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EDITORIAL

Special issue on "Multidimensional Signal and Image Analysis on HealthCare Applications"

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The rapid approaching of elderly era has caused the impending needs for applying new technology for elderly and disabled people to improve health conditions and increase the quality of life. Under such a situation, novel bioengineering devices and tools are being developed to gain better understanding of human metabolic, anatomy and functions of organs. On the other hand, chronic diseases cause healthcare to be shared by daily health maintenance, triggering the impending need for intelligence of devices in which preliminary decisions need to be built into the system for providing preliminary recommendations. To achieve the development of novel and intelligent bioengineering and healthcare devices, the techniques of multidimensional signal and image processing and analysis can play one of the major roles.

Compared with one dimensional signal analysis, the analysis of multidimensional signals and images provides more information. On the other hand, the high dimensionality of data may also cause large computational cost and, therefore, reduce the feasibility. Consequently, how to extract information for best estimation of health situations from the correlated or uncorrelated signals needs to be addressed. The goal of this special issue is to provide most up-to-date and recent advances of multidimensional signal and image analysis techniques for healthcare applications. This special issue serves as a forum and venue for researchers in academia, clinics and industries working in this area to share their experiences with the readers. For this special issue, we received a total of 13 submissions, each of which has gone through rigorous peer review. Based on the review results, six papers are selected for publication in this special issue, with brief description as follows.

In "Enhancement of Blood Vessels in Retinal Imaging Using the Nonsubsampled Contourlet Transform", Lee et al. propose a modified version of the nonsubsampled

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contourlet transform (NSCT) to enhance the blood vessel structure in the green channel retinal images. The proposed method uses the NSCT to decompose the input retinal image into eight scales from coarser to finer, and then classifies the image pixels into three categories according to the NSCT coefficients. Then, according to the class of each pixel, the NSCT coefficients are modified to reconstruct the enhanced image using a nonlinear mapping function.

In "Regions of Interest Extraction from SPECT Images for Neural Degeneration Assessment Using Multimodality Image Fusion", Jiang et al. use the computed tomography (CT) image as the median to register the magnetic resonance (MR) and single-photon emission computed tomography (SPECT) images such that the region of interest (ROI) delineated in the MR image can be mapped onto the SPECT image at the corresponding area. A robust registration scheme using the maximal cross-section of the head as the feature combined with the general Hough transform was developed to overcome the problem of inconsistent target volumes between the two scan datasets.

In "Elderly-Falling Detection Using Distributed Direction-sensitive Pyroelectric Infrared Sensor Arrays", Liu et al. use five pyroelectric infrared (PIR) sensors deployed at different height to detect the fall posture for elderly people, and propose a two-layer hidden Markov models (HMM) for modeling the features of activities, including walking, jogging, crouching down, standing up, sitting down, standing up and falling. The first-layer HMM of the fall detection algorithm detects the horizontal activity by using the walking and jogging database, and the second-layer HMM separate the normal vertical activities and fall based on the falling database.

In "Contour Extraction In Medical Images using Initial Boundary Pixel Selection and Segmental Contour Following", Hsu et al. propose a contour extraction method composed of two consecutive steps of initial boundary pixel selection (IBPS) and then the segmental contour following (SCF). The IBPS automatically searches for initial boundary pixels along initial scan lines, and then iteratively generates new scan lines between the previous pairs of initial boundary. The SCF effectively traces each segmented contour formed by a pair of neighboring initial boundary pixels found by the IBPS.

In "A Multiplicative Nakagami Speckle Reduction Algorithm for Ultrasound Images", Yu et al. employ the Nakagami speckle reduction algorithm to process ultrasound images contaminated with Rayleigh noise. It is demonstrated that the proposed algorithm performs better than a Rayleigh noise model in terms of signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR). Furthermore, a total variation regularized convex optimization model was constructed based on the statistical properties of the Nakagami noise, which can produce a piecewise-smooth result.

In the short paper "A Computerized System of Nail-fold Capillaroscopy for Dry Eye Disease Diagnosis", Hou et al. use three criteria of microcirculation which are capillary density, capillary width and blood flow velocity for characterizing nail-fold capillaroscopy images for dry eye disease (DED) detection. The used methods included panoramic mosaic image, cross correlation, binarization, manual, and two double-windows algorithms; and the experimental results demonstrate that the proposed system could be a good auxiliary diagnostic tool for DED.

The scope of topics covered in this special issue provides a glimpse of healthcare examples in multidimensional systems and signal processing. Needless to say, there are also many interesting healthcare applications which we are not able to cover in this issue. Nevertheless, we hope that this special issue has served its goal well as an initiative and further stimulates readers' interest in developing multidimensional systems and signal processing techniques on healthcare applications for many years to come.