AbstractID: 9142 Title: Feasibility study of Hadamard multiplexing radiography based on carbon nanotube field emission multi-pixel x-ray technology

Purpose:
Current CT scanners perform CT scans by rotating a single beam x-ray source around an object and collect multiple projection images sequentially, one at a time. The serial approach demands fast gantry rotation and high x-ray peak power which in turn limits the CT scanning speed. To overcome those limitations, novel CT scanners with multiple x-ray sources have been proposed and developed, such as the Dynamic Spatial Reconstructor (DSR) from Mayo Clinic and the dual source CT from Siemens. Our approach is based on the carbon nanotube field emission multi-pixel x-ray technology and Hadamard multiplexing principle.

Method and Materials:
For the proposed stationary multiplexing CT scanner, multiple x-ray sources are spatially distributed along the CT scanning path. It completely eliminates the need for gantry rotation during CT scans. Furthermore, since the x-ray radiation can be readily modulated to form different waveforms due to its field emission mechanism, the CT scanning procedure can be multiplexed based on Hadamard multiplexing principle which has been widely used in analytical instruments and communication areas to improve data throughput.

Results:
Without considering noise effects, Hadamard multiplexing method can increase the imaging speed by a factor of $(N+1)/2$ where N is the number of projection images, without increasing the x-ray peak power. This becomes significant when N is large (~1000). Experimentally, even with the presence of noises, we have successfully demonstrated that significant gain in terms of imaging speed for Hadamard multiplexing can be achieved using our prototype multi-pixel x-ray imaging system.

Conclusion:
We show the feasibility of Hadamard multiplexing radiography that enables simultaneous collection of multiple x-ray images. The combination of the multi-pixel x-ray technology and multiplexing principle has the potential to lead to a new generation of stationary multiplexing CT scanners that have drastically increased data throughput and reduced x-ray peak power.