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Editorial

Editorial for the Special Issue on MICCAI 2015

The 18th International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI 2015) was held in Munich, Germany. It was organized by the Technical University Munich (TUM) in collaboration with the Friedrich Alexander University Erlangen-Nuremberg (FAU). MICCAI 2015 and its satellite events gathered word-leading scientists, engineers, and clinicians, who presented excellent scientific work covering different fields including medical image processing, medical image formation, medical robotics and computer assisted interventions.

MICCAI 2015 received 810 validated paper submissions from which 263 papers were accepted after a rigorous double-blind three-phase review process. Upon the invitation for submissions to MICCAI 2015 special issue of Medical Imaging Analysis, we required that the authors of invited papers extend their corresponding MICCAI papers and then once again undergo the regular review process of MedIA. The current issue includes eleven research papers nominated from the papers presented at MICCAI 2015 in Munich, Germany, for which the review and revision process could be finalized in time for inclusion in this special issue.

Big data, particularly in the context of image analytics over large-scale image or multimodal databases has increasingly attracted the attention of our research community as evidenced by several of the papers selected in this special issue. Machine learning, uncertainty modeling, and content-based retrieval are various enabling technologies with applications across many image computing domains. Effective retrieval in large databases, for instance, requires methods that scale well, e.g., hashing techniques. The paper by Jiang et al. demonstrates an approach that uses a kernel-based method to combine multiple features to obtain high performance in breast tissue classification. In 'Metric Hashing Forest' of Conjeti et al., novel hashing technology developed based on a supervised variant of random forests offers superior performance in retrieving neurons from a collection of 22265 neurons from more than 120 archives. Incomplete and inconsistent datasets often pose difficulties in mining multimodal clinical databases. Hor et al. focus on the problem of learning in such multimodal scenarios and introduce the concept of scandent trees that build decision trees for block-incomplete modalities based on trees trained on the more complete modality. They have illustrated this technique in prostate cancer detection and Alzheimer's Disease staging using both genomic and MRI data.

Probabilistic approaches provide a natural way of handling uncertainty in medical image analysis problems, e.g., segmentation, however, the high dimensionality can prove challenging. Lê et al. develop an approach based on Gaussian Process models that can provide samples from a distribution on segmentations from a single example. The approach is shown to be useful in a radiotherapy setting. Neumann et al. move the learning focus to biomechanistic models and on how to automatically personalize the multiple parameters they entail. Their agent-based method emulates the way a human operator would address the problem but provides a general, objective and systematic approach to identify model parameters. The technique is demonstrated in the context of cardiac electrophysiology and whole-body systemic circulation models. In 'Seeing the Invisible in Differential Interference Contrast Microscopy Images', Jian and Yin propose a method for magnifying the gradients and the tiny motion of the cells while attenuating the intensity variation of the background, improving both the processing and visualization in microscopic imaging.

In interventional imaging real-time support of the surgeon makes interventions both faster and safer. "Real-time Localization of Articulated Surgical Instruments in Retinal Microsurgery" by Rieke et al. contributes to this aim by introducing novel methods for instrument tracking in retinal microsurgery. Hat et al. focus on real-time pose-estimation of the TEE probe observed by X-ray Fluoroscopic imaging (XRF) and apply their results to improve X-ray/Echo registration in cardiac interventions. They present Direct Splat Correlation (DSC) and Patch Gradient Correlation (PGC) as two novel similarity metrics designed for fast pose estimation of the TEE probe within XRF images. In "Automated Integer Programming Based Separation of Arteries and Veins from Thoracic CT Images", Payer et al. present a highly innovative approach to separate veins from arteries in CT lung images. This is performed in a two-step approach. First vessel subtrees are identified which are then classified as veins or arteries. Another application in CT imaging is explored in "Automatic Coronary Artery Calcium Scoring in Cardiac CT Angiography Using Paired Convolutional Neural Networks". Here the authors first detect a bounding box around the heart in which automatic calcium scoring is performed using neural networks. With 100 data sets for training, they achieve 71% sensitivity with 0.48 false positives per scan on 100 disjoint test images. Finally, the last paper in this special issue comes from a team of MICCAI scientists at University College of London, who aim at improving fetal surgery. As part of their project, Wang et al. propose a minimally interactive method for the segmentation of placenta from multiple views of MRI. The proposed Slic-Seg method combines online random forest and conditional random fields for segmenting sparse motion-corrupted MRI volumes and needs interaction only in a single slice.

We believe that this special issue provides an exciting selection of various topics covered in MICCAI. We hope that the readers will enjoy this collection of papers. We would like to thank the reviewers of the papers and the staff in the editorial office of Medical Imaging Analysis for their efforts and contributions.

Guest editors

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