilitation and recovery processes of injured athletes.

11 Environmental and Contextual Factors in Markerless Motion Analysis:

- Study how different environmental and contextual factors, such as terrain and weather conditions, affect the accuracy and applicability of markerless motion analysis in outdoor sports.

12 Customization of Markerless Motion Analysis for Individual Athlete Needs:

- Discuss the customization and personalization of markerless motion analysis systems to cater to the specific needs and goals of individual athletes.

13 Integration of Markerless Motion Analysis with Virtual Coaching Platforms:

- Explore the integration of markerless motion analysis technology with virtual coaching platforms, enhancing remote training and coaching capabilities.

14 Comparative Effectiveness of Markerless Motion Analysis in Amateur vs. Professional Athletes:

- Investigate the differences in the effectiveness and utility of markerless motion analysis between amateur and professional athletes.

15 Future Trends and Technological Innovations in Markerless Motion Analysis:

- Provide insights into future trends, emerging technologies, and potential innovations in the field of markerless motion analysis in sports and exercise.