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Multiple contrast agent imaging using MARS-CT, a spectroscopic (multi-energy) photon counting microCT scanner.

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PURPOSE

To establish that a spectroscopic (multi-energy) CT scanner can differentiate multiple contrast agents and background tissues. This is clinically significant because it enables multi-phase contrast studies to be performed in a single scan. eg. A "triple phase liver" is possible in a one acquisition. This is a significant improvement from dual energy CT which is limited to non-contrast and post-contrast images from a single acquisition.

METHOD AND MATERIALS

A spectroscopic photon counting micro-CT scanner was constructed. This scanner, dubbed MARS-CT, uses CERN's energy selective photon counting detector Medipix. CT scanners based using this technology are often referred to as Medipix All Resolution Systems (MARS) since the scanners produces data with energy, spatial, and temporal information.

Spectroscopic (energy resolved) images where obtained by adjusting the energy threshold above which the Medipix detector counts photon interactions. Non-energy resolved images where obtained by summing together all energies producing images similar to single energy CT images.

K-edge Contrast agents included pharmacological preparations of barium, iodine, gadolinium, and lead were imaged in both phantoms and mice. Principal Components Analysis (PCA) was applied in the spectral (energy) domain to differentiated the contrast agents.

RESULTS

K-edge contrast have measurably different spectral characteristics. Within mice this allows differentiation of contrast agents. On single energy CT these contrast agents are all "bright" and can not be differentiated. The left side of the figure shows a volume rendering of standard intensity CT of a mouse's chest. The right side of the figure demonstrates the application of PCA to identify iodine and barium. Iodine in the vascular system is red and barium in the lungs in blue.

CONCLUSION

Spectroscopic (multi-energy) CT can differentiate multiple contrast agents. This allows multi-phase imaging protocols to be performed in a single acquisation. eg. Pre-, portal venous, and delayed phase contrast in a single scan. This will reduce patient x-ray dose and increase patient throughput.

CLINICAL RELEVANCE/APPLICATION

Multi-energy (spectroscopic) CT allows many phases of contrast enhancement to be acquired from a single scan.

FIGURE (OPTIONAL)

Uploaded Image

View Larger Image

Disclosures:

Director, MBI Ltd	Anthony Butler
Nothing to disclose:	Nigel Anderson
Nothing to disclose:	Michael Hurrell
Nothing to disclose:	Nick Cook
Nothing to disclose:	Nicola Scott
Director MBI Ltd	Phil Butler

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14.

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Does this work include Quantitative Imaging which is the extraction of clinically relevant quantifiable features from medical images?

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