AbstractID: 11956 Title: New High Resolution Dynamic Detectors and Flow Modifying Stents for Neuro-endovascular Image Guided Interventions

As the field of minimally invasive endovascular image-guided interventions (EIGI) advances, there has been progress in the development of new endovascular devices such as the asymmetric vascular stent for treatment of aneurysms as well as progress in the image guidance systems needed to improve both the diagnoses and interventions and the methods used to evaluate the improved imaging performance. High resolution imaging systems with MTFs extending past 8 Lp/mm and with ability to visualize not only radioopaque markers but the detailed structure of devices such as stents have motivated the development of new asymmetric devices such as the blood flow modifying asymmetric vascular stent (AVS). The AVS has now come through a number of generations from balloon expandable stainless steel strutted structures with laser micro-welded mesh flow diverters to new super-elastic nitinol closedcell self-expanding stents with organic material flow diverters. The methods of laser machining, surface finishing, and deployment will be described with progress in animal models reported. In parallel with advances in EIGI devices has come new high resolution detector development. The detectors have a unique combination of features such as far superior spatial resolution compared with conventional dynamic flat panel detectors, large dynamic range of sensitivity with negligible lag and ghosting to enable both fluoroscopy and angiography, and low noise to enable quantum limited performance over the full useful range including during lowdose fluoroscopy. The Micro-Angiographic Fluoroscope (MAF) consists of an x-ray converter phosphor sensed by a micro-channel plate light image intensifier which is in turn coupled to a high performance CCD camera using a fiber optic taper. The MAF is a region of interest (ROI) imager with 4 cm field of view centered at the interventional site and may be moved in front of a larger conventional detector when improved resolution is needed. The Solid State X-ray Image Intensifier (SSXII) while having much of the benefits of the MAF in superior imaging capability achieves its great sensitivity using only electron multiplying CCD sensors. An array design is being developed so that the imaging FOV may be expanded by adding modules each with its own EMCCD-based detector. To more fully characterize detectors, new evaluation methods are being explored. For example, the accurate determination of MTF from measurements of noise only, without the need for a slit or edge will be reported. Also from a careful analysis of noise, the exposure range for detector quantum limited performance can be well demarcated by the instrumentation noise equivalent exposure (INEE). Finally, more realistic linear system parameters that include focal-spot size, geometry, and scatter provide generalized MTFs and DQEs or GMTFs and GDQEs. All told, there is much happening in EIGI.

Learning Objectives

1. Appreciate the progress being made in improved EIGI devices and in particular flow modifiers such as the asymmetric vascular stent (AVS) for aneurysm treatment.
2. Understand the operation of new high-resolution micro-angiographic systems including the MAF and SSXII.
3. Understand new objective image detector evaluations including INEE, GMTF, GDQE, and determination of MTF from noise measurements alone.

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