

A NEW METHODOLOGY FOR HUMAN MOVEMENT ANALYTICS: FROM CHEMICAL ENGINEERING PRINCIPLES TO NEW SPORTS SCIENCE

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ABSTRACT 350

In the last decade the area of Sports Science has been developing rapidly with the development of advanced biomechanical models [1], introduction of metabolomics and genomics [2], and empowered by the introduction of new techniques for measuring movement and performance [3]. However, in terms of analysing the current condition of athletes and then designing personalized training programs that can enhance their performance, methods developed over 50 years ago are still being used. Indeed the need for a “Grand Unified Theory of sports performance” was recently suggested [4].

A theory based on Chemical Engineering and Sports Science principles was developed connecting the energetics with the kinematics of human movement, specifically of a kinetic-chain moving under imposed resistance. The model consists of two parts. The first is movement evaluation which is achieved by a series of tests emphasizing different aspects of the movement. This analysis provides insights into how an individual performs a movement by determination of physically meaningful model parameters. The second part of the model utilizes the determined individual parameters of movement extracted from the first model to optimize a series of dimensionless metrics of performance. As a result, instead of using a single metric of movement (e.g., one repetition maximum) to outline a training program with two parameters (e.g., %1RM and volume) one can now utilize many more metrics of movement to prescribe multiple parameters of training.

This new model is the first one that provides both a deep evaluation of movement and also a truly personalized resistance training depending on the current condition of the athlete but also optimized towards the desired training improvements. The models were validated in a study of students at the Democritus Univ. Thrace over a period of 4 weeks training with a leg extension machine resulting in +26% more improvement in the optimally trained group. [5]

The potential of these developments are obvious in the field of Sports but extend well beyond to other areas where a deeper assessment of human movement is needed. These areas include rehabilitation, monitoring of movement during active living, monitoring of sarcopenia, progression of neurodegenerative disorders, and more.

KEYWORDS: Movement analytics, resistance training, energetics, kinematics, personalized

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