Contribution ID: **418** Type: **Poster presentation**

The Detector System Design for the Grating-based Phase Contrast Imaging CT Prototype

Thursday, June 14, 2018 3:50 PM (15 minutes)

In the hard X rays domain, the phase shift of the wave passing through the soft materials like tissues is typically three orders of magnitude larger than the absorption. Therefore the phase-sensitive X-ray imaging methods can obtain substantially increased contrast over conventional absorption-based imaging. The grating-based phase contrast imaging(GBPCI), which can achieve a large field of view with low requirement on time and spatial coherence of the light source, is considered as a potential imaging method for clinical applications. A CT prototype based on GBPCI is developed by National Synchrotron Radiation Laboratory (NSTL), and the detector system for the prototype is designed.
The detector of the prototype consists of 43 Hamamatsu silicon photodiode S12058(X) modules to achieve 200mmx200mm measurement field of view. Each S12058(X) module can provide maximum 384(16x24 pixels) outputs, which the minimum pixel size is 0.75mmx1mm. The detector output low-level current is transmitted to the front-end readout electronics via the high density connector. The Ti DDC1128 are used to complete both current-to-voltage and A/D conversion. After the linear correction and time drift correction in FPGA, the digital signal is converted to the imaging data, and sent to the control system through a data buffer.
The test result shows that the SNR of the detector system is about 14.6 bits which can satisfy the 14.3 bits dynamic range requirement of the prototype experimental platform. The spatial resolution can reach about 0.38mm which close to the theoretical value 0.36mm for the principle experiment.

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Session Classification: Poster 2

Track Classification: Data Acquisition