Advances in Medical Imaging

Phaneendra K. Yalavarthy
Indian Institute of Science, Bangalore

The recent advances in medical imaging have revolutionized the diagnostic accuracy of the medical images. These advances included multi-modal imaging, dynamic imaging, and diagnostic imaging with non-ionizing radiation. Most of these advances included a development of robust, rapid, and reliable instruments, with an emphasis on seamless operation in the clinic.

The grand challenge has been effective usage of the imaging data either to improve the diagnosis/prognosis of the disease. To handle this problem, new generation of radiology workbenches are equipped with the computer aided diagnosis/detection (CAD) tools to utilize the data more competently by the physicians (doctors). As Imaging processing techniques are at the core of the CAD tools, the demand for developing competent and reliable algorithms that can either reduce the procedure time and/or aid in the diagnosis/detection of disease. Few advances in this aspect are highlighted to show the efficacy of the CAD tools.

Development of rapid imaging instruments/techniques resulted in the high volumes of dynamic imaging data. For example typical dynamic lung computed tomography results little over 5 Giga Bits of imaging data, interacting and registration of these data sets for motion management has been a major challenge in the recent past. Usage of Graphical Processor Units (GPUs) and/or gating techniques has been able give reasonable solution. These recent developments will be discussed with an emphasis on the positive impact of information technology on modern radiology.

As most of the critical diagnostic decisions in the past decade had been based on multi-modal imaging data, seamless fusion of these images still remains as the challenge. The seamless fusion of anatomy and function had been elusive unless the images are obtained in the same position and time. Few example cases that can highlight the need and efficacy of multi-modal fusion, with a focus on computational challenges, will be presented.

As the continuous monitoring of disease (bed-side) has been highly desirable in the clinic, resulting in a demand that the imaging equipment should be portable and non-ionizing. This has lead to new advances in biomedical optical imaging, particularly in breast and brain imaging. Currently, the optical imaging equipments are undergoing clinical trails to prove their efficacy in the clinic, including monitoring of neoadjuvant chemotherapy and neonatal brain imaging. These new advances will be discussed with a stress on challenges associated in acquiring or reconstruction of these optical signals.

As techniques like image guided radiation therapy (IGRT) and imaging guided surgery (IGS) are becoming more prevalent in the clinic, the demand for quantitative information extraction is becoming much higher. As modern radiology is moving towards non-invasive procedures, these advances in medical imaging have improved the quality of life and reduced the associated risk with these procedures. At the same time, these advances in medical imaging posed new challenges and this talk will highlight these challenges along with the advances.