Real-Time Biomechanical Feedback for Injury Prevention in Baseball Pitching

Ebenezer Olubayode[1], Dr. Daniel Larson[2], [3]Ayobami Omolusi

[1]Sports Data Analytics, Department of Health & Exercise Science, University of Oklahoma, USA
[2] Sports Data Analytics, Department of Health & Exercise Science, University of Oklahoma, USA
[3] Collective Intelligence, UM6P-Mohammed VI Polytechnic University, Morocco

Introduction:

Sports injuries, particularly in high-impact and repetitive-motion sports like baseball, pose significant challenges to both players' health and team performance. Pitching-related injuries are a leading cause of long-term mechanical inefficiencies, lost playing time, and financial burdens for teams due to salary expenses, rehabilitation costs, and reduced competitive advantage. While existing biomechanical tracking tools provide valuable data on pitch mechanics, joint stress, and movement efficiency, most rely on post-game analysis, delaying injury prevention interventions. There is a growing need for real-time biomechanical monitoring to enable instant corrections, reduce injury risk, and enhance performance longevity.

Objective:

This study introduces PitchPerfectAI, an AI-powered real-time biomechanical feedback system that tracks key pitching mechanics, detects deviations from optimal movement patterns, and alerts players and coaches to potential injury risks. The goal is to bridge the gap in traditional injury biomechanics tracking by providing immediate feedback, allowing for in-game corrections to prevent overuse injuries and mechanical breakdowns.

Methodology:

PitchPerfectAI integrates computer vision and AI-driven motion analysis to track key biomechanical metrics, including arm angles, shoulder rotation, kinetic sequencing, and fatigue-induced variations. The system captures live motion data, detects deviations from established biomechanical norms, and sends real-time alerts for corrective adjustments. Additionally, it incorporates historical tracking capabilities, generating individualized biomechanical reports to assess long-term movement trends and injury risk factors.

Results:

Preliminary testing has shown high accuracy in tracking movement patterns and detecting biomechanical deviations. Pitchers using the system were able to make immediate adjustments, resulting in:

- Improved pitch consistency
- Reduced joint stress and injury risk
- Enhanced fatigue monitoring to prevent late-game mechanical inefficiencies

Additionally, this research has expanded beyond sports applications, incorporating a digital therapeutic model to assist individuals with musculoskeletal disorders, such as stroke patients, during rehabilitation. By applying real-time biomechanical feedback, this system helps prevent further injury, ensuring safer recovery and improved rehabilitation outcomes.

Conclusions:

This work contributes to injury biomechanics research by demonstrating how real-time AI-powered biomechanical feedback can be integrated into sports injury prevention strategies and rehabilitative healthcare applications. The product provides both instant corrections for in-game performance and long-term monitoring for injury prevention, making it a valuable tool for sports medicine, athletic training, and injury biomechanics research.

Please fill out the following table of information:

Name of primary student author:	Ebenezer Olubayode
University where research was completed:	University of Oklahoma
Department/Program enrolled (e.g., Mechanical Engineering):	Sports Data Analytics, Health & Exercise Science
Degree sought during work done for abstract (e.g., BS, MS, PhD):	MS
Expected or actual degree completion date:	May 2025 with PhD in view
Advisor's name:	Dr. Daniel Larson
Student's current affiliation, if different from above:	
Current address:	1800 Beaumont Drive, Norman, Oklahoma
Phone:	4057771697
Email:	olubayodeeben@gmail.com
Word count of abstract (must be 500 or less)	
Preference for podium or poster presentation?	I would prefer a podium presentation, but I am open to a poster presentation if that aligns better with the symposium's format

*Please save this form with your **last name in the file name**.*

*Please save this form as a **Word document** (do not convert to pdf).*

To submit, please email the Word document to ibrc@osu.edu