AbstractID: 8794 Title: A physiologically gated micro-CT scanner for dynamic small animal imaging based on a carbon nanotube x-ray source

Purpose:
Current commercial micro-CT scanners have the capability of imaging objects *ex vivo* with high spatial resolution, but performing *in vivo* micro-CT on small animals is still challenging because their physiological motions are at least ten times faster than those of human. The purpose of this research is to develop a respiratory and cardiac gated micro-CT scanner with both enhanced spatial and temporal resolutions, and more versatile imaging capabilities for *in vivo* imaging of small animal models.

Method and Materials:
A physiologically gated micro-CT scanner was constructed based on a carbon nanotube micro-focus x-ray source. The scanner consists of a carbon nanotube x-ray source, a flat panel x-ray detector, and a rotation sample stage aligned in cone-beam geometry. The dynamic gating was achieved from a small animal physiological monitor system plus some home-made gating electronics. The spatial and temporal resolutions of the scanner were evaluated by MTF analysis and temporal analysis, respectively. Cardiopulmonary gated micro-CT images were collected and analyzed on several anesthetized free-breathing mice to evaluate the system's performance.

Results:
The scanner was found to have 50 microns spatial resolution and ~20 milliseconds temporal resolution. Imaging sequences were readily synchronized and gated to non-periodic physiological signals of free-breathing mice. Quantitative physiological measurements can be obtained from the four-dimensional micro-CT results for the cardiopulmonary organs of the mice.

Conclusions:
We have developed a physiologically gated micro-CT scanner based on a carbon nanotube micro-focus x-ray source. The scanner can easily acquire images at the desired cardiopulmonary phases with fast temporal resolution and minimized delay. The high spatial and temporal resolutions of the micro-CT scanner make it well suited for *in vivo* imaging of small animal models. The system performance can be potentially enhanced through further development of a carbon nanotube micro-focus x-ray tube with higher flux.