Guest editorial

Advances in Biomedical Engineering and Biotechnology during 2013–2014

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Abstract. The 3rd International Conference on Biomedical Engineering and Biotechnology (iCBEB 2014), held in Beijing from the 25th to the 28th of September 2014, is an annual conference that intends to provide an opportunity for researchers and practitioners around the world to present the most recent advances and future challenges in the fields of biomedical engineering, biomaterials, bioinformatics and computational biology, biomedical imaging and signal processing, biomechanical engineering and biotechnology, amongst others. The papers published in this issue are selected from this conference, which witnesses the advances in biomedical engineering and biotechnology during 2013–2014.

Keywords: Advances in biomedical engineering, iCBEB

1. Introduction

New methods and advanced technology in biomedical engineering and biotechnology can assist in improving the accuracy of diagnosis. The 3rd International Conference on Biomedical Engineering and Biotechnology (iCBEB 2014), held from the 25th to the 28th of September 2014, provides an opportunity for researchers and practitioners around the world to present the most recent advances and future challenges in the fields of biomedical engineering, biomaterials, bioinformatics and computational biology, biomedical imaging, signal processing, biomechanical engineering and biotechnology, amongst others. The first iCBEB was held from the 28th to the 30th of May 2012 in Macau, and the second conference was held from the 11th to the 13th of October 2013 in Wuhan, China.

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2. Highlighted papers

The following sections highlight some papers from the conference as recommended by the conference committees and reviewers.

2.1. Biomedical imaging

In the paper "Improve accuracy for automatic acetabulum segmentation in CT images", a new method to improve the accuracy of the segmented acetabulum using surface fitting techniques is proposed. Separation of the femur head and acetabulum was one of main difficulties in the diseased hip joint due to deformed shapes and extreme narrowness of the joint space. Several improvements were proposed in this paper. An iterative process for optimal surface fitting where the authors enlarged flexibility from two-freedom to multi-freedom and used the distance match and the normal match and the optimum region selection method could remove noises and fill holes. The methodology was tested about four CT data-sets according to literature [1] and the results showed that the accuracy of this method was largely improved with respect to similar methods.

The paper "A novel lung nodules detection scheme based on vessel segmentation on CT images", proposes a novel method to detect lung nodules, first detecting by active contours the vascular structure and then through a filter shapes "Hessian matrix", differentiated tubular and spherical structures, where it was assumed that the latter were suspicious nodules. This paper also studies some features as density, shape and position features calculated in this suspicious areas and uses a Rule-Based Classification method [2,3] to identify true positive nodules.

The paper "Automatic detection of microcalcifications with multi-fractal spectrum", proposes the use the fractal properties to identify the MCs, so the concept the Multi-fractal spectrum was used about certain properties of fractals such as self-similarity and scale-invariance and it's created a criterion to classify suspicious abnormalities. The multi-fractal spectrum [4], was calculated by performing a Legendre transform and the identification the MCs could be made using the deviations between the multi-fractal spectrums from ROI and the common trend. The methodology was compared with different classifiers and the evaluation validated that the proposed system was superior in detection sensitivity, specificity and accuracy.

2.2. Biomechanical engineering

The paper "Fundamental study of lower limb muscle activity using an angled whole body vibration exercise instrument" aims to determine the effect of vibration frequency and gradient on proximal lower extremity muscle activity with the overall goal of improving strength based exercise programs. The results showed that the muscle activity of vastus lateralis increased significantly at 40 Hz and 30° compared to 0 Hz and 0° respectively. In terms of the vastus medialis, muscle activity increased at 30 Hz and 40 Hz and 30°. These results suggest that whole body vibration training may be an effective and alternative method lower extremity training method.

The effects of restricting the flexion-extension motion of the first metatarsophalangeal joint on human walking gait was performed in an attempt to determine what effect restricting the motion of the first metatarsophalangeal joint had on gait patterns, with application to exoskeleton and prosthesis design and physical therapy. Participants performed a standardized walking trial barefoot and with the first metatarsophalangeal joint restricted with a custom wood splint. Participants walked significantly slower and with shorter strides when the toe was restricted. A significant increase in the utilized coef-

ficient of friction was also observed in the restrained condition and these results indicated that when the first metatarsophalangeal joint was restricted there might be an increased risk of slipping and falling.

Precision stress analysis and force application were of essence to the success of clinical orthodontic treatment. The miniaturization of pressure sensing units was deemed impractical for uses in clinical surgery. The paper "Digital design and fabrication of simulation model for measuring orthodontic force" brings you a flavor of an alternative route through a reconstructed oral cavity environment that can be tailored and assembled based on the combined 3D stress analysis, oral cavity modelling and 3D printing approach.

2.3. Biosensors and bio-signal processing

In the paper "Intracerebral hemorrhage (ICH) evaluation with a novel magnetic induction Sensor", Zhang et al. reported for the first time that the use of a novel magnetic induction sensor combined with high-fidelity simulations could effectively increase its sensitivity in detecting early ICH on the Chinese head model. This preliminary study had potentially laid the foundation for the development of affordable, convenient and real-time monitors for the early diagnosis of ICH in the Chinese population.

2.4. Biomaterials

The paper entitled "Cytotoxicity of PEGylated graphene oxide on lymphoma cells", aimed to improve the drug delivery by a nanocarrier named Graphene oxide (GO). In this study, Li et al. successfully generated PEG-GO by grafting polyethylene glycol (PEG) on the surface of GO by amide reaction. They have shown that PEG-GO significant enhanced the solubility of GO in biological solutions. More importantly, PEG-GO maintained its low cytotoxicity to lymphoma cells in vitro. This study provided cytological evidence for the application of PEG-GO in medicine.

2.5. Biomedical diagnosis

Yoo and colleagues examined the prognostic value of ^{18}F-FDG PET/CT scan in early stage non-small cell lung cancer (NSCLC) patients. They have found that maximum standardized uptake value (SUVmax) of FDG was a significant independent prognostic factor for shorter disease free survival (DFS) in patients without lymph node (LN) metastasis. This retrospective single-institutional study provided rationales for prospective, large sample size and multi-center studied to validate the prognostic value of FDG PET/CT scanning in NSCLC patients. These studies would further provide guidance in the prophylactic adjuvant chemotherapy or radiation therapy in early stage patients with high FDG uptake.

The paper "Computer-aided diagnosis of early knee osteoarthritis based on MRI T2 mapping" assesses an MRI and computer based method for detecting the onset of osteoarthritis of the knee. This relevant paper used open-source imaging software in combination with high level data mining statistical techniques to identify regions in the knee affected by osteoarthritis. The results showed a 100% success rate in identifying normal, unaffected knees and only small errors for detecting mild and severe osteoarthritis cases. This study contributed to the growing body of work aimed at developing effective and efficient knee osteoarthritis classification methods.

2.6. Systemic and computational biology

The paper "Anti-inflammatory mechanism research of tanshinone II A by module-based network analysis", demonstrated that the systemic network analysis approach could serve as a new approach to elucidate the molecular and cellular signaling. Based on the protein interaction network (PIN) and gene ontology (GO) enrichment analysis, Zheng et al. identified 3 interesting modules: the NIK/NF-kappaB cascade, the toll-like receptor and AGER-HMGB1 signaling, which were associated with anti-inflammatory actions of tanshinone II A (Tan IIA). Although further experiments were required to validate the conclusions, this module-based network analysis provided informative predictions on the potential signaling pathways.

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