The Christchurch MARS-CT project.

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The MARS-CT project aims to develop novel x-ray imaging systems based on state of the art spectral x-ray detectors from CERN (European Centre for Nuclear Research). The MARS-CT system being developed provides energy-specific attenuation of tissue, in addition to conventional information.

Dual energy systems have demonstrated clinical benefit in a wide range of areas such as cancer imaging (including breast and bowel) and vascular imaging (e.g. heart disease). These dual energy systems are based on two x-ray beams at different energies. Unfortunately this dual beam approach increases the x-ray dose to the patient and this has slowed the adoption of the technology. With the MARS approach we use a single x-ray beam with a spectral detector. This means not only no extra dose to the patient but also multiple energy measurements. The extra energy information provides enhanced differentiation between tissue types such as bone, muscle, fat and contrast agents. Thus we are able to provide more information to the radiologist, enabling better diagnosis, and without the drawbacks of the dual source approach.

The MARS (Medipix All Resolution System) is based on CERN's Medipix x-ray detector. Collaborations of more than 18 universities from around the world have developed the technology over 12 years. Medipix is a photon processing detector, that is, it records the properties of an x-ray beam on a photon by photon basis with virtually no detector noise. In particular, each pixel of the Medipix detector has the electronics to measure and record the energy of each photon. Research by us, our partners, and others have demonstrated that photon processing detectors give an increased signal-to-noise of between 5-100 times. This promises a significantly lowered radiation dose to the patient.

The project has developed small animal and pathology scanners based on the technology. These machines provide a medium cost device, enabling pre-clinical researchers to investigate the technology and confirm clinical benefit. To date, medical researchers at the University of Otago Christchurch and the University of Canterbury have been successfully using the technology. We are now forging research relationships with the radiology department of Johns Hopkins University and the small animal imaging lab of the Mayo Clinic, Rochester, both of whom wish to use MARS-CT scanners for their pre-clinical research.

In future we plan to develop the technology further so that a body part scanner can be constructed, enabling clinical trials of the technology. Currently we plan to develop a MARS breast CT unit. Following this, we intend to develop detector assemblies that can be used in the full body CT scanners, that are used in virtually all modern hospitals.