PhD positions available:
Several fully funded PhD projects are available now with the MARS Bio-imaging group (University of Otago and University of Canterbury) as part of a project to develop human scale, spectral CT technology. The MARS team is formed by scientists from a broad range of disciplines including; computer scientists, mathematicians, engineers, physicists, biologists, radiologists, and surgeons. The project covers an equally large range of topics including image processing, medical databases, visualisation, high energy physics, and many applications in biology and medicine. Currently, we are interested in advancing our software and algorithms in image processing and visualisation.

Topics:
The current topics of immediate interest include (but are not limited by):

- High performance material reconstruction software for new algorithms and large datasets
- High performance rendering algorithms for visualising MARS datasets
- Data analysis tools for biological and pre-clinical research

Student Skills:
Students should have strong skills in either computer science, engineering, mathematics, physics, or biology. They should have a strong desire to expand their knowledge over the wide range of disciplines that makes up bioengineering research. They will also need to have had excellent undergraduate grades, and good English skills that meets the scholarship requirements of the host university.

Research Location:
The research will be hosted in Christchurch, New Zealand through either the University of Otago (Christchurch), or the University of Canterbury. It is expected that the candidate will earn a PhD Scholarship from either of the above universities. Note that most international PhD students will be eligible for a NZ student visa.

To Apply:
Please send a copy of your full CV (including lists of publications and conference proceedings); copies of academic transcripts; letters of reference from two referees, and any other supporting information relevant to the projection to:

Contacts:
phil.butler@canterbury.ac.nz    niels.deriuter@canterbury.ac.nz    anthony.butler@otago.ac.nz

For more information please visit: http://www.bioengineering.otago.ac.nz/mars
Potential PhD topics

1. **High performance CT material reconstruction for large datasets**
   
The MARS project has a new computed tomography (CT) reconstruction algorithm that converts a large set of x-ray projections (2D images) into a set of volumetric representations (3D images) of materials (fat, calcium, muscle, etc.). For our small specimen scanner (mice sized objects), this algorithm performs reasonably. In the near future, we will start using a human sized scanner that will greatly increase the amount of data.

   In this project, you will work with the reconstruction algorithm and modern computing technologies to support the fast processing of datasets that can exceed memory limits.

   A suitable candidate will have a solid background (e.g. master’s degree) in computer science, or computer/software engineering. A familiarity with mathematics and medical physics would also be beneficial to this project.

2. **High performance rendering algorithms for visualising large volumetric datasets**
   
   Visualisation of medical datasets is slowly transitioning to volume rendering as it becomes more feasible for general use. Rendering algorithms such as raycasting allow for high quality viewing of most volumetric datasets with realistic shadows, and interactive frame-rates. The MARS project is currently producing datasets with multiple volume representing materials. Also, we will soon start using a human sized scanner that will greatly increase the size of these volumes. We will need a better optimised rendering pipeline to be able to continue providing high quality visualisations of these large datasets.

   In this project, you will review and improve our current rendering pipeline. The goal is to allow for real-time rendering of datasets that exceed the size of the memory limits of current graphics cards. Ideally, the rendering will be fast enough to support stereoscopic 3D (more than 120 fps).

   A suitable candidate will have a solid background (e.g. master’s degree) in computer science, software engineering, or mathematics. A familiarity with visualisation, graphics, and lighting physics would also be beneficial to this project.

3. **Tools for volumetric data analysis to support pre-clinical and scientific research**
   
   The MARS project produces high quality, volumetric, medical datasets that are actively used in pre-clinical, and scientific research. These research projects often require some form of volumetric data analysis. For example, determining the average width of trabeculae in bone. In some cases, tools already exist to perform this research e.g. Bone J. In other cases, this analysis is done manually using potentially error prone methods. We would like better support for analysing datasets in our current research.

   In this project, you will closely with the pre-clinical, and scientific research teams to identify how to measure their intended variables quickly and reliably.

   A suitable candidate will have a solid background (e.g. master’s degree) in computer science, or computer/software engineering. A familiarity with medical physics, and mathematics would also be beneficial to this project.

For more information please visit: [http://www.bioengineering.otago.ac.nz/mars](http://www.bioengineering.otago.ac.nz/mars)