IDENTIFYING CLINICAL APPLICATIONS OF SPECTROSCOPIC X-RAY IMAGING

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Introduction: Spectroscopic x-ray detectors, such as Medipix, are opening the door to the widespread use of energy selective biomedical x-ray imaging. With dual energy computed tomography quickly becoming the clinical standard, spectroscopic imaging is a likely next step. However to confirm the utility of spectroscopic x-ray detectors there needs to be a clearer indication of the clinical benefits of the technology.

Methods: In order to identify possible applications of spectroscopic imaging we conducted a brief literature review of clinical applications of dual energy systems. In addition we analysed simulation results from our own group, our collaborating partners, and industry. This information was coupled with information regarding the clinical significance of diseases and radiology work practices.

Results: Broadly, we grouped the benefits of spectroscopic x-ray imaging into three areas;

1) Improved image quality, in particular reduction in beam hardening artefact.
2) k-edge imaging, the identification of high Z-number contrast agents based on their k-edge. This technique will lead to better use of contrast agents. eg. a) less contrast agent required in high risk patients such as in renal impairment, diabetes, and elderly. b) separation of several contrast agents allowing for multiphase studies to be performed with less x-ray dose and less time on the scanner.
3) Improved soft tissue contrast from differences in mass attenuation coefficients of different tissues. The diagnosis of several diseases, such as breast cancer, are known to be improved by dual energy systems. In addition, there is improved soft tissue contrast of normal structures.

Discussion: The review suggests there will be significant clinical benefits from spectroscopic imaging across a wide range of radiological problems. In addition, technologies like Medipix are rapidly developing and full body spectroscopic imaging is likely to be technically possible in the near future. However, there exists a "chicken and egg" problem in which the clinical applications can not be developed or confirmed without a working spectroscopic system, but full body spectroscopic systems are unlikely to be built without confirmation of clinical benefits.

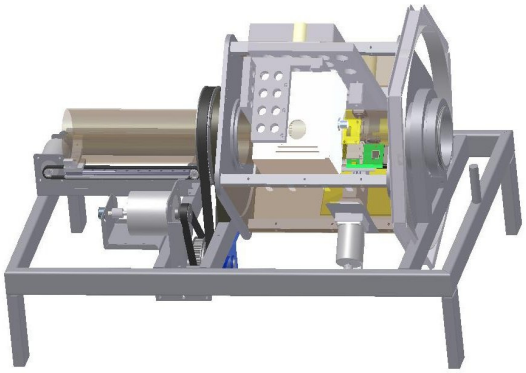

Fig. 1: Technical plan of the MARS scanner.

Conclusions: It was decided that the only way to confirm clinical applications and provide feedback to detector design teams was to build a small 3D spectroscopic system. Our scanner is based on Medipix and dubbed MARS (Medipix All Resolution System). A feasibility study to assess technical difficulties was planned and construction of the scanner began.