Guest Editorial: Medical Image Understanding and Analysis

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The Medical Image Understanding and Analysis (MIUA) conference series which began in Oxford in 1997 has become the main UK meeting for discussion and dissemination of research progress in image analysis applied to medicine and the biological sciences. In July 2008 we had the pleasure of hosting the 12th MIUA at the University of Dundee. The conference programme included fifty-one full papers from ten countries as well as talks from three invited speakers (Jayaram Udupa, Michael Unser, and Nikos Paragios).

The seven papers in this issue of the Annals of the BMVA are based on selected papers from MIUA 2008. Authors of some of the best papers at the conference were invited to submit expanded versions for consideration. In addition to the conference reviewing process, each manuscript in this issue has been revised in response to further multiple reviews. This collection of papers addresses issues such as registration, classification, segmentation and multimodality in a variety of imaging settings that includes open heart surgery, biomechanical study of lower limb joints, and imaging of disease in the brain and in tendons.

Registration of images from multiple sources is a key problem in medical image analysis, and this special issue presents two papers on this topic. The correct positioning of bypass grafts in heart surgery is key to success and recovery. In [Registration of Cardiac MSCT and Optical Tracking Data: Image-guided CABG at the Arrested Heart] Claudia Gnahm et al. describe a system that registers preoperative cardiac CT data to optical data obtained during heart operations. This registration allows for accurate positioning and is demonstrated in challenging live situations with 20 patients. The efficiency of computing 2D–3D registration of medical data is the core issue behind Osama Dorgham et al.’s paper, [Performance of a 2D-3D Image Registration System using (Lossy) Compressed X-ray CT]. They propose that using octree compression of volumetric data can lead to memory-efficient registration without sacrificing much in terms of accuracy.

Segmentation of structures forms the basis for much work in the field, represented here by two papers. [Karin Engel and Klaus D. Toennies] present a paper on the segmentation of brain structures from noisy sonography images. Their method combines a deformable-
shape search method using local features for robust search with an active contour model for final segmentation. Their conference paper of the same name won the best paper prize at the MIUA meeting. The segmentation of multiple structures in medical images such as CT scans is often required and generally not achievable through single-object segmentation procedures. Dagmar Kainmueller et al. propose a method for building a correspondence relation between adjacent surfaces. The resulting shared intensity profile guarantees the non-overlap of adjacent surfaces and couples the surfaces to allow for segmentation.

A common approach to separation of grey-matter, white-matter and cerebro-spinal fluid in brain images is to use clustering of intensity values. Bill Crum’s paper describes a careful empirical study of the use of spectral clustering for this tissue classification problem. Stochastic sampling methods are used to make the problem tractable with full 3D MRI volumes. Loss of grey matter is a characteristic of Alzheimer’s disease; Lilia Mesrob et al. describe a method to distinguish between patients with this disease and elderly control subjects using a support vector machine and feature selection. Anatomical regions in whole brain MRI images are identified using registration and estimates of grey-matter intensity distributions within each region are then used to extract features.

Finally, Ann Harvey et al. describe ex vivo imaging of tendon using two modalities: ultra-high field magnetic resonance imaging and near-infrared multiphoton laser scanning microscopy. They demonstrate that normal and enzyme-digested tendon can be discriminated using these modalities. A motivation for this study is as a step towards in vivo functional imaging for future assessment of tendon injury, disease and repair.