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Sparsity techniques in medical imaging

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With the advent of the age for big data and complex structure, sparsity has been an important modeling tool in compressed sensing, machine learning, image processing, neuroscience and statistics. In the medical imaging field, sparsity methods have been successfully used in image reconstruction, image enhancement, image segmentation, anomaly detection, disease classification, and image database retrieval. Developing more powerful sparsity models for a large range of medical imaging and medical image analysis problems as well as efficient optimization and learning algorithm will keep being a main research topic in this field. The goal of this special issue is to publish original and high quality papers on innovation research and development in medical imaging and medical image analysis using sparsity techniques. This special issue will help advance the scientific research within the field of sparsity methods for medical imaging.

This special issue is composed of nine high quality research articles that are selected from over 20 submissions based on rigorous peer reviews. These papers cover a broad spectrum of research topics in medical imaging and medical image analysis, including image registration, segmentation, reconstruction, estimation, modeling, classification and visualization.

Specifically, Belilovsky et al. in collaborative research among Centrale Supelec, Inria Saclay, Research Center Athena, Stony Brook University, Mount Sinai and MIT have proposed the k-support norm to predictively model fMRI data for both classification and regression tasks. Chen and Srinivas from Ventana Medical System have developed a stain unmixing algorithm for brightfield multiplex immunohistochemistry (IHC) images using a group sparsity model. Xu et al in a collaborative efforts among Nanjing University of Information Science and Technology, Rutgers Cancer Institute of New Jersey, University of

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Pennsylvania and Case Western Reserve University have developed an unsupervised sparse non-negative matrix factorization (SNMR) approach for color unmixing in digital pathology image analysis. Deshpande, Maurel and Barillot from University of Rennes, INSERM, CNRS and Inria have developed an adaptive dictionary learning method to automatically classify multiple sclerosis (MS) lesions in MR images. Zheng et al. in collaborative research between University of Pennsylvania, Shandong University of Traditional Chinese Medicine and Dalian University of Technology have proposed a model to treat the intensity's temporal variation as "corruptions" with L1 and Lorentzian norms for accurate registration of dynamic contrast-enhanced (DCE) MR breast images. Neubert et al. from University of Queensland, SCIRO and University Hospital Heidelberg have integrated the traditional statistical shape models with the sparse shape composition to accurately describe anomalous deformations for 3D segmentation and intervertebral disc classification. Fang, Jiang and Huang from Florida International University and University of Texas at Arlington have proposed a tissue-specific model to robustly estimate the perfusion parameters in the low-dose CT perfusion. Zhou et al. in collaborative research among University of Maryland, Rutgers University and University of Texas at Arlington have developed a framework to automatically comprise the right lung segmentation using a robust, atlas-based active volume model with a sparse shape composition prior. Wang et al. from Hebei University, Peking Union Medical College Hospital and Shanghai Jiaotong University have developed a sparse group composition approach to incorporate the spatial constraints from multiple shapes in left ventricular (LV) epicardium segmentation.

We believe that these articles reflect the most recent research advances of sparsity techniques in medical imaging, with clear demonstration of methodological novelty and power in clinical applications.

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