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Editorial

Editorial: Advanced Computer Methods and Programs in Biomedicine

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Computer methods and programs have been widely used in biomedical researches and applications during the past decades. However, due to the hardware and software limitations in data acquisition, processing, analysis, imaging and visualization, etc. there are various bottlenecks that prevent the state-of-the-art computer methods and programs from being applied in biomedical practices. This motivates researchers to develop novel and really applicable computer methods and programs to promote the biomedical researches and applications. Fortunately, with great progresses in computing hardware in recent decade, a large variety of advanced mathematical and computational methods have been proposed to facilitate existing biomedical researches and many potential new applications. The aim of this issue is to present timely and advanced computational and mathematical approaches for biomedical researches and applications.

There are 24 papers contributed by the researchers from various fields of biomedicine. All of them are focusing on technical advances of the computer methods and programs for important biomedical problems. Generally, these papers have mainly demonstrated the advances in three aspects of biomedical research: 1) technical improvement for biomedical detection, 2) human motion understanding, and 3) disease analysis and diagnosis.

In the first aspect, the papers dealt with the advanced methods and computational tools for detection of biomedical tasks. To strengthen the detections of ultrasound images, Xu et al. [1] proposed a Gabor-based anisotropic diffusion with lattice Boltzmann method to suppress the speckle noise. Song et al. [2] presented an ultrasound image segmentation method for myocardium via an improved graph cut model with features of super-pixels and neighborhood patches. Wang et al. [3] further adopted a feasibility study of global tracking of myocardial motion in ultrasound sequence images. Meanwhile, in consideration of the size impact of region of interest, Fei et al. [4] demonstrated their influences on transcranial sonography based computer-aided diagnosis. Based on

numerical evaluations, Wang et al. [5] investigated the relationship between the ablation zone and the ablation time under different tip temperatures during radiofrequency ablation. By using optically driven microspheres, Hu et al. [6] established a control strategy to quantitatively generate microfluid flow. To expand the traditional biomedical imaging, Zhou et al. [7] proposed a 3D shape measurement method based on structured light field imaging.

In the second aspect, the papers are concerned with the mathematical models and data analysis for understanding body movements and brain activities of human. For researches on body movements, Li et al. [8] utilized time-varying synergy and synchronous synergy theories in the analysis of human hands-and-knees crawling movement. Meanwhile, during a typical Tai Chi movement, brush-knee and twist-step of the meniscus and cartilage of the knee are also studied by Li et al. [9]. In conduction of reaching task, Xiao et al. [10] incorporated 3D kinematic data in the analysis of dominant hand versus non-dominant hand. Furthermore, by biomechanical and neuromuscular strategies, Wu et al. [11] also analyzed much more intensive actions such as backward somersault landing in artistic gymnastics. For analysis of eye movement, Zheng et al. [12] conducted a model with geometric solutions for gaze correction in eye-tracking. For researches on brain activities, Ma et al. [13] used visual graphic stimuli for localization of brain activities for event-related potential-based speller. Jiang et al. [14] built a deep learning based transfer learning model to estimate brain age through magnetic resonance T1-weighted images.

In the third aspect, the papers aimed to address the problems of disease analysis and computer aided diagnosis from various techniques. Taking Micro-CT as an example, Gao et al. [15] utilized a mouse model to study human ankle sprains via comparative anatomy of mouse and human ankle joint. Because ultrasound imaging has the advantage of no radiation risk compared to CT scan, Li et al. [16] used the multilevel side-to-side image contrast for ultrasonic diagnosis of unilateral peripheral entrapment neuropathy. Jiang et al. [17] further proposed a fast 3D ultrasound projection imaging method for scoliosis assessment and an ultrasound based method extracting coronal images for automatic measurement of spinal curvature in adolescent idiopathic scoliosis [18]. Ouyang et al. [19] comprehensively reviewed the ultrasound detection methods for breast micro-calcification. Furthermore, Shen et al. combined multiple ultrasound parameters to quantitatively analyze non-alcoholic fatty liver in rats [20]. For liver tumor thermal ablation, Zhang et al. [21] systematically reviewed the computer-assisted needle trajectory planning and mathematical modeling. Zhu et al. [22] used surface electromyography for examining and monitoring paretic muscle changes during stroke rehabilitation. In consideration of 3D printing technique in biomedical researches, Liu et al. [23] utilized gait analysis data to study the 3D printing of specific ankle-foot orthoses for persons after stroke. Yao et al. [24] further proposed a minimally invasive technique for treatment of calcaneal fractures via the sinus tarsi approach in combination with 3D printing.

In summary, the 24 excellent review/research papers have provided a wealth of knowledge in advanced computer methods and programs in a wide range of biomedical applications. This special issue delivers valuable information to clinicians to expand the frontier of biomedical research.

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