Guest Editorial
Special Issue on Interventional Imaging

IN RECENT years, imaging is increasingly moving from being a primarily diagnostic modality towards a therapeutic and interventional aid, facilitated by advances in minimal access and robotic assisted surgery, along with the emergence of novel drugs and other forms of treatment. The first medical imaging device was the human eye coupled to the human brain, and this medical imaging system has been used both for diagnosis and intervention since before the time of Imhotep. Technological advances have greatly extended our ability to image patient anatomy and physiological processes, to diagnose disease, to plan and monitor medical interventions, and to assess therapeutic outcomes. Common modalities now include X-rays, computed tomography, ultrasound, MRI, PET/SPECT, video endoscopy and microscopy, emerging biophotonics techniques, and more. As devices and systems have become more sophisticated, their use has become more specialized, based in part on where they are used in the "diagnose-plan-treat-assess" cycle. Diagnostic systems frequently emphasize exquisite image quality, but generally do not impose real-time imaging performance requirements. Interventional imaging systems, on the other hand, have to satisfy a number of design requirements, even at the expense of image detail, particularly in terms of real-time/interactive responses and the ease of being integrated with interventional workflows. For example, these systems must be able to operate within the complex environment of the operating room or intervention suite, working side-by-side with the clinical team. They must provide timely information needed for real-time intraoperative decision-making, monitoring, and control. As a result, the development of these systems poses new challenges to the medical imaging community.

This special issue received 19 submissions, and the peer review process resulted in the acceptance of 11 papers representing different advances in the interventional imaging. The papers selected for publication cover many important subjects for interventional imaging. In particular, they cover different aspects of intraoperative and interventional *segmentation, registration, reconstruction, motion analysis and compensation, visualization and therapy monitoring*. Although the represented topic areas do not cover all aspects of interventional systems and image-guided interventions relevant to interventional imaging, e.g., medical robotics, workflow recovery, user interfaces and human–computer interaction, they do represent many central aspects of this emerging field and, in particular, those imaging aspects which have reached sufficient maturity to allow consistent validation and outcomes for publication within this special issue.

In *segmentation*, Lucas et al. [1] present an active contour method for bone cement reconstruction from C-arm X-ray images. Their novel sparse X-ray multiview active contour (SxMAC) method uses X-ray images acquired on a noncircular trajectory and incorporates prior CT information to reconstruct objects for which the background partially occludes the object in X-ray images. Brost et al. [2] and Daga et al. [3] present novel registration methods respectively for motion compensation in atrial fibrillation ablation (AFib) and for accurate localization of optic radiation during neurosurgery interventions. Fieselmann et al. [4] and Chen et al. [5] describe advanced methods for 4-D C-arm cone-beam CT *reconstruction* methods respectively for tissue perfusion and time-resolved cardiac imaging. Two of the accepted papers also focus on *visualization*. Wang and Tewfik [6] present their work on 3-D visualization for intraoperative organ deformation, which focuses on the *registration* of preoperative MRI/CT images with intraoperative optical images for improved *visualization* during the procedure, while Schultz et al. [7] present a new method for visualizing the RF fields, enabling better control of lesion shape and size. *Navigation* for computer assisted interventions is addressed here through two papers. Otake et al. [8] propose a multiview 2-D/3-D *registration* for image guided orthopaedic surgery taking advantage of fiducial-based C-arm tracking and GPU acceleration, and Mirota et al. [9] present a video-based *navigation* system for endoscopic endonasal skull base surgery. Finally, two papers aim at *multimodal imaging* and *monitoring* within interventional and therapeutic procedures. Oduneye et al. [10] present a consistent study on the feasibility of endocardial propagation mapping using MR guidance, whereas Fuentes et al. [11] present a method for MR temperature imaging for laser induced thermal therapies.

The quality of the papers presented in this special issue, the great number of submissions and growing number of research projects in this field are only a few indications that interventional imaging is coming rapidly into the focus of both medical image computing and computer assisted intervention communities. Advances in diagnostic imaging during the last few decades need to be followed by a series of scientific and technological developments of the highest quality for assuring their clinical impact and patient benefit. The complexity of this domain poses many challenges to medical imaging and computer assisted interventions community. Special journal issues like this one play an important role by proposing innovative solutions and opening new paths towards the ultimate goal of improving the standards of care in our society.

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