AbstractID: 2556 Title: Cone-Beam CT with Flat-Panel Detectors: Applications in Diagnostic and Image-Guided Procedures

Flat-panel detectors featuring real-time readout, distortionless image capture, and high imaging performance at low dose offer a breakthrough technology for fully 3D x-ray imaging. Used in conjunction with techniques for 3D reconstruction, flat-panel cone-beam computed tomography provides soft-tissue imaging capability in combination with nearly isotropic, sub-millimeter 3D spatial resolution. Depending on the application and implementation, the volumetric field of view achieved in a single rotation about the patient is large (e.g., 40 x 40 x 25 cm3), and the imaging dose is low (e.g., lower than that of a diagnostic CT scan). Applications of flat-panel cone-beam CT represent a broad spectrum of medical imaging research. In breast imaging, dedicated cone-beam CT scanners could dramatically increase the sensitivity and specificity of subtle lesion detection. In small animal imaging, systems offering high-resolution, high-speed 3D imaging will likely form an important technology for imaging therapeutic response. In image-guided radiation therapy, flat-panel cone-beam CT is being used to guide precise radiation delivery based on the position of soft-tissue targets at the time of therapy. And in image-guided surgery, systems are under development for multi-mode fluoroscopic / cone-beam CT guidance in a broad range of procedures, including head-and-neck surgery, orthopedic and spinal surgery, and interventional radiology. The basic process of 3D image formation, the physical factors that challenge imaging performance, the scope of applications in diagnostic and image-guided procedures, and important areas for future research are discussed.

Educational Objectives:

1. Understand the means by which volumetric cone-beam CT images are reconstructed from multiple projections acquired using a flat-panel detector.
2. Understand the physical factors (e.g., x-ray scatter) that limit image quality in cone-beam CT.
3. Discuss the latest applications of flat-panel cone-beam CT in medical imaging, including:
    - Diagnostic imaging
    - Small animal imaging
    - Image-guided radiation therapy
    - Image-guided surgery
4. Discuss the near and long-term areas of research in fully 3D digital x-ray imaging.