

“Hybrid Imaging for Guidance of Interventional Procedures”

The last decade has seen an explosion in the number of procedures carried out using minimally invasive approaches, as devices and techniques develop. The promise of these new procedures is realized only with a parallel improvement in imaging techniques. Hybrid systems that combine real-time acquisition with cross-sectional and/or functional data are one response to the need, and several such systems have now reached the clinic. Depending on the application, different combinations can be used to greater advantage. The interventionalist's familiarity with x-ray fluoroscopy and the real-time and projection capability makes it a logical first choice to marry with others such as ultrasound, CT or MR.

The combination of fluoroscopy with C-arm CT for application to 3D vascular imaging was first implemented in the mid-90's. New flat-panel detector technology is now expanding the role of C-arm CT into low-contrast imaging applications such as detection of fresh bleeds during treatment of intracranial abnormalities and guidance of vascular and percutaneous abdominal interventions. Highest image quality depends on correction algorithms for lag, truncation, scatter etc. all of which are still under investigation. Recent investigations indicate that contrast resolution as low as 5 HU is possible under clinically realistic conditions.

The combination of fluoroscopy with MR has also been under investigation since the mid-90's with several prototype long-travel systems installed in research clinics. While feasibility of such systems has been shown, patient transport between imaging FOVs has been complicated and enthusiasm for the systems has been limited. New flat-panel detectors which are immune to static magnetic fields, and new x-ray tube designs are now under development that allow close integration of fluoroscopy and MR systems. Using a double-donut interventional magnet and a static-anode x-ray tube, good image quality can be achieved from both modalities if care is taken to maintain magnetic field homogeneity, rf noise is limited, and the electron optics of the x-ray tube are controlled. Switching between modalities can take a little as one minute.

The current status of X-ray/MR, and of X-ray/CT and C-arm fluoroscopy/C-arm CT will be discussed and described. New hardware and software for X-ray/MR and new image correction and visualization algorithms for fluoroscopy/C-arm CT will be described. Current challenges in the area will be outlined.

Educational Objectives:

1. Understand the options available for hybrid interventional guidance.
2. Understand the issues related to image quality in C-arm-based CT and XMR
3. Understand the current challenges relating to clinical workflow, multi-modality registration and image visualization

Disclosure:

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