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Editorial

Special Issue on Biotechnology and Sports Engineering

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1. Introduction

We are in the midst of the fourth industrial revolution, a time of change and innovation. The limitations to independent studies have been shown, and a multidisciplinary convergence that transcends the boundaries of academic disciplines has become indispensable. Biotechnology and sports engineering are especially intimately connected, and when they advance together, they may significantly improve the quality of human life.

The aim of this Special Issue is to share the latest research trends in biotechnology and sports engineering that explore future directions for development. In total, 40 papers were submitted, and 16 papers covering various topics of interest were accepted (i.e., a 40% acceptance rate). Here, a brief introduction to the research topics and related works is given.

2. Integration of Biotechnology and Sports Engineering

Biotechnology covers a wide range of topics that make use of living organisms and subcellular components, but its biggest concern is human health. The first paper by Chang et al. [1] presented therapeutic strategies for amputees with lower back pain associated with a lack of neural control of movement. The intramuscular characteristics of the lumbar muscle at rest were analyzed using a myotonometer with age-matched lower limb amputees and controls. Lee et al. [2] provided a valuable reference for the pathophysiology and treatment of bone diseases. This study used the commonly used method of dual-energy X-ray absorptiometry to measure the difference in Korean subjects' bone mineral density and content based on age and gender.

Today's frontiers in biotechnology include cellular and molecular systems which are incredibly complicated, making their investigation more difficult. Two studies on biomedical visualization suggested novel approaches to detect biomolecules. It is important to distinguish between different cellular types in diagnosis and treatment given their significant impact on therapeutic approach and prognosis. Hyun et al. [3] compared three different center point localization methods using the time-lapsed images of cellular dynamics. They found that modified active contours with denoising significantly reduced localization errors. To precisely detect biomolecules, Lee et al. [4] built micro/nano-scale structures composed of silver (Ag). Their ring patterned fabrication method showed enhanced intensity that can be applied to surface-enhanced Raman spectroscopy studies.

The goal of computer-aided surgery is to supplement human limitations in surgery, improve the consistency of surgical procedures, and achieve higher quality surgical operations while reducing the time they take. Choi et al. [5] proposed a unique registration process for the use of image-guided surgical navigation systems. Their strategy was to optimize the registration point cloud by applying specialized augmentation and creation steps. The new protocol exhibited improved registration accuracy in all conditions when compared with the conventional method.

Biosensors in the field of human movement study provide the advantage of detecting and interpreting the motor signals of the central nervous system. In two studies, surface electromyography was used in a non-invasive manner to measure the magnitudes and patterns of muscle activity. Park et al. [6] designed a unique balancing handle as a symmetric

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upper extremity training method, which allowed the quantitative evaluation of physical function and monitoring of rehabilitation therapy outcomes. Cho et al. [7] proposed logarithmic parameters to assess the potential endurance times in low-effort tasks.

Strut chordae (SC) that sustain the tunnel-shaped mitral valve (MV) have distinctive structures and functions in the inflow and outflow tracts of the heart. To better understand the complicated MV structures and implant design, Hong et al. [8] simulated how changes to the SC insertion position affect MV function and dynamics. The stress distributions and the leaflet coaptations over the whole cardiac cycle were compared, and the best design was evaluated.

Studies regarding physical recovery programs, such as fatigue recovery and muscle reparation from sports injuries, are being actively developed. Kim et al. [9] evaluated the potency of a deep-sea water thalassotherapy (DSWTT)-based exercise program on fatigue and muscle rehabilitation, with findings indicating a considerable effect on muscle recovery in particular. Park et al. [10] reported the relationship between cold-water immersion (CWI) and antioxidant enzyme activation in elite Taekwondo athletes. Blood tests revealed the increase in antioxidant enzyme concentration in the experimental group. Finding the right exercise intensity is just as important in preventing sports injuries and obtaining exercise benefits. To help individuals find/achieve the appropriate exercise intensity, Wu et al. [11] presented a novel machine-learning-based method that combined the advantages of absolute and relative intensity methods. A user's static body data and questionnaire survey could predict personalized exercise targets.

Today's sports are combined with diverse engineering technologies (e.g., finite element analysis (FEA) and internet of things (IoT)) in order to promote athletic ability, player safety, and fan engagement. FEA is a fundamental technique for reducing development costs and times. Fraccaroli and Concli [12] created a precise virtual model of ski mountaineering that used sports mechanics to simulate the behavior of actual materials. Taekwondo electronic protection devices have IoT features that automatically detect the strength of an attack and judge its validity using an advanced sensor attached to the protective equipment. Park et al. [13] investigated athletes' acceptance intention of electronic devices in Taekwondo matches using a predictive model. Their model revealed better means to regulate the sensitivity of these devices and facilitated the application of engineering technologies in sports.

Clinical exercise physiology is a field that examines how physical activity and exercise affect both short-term and long-term bodily responses. Lee et al. [14] used accumulated measurement data from local sports centers to investigate relevant physical factors in sports events. Physical fitness measurements from 16,645 subjects were used to calculate the relative weights of each factor (muscular power, muscular endurance, power, coordination capability, agility, flexibility, cardiorespiratory endurance, and balance) in four sports categories. Hyun and Jeon [15] studied the effects of 12 weeks of Pilates on pregnant women with regard to body composition, lipid metabolism, pelvic stabilization, and muscle damage. The results demonstrated that mat Pilates is a safe and effective form of exercise for pregnant women. Muscle strength is associated with health outcomes and can be a good indicator for the diagnosis of metabolic status. The 16-year cohort study of Jeon et al. [16]'s with 2538 participants verified that lower relative hand grip and back muscle strength are associated with a high risk of future metabolic abnormality.

3. Present Findings and Future Pathways

The first Special Issue entitled "Biotechnology and Sports Engineering" has successfully brought together the contributions of authors and peer reviewers across different disciplines. Knowledge building is not just a matter of linearly adding to previous information but making more synergistic and complementary effects. The continuous exchange of knowledge between disciplines must be made to facilitate the advancement of human health and wellbeing.

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