Editorial
Machine Learning and Data Mining in Medical Imaging

MEDICAL imaging is becoming indispensable for healthcare and many other biomedical applications nowadays. With advances in medical imaging, such as cone-beam/multislice CT, 3-D ultrasound imaging, tomosynthesis, diffusion-weighted magnetic resonance imaging (MRI), positron-emission tomography (PET)/CT, electrical impedance tomography, and diffuse optical tomography, there are increasing demands for advanced machine learning algorithms and applications in the medical imaging field. Machine learning plays an essential role such as in computer-assisted diagnosis, image segmentation, image registration, image fusion, image-guided therapy, image annotation, and image database retrieval. Due to large intersubject variability, it is generally difficult to derive an analytic formulation or a simple equation to represent objects, such as lesions and anatomies in the medical data. Therefore, tasks in medical imaging demand learning from patient data for heuristics and prior knowledge in order to facilitate detection and diagnosis of abnormality in medical data. Because of its essential needs, machine learning in medical imaging is becoming one of the most promising and growing fields.

The main aim of this special issue is to help advance scientific research within the broad field of machine learning and data mining in medical imaging. The special issue was planned in conjunction with the International Workshop on Machine Learning in Medical Imaging (MLMI) 2014 [1]. Being the first workshop on this topic, MLMI has been successfully held along with the International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI) for five consecutive years since 2010. The focus of this special issue is on major trends and challenges in this area. It presents work aimed at identifying new cutting-edge techniques and their use in medical imaging.

The quality level required of submissions for this special issue was very high. A total of 15 papers were invited and submitted to this issue in response to the call for papers. Based on a rigorous review process, six papers (40%) were accepted for publication in the special issue.

The special issue covers a wide spectrum of machine learning methods with applications to different medical imaging modalities. The biomedical imaging data treated in this special issue include MRI [2]–[4], PET [3], ultrasound images [5], and histological images [6]. The studied problems include brain image segmentation [2]–[3], neuroimaging-based dementia diagnosis [4]–[5], ultrasound standard plane localization [6], and histological tumor classification. The fusion of machine learning methods and medical imaging applications further demonstrates versatility and productivity of this multidisciplinary research after years of development. In this special issue, we first include two atlas-based segmentation approaches. Specifically, one is based on estimating the optimal maximum-a-posteriori (MAP) parameters in STAPLE using local intensity similarity information [2], and the other one is based on using subject-specific sparse dictionary learning methods [3]. Then, in this special issue, we also include two papers for neuroimaging-based diagnosis of Alzheimer's disease and mild cognitive impairment. Specifically, a robust deep model is developed based on multimodal MRI and PET images in [4], and feature selection based on support vector machine (SVM) weights is proposed in [5]. Also, this special issue includes a paper for automatic localization of the standard plane in fetal ultrasound using the domain transferred deep neural networks [6]. Finally, this special issue includes a paper for nuclear atypia scoring in breast histopathology images using a global covariance-based image descriptor [7].

We would like to thank all the authors for their excellent contributions to this special issue and to all the reviewers for their high-quality reviews and constructive suggestions. We hope that this special issue will inspire further ideas and collaboration for creative research, advance the field of machine learning in medical imaging, and accelerate the translation of the research findings from bench to bedside.

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Digital Object Identifier 10.1109/JBHI.2015.2444011

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