

Comparison of High Precision and Performance of Invisible Jumpers Performance Comparison

Article Overview

Invisible jumpers, such as IMU-based systems, can achieve high precision in measuring countermovement jump performance, closely matching force plate data for key metrics like jump height, contraction time, and RSImod.

Accuracy and Precision

Inertial Measurement Units (IMUs) placed on the lumbar spine (L5) have been shown to provide highly accurate measurements of CMJ parameters when compared to force plates, the gold standard. Metrics such as contraction time ($r = 0.902$), negative impulse phase time ($r = 0.773$), flight time ($r = 0.737$), jump time ($r = 0.708$), RSImod ($r = 0.725$), and minimum force ($r = 0.758$) demonstrated strong correlations with force plate data, indicating that IMUs can reliably capture the temporal and force characteristics of jumps. However, positive impulse phase measurements may be less precise depending on device placement and calibration. Low-sampling rate IMUs using Numerical Double Integration methods also showed excellent reliability (0.88) and low bias (2.5 cm) in estimating jump height, making them a portable and practical alternative for field-based assessments. Other computational methods like Take-Off Velocity and Flight Time performed well for bilateral jumps but were less accurate for unilateral jumps.

Performance Metrics

CMJ performance is typically evaluated using jump height, peak power, and RSImod, which reflect an athlete's explosive strength and neuromuscular readiness. Studies indicate that jump height correlates strongly with peak power, positive impulse, and concentric center of mass position, highlighting the importance of phase-specific analysis. High-performing jumpers exhibit shorter times to takeoff, greater unloading and concentric RFD, and higher eccentric braking RFD, which are critical for explosive performance.

Practical Implications

IMU-based invisible jumpers offer several advantages over traditional force plates:

- o Portability and ease of use: Can be used outside laboratory settings for field testing.
- o High correlation with gold-standard metrics: Provides reliable data for training monitoring and performance assessment.
- o Phase-specific insights: Allows coaches to analyze contraction, eccentric, and concentric phases to optimize training interventions. Force plates remain the most precise tool for detailed kinetic analysis, but IMUs provide a cost-effective, practical, and sufficiently accurate alternative for most athletic applications.

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Conclusion

Invisible jumpers, particularly IMU-based systems, can achieve high precision and performance in measuring CMJ metrics, closely approximating force plate data for key parameters. They are especially useful for field-based monitoring, athlete training, and performance optimization, while still allowing phase-specific analysis to identify strengths and weaknesses in jump mechanics .

Our work advances the understanding of jumping, shows a new level of performance, and underscores the

The study focuses on the development of control methods for technical performance and physical fitness of athletes-jumpers on the

"The key to meaningful biomechanical analysis isn't just in data collection--it's in applying those insights to training that truly impacts

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The present study extends existing literature by examining a homogeneous cohort within a narrow performance

Our comprehensive comparison of men's sports jumpers brands reveals clear winners in each category, whether

Regarding lower limb amputee long jumpers, larger inter-limb asymmetry was reported for average sprinting vertical

We reviewed a broad set of methods available in the literature for network comparison, assessing their performances

The purpose of this study was threefold: (i) to compare CMJ performance between elite

Introduction Countermovement vertical jump testing has become a staple in athlete assessment protocols. As

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the

Therefore, the purpose of this study was to determine and compare the vertical jumping performance presented by top

A simulation was matched to a recorded high jumping performance by varying the activation profiles of each of the

The greater-than- g acceleration of a bungee jumper discussed in a previous article in this journal by Kagan and Kott 1

A comparison of the energetics of jumping between biological and engineered systems shows that engineered

Jump assessments offer insights into physical qualities that impact performance beyond just vertical displacement. Basketball sees

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