2014/2015 Summer Studentship Project Application Form

Send to: Research Office, University of Otago Christchurch, PO Box 4345, Christchurch, by 5pm on **4 July** 2014

Supervisor Information (First named supervisor will be the contact):	
Supervisor's Name(s): Dr. Nigel Anderson, Kishore Rajendran	
Department: Academic Radiology/Centre for Bioengineering	Institution: UOC
Phone: UOC Ext 81987, or Cell 021 226 7711	E-mail: nigel.anderson@otago.ac.nz
Mailing Address: Centre for Bioengineering, 8th floor, UOC, 2 Riccarton Road	

Research Category (Choose one category only – to be used for judging the students' presentations):		
	Laboratory	_

Project Title (20 words MAXIMUM):

Measuring bone density using MARS spectral CT

Project Description:

Introduction: Currently, osteoarthritis and inflammatory joint disease is treated symptomatically, or, at the end-stage, by joint replacement. There is a strong clinical need to find new strategies to treat early-stage arthritis to reduce the need for joint replacement [1]. Measuring the deterioration in bone and cartilage health which underlies most joint diseases is a key to improving diagnosis and treatment [2]. Our group is at the forefront of spectral molecular CT research and development [3]. MARS CT can assess cartilage health in excised specimens [4]. Imaging assessment of bone health is the next task.

Aims

1. To use MARS spectral CT determine bone density in subchondral bone
2. To generate a method for MARS spectral CT to determine bone densitometry at any site.

Method: The student will work with the MARS research team and CReaTE group at UOC on a self-contained project within the bone-cartilage section of our multidisciplinary group which aims to translate a novel molecular spectral CT modality to human imaging. Focal changes in bone density near the bone-cartilage interface cannot be measured with current imaging techniques. The ability to characterize bone health will facilitate better treatments for osteoporosis and osteoarthritis. The student will use a state-of-art MARS spectral CT equipped with a CdTe Medipix3RX detector module to carry out phantom studies using bone-equivalent substitutes like hydroxyapatite. This will be followed by spectral scanning of existing ex-vivo bone samples from bovine tibia. The student will subject the imaging data to the conventional data-processing chain to reconstruct the spectral images for quantification then use spectral material decomposition techniques established for segmenting and quantifying target materials to establish a bone-density score. The student is expected to identify a suitable procedure to validate the MARS bone-density score. This studentship can be completed in 10 weeks. The student will translate scan protocols from phantom experiments to bone imaging and validate the findings. The student will be exposed to the scientific method – literature review; hypothesis and experimental design, and write- up. The student has the opportunity for co-authorship on publications arising from this research.

Significance

Measurement of bone density near the bone-cartilage interface is a marker of bone health. The methodology developed in this studentship will allow bone health (bone densitometry and bone architecture) measurements at any bone site. DEXA scanning the current method of choice for bone densitometry has disadvantages: it is 2D, inaccurate in the presence of calcification or osteophytes, and assumes standard bone size [5]. Spectral CT overcomes these disadvantages to measure bone density directly.

1. Carr AJ, Robertsson O, Graves S, Price AJ, Arden NK, et al. 2012. Knee replacement. *Lancet* 379:1331-40
2. Oei EH, van Tiel J, Robinson WH, Gold GE. 2014. Quantitative radiological imaging techniques for articular cartilage composition: Towards early diagnosis and development of disease-modifying therapeutics for osteoarthritis. *Arthritis care & research*
3. Anderson NG, Butler AP. 2014. Clinical applications of spectral molecular imaging: potential and challenges. *Contrast media & molecular imaging* 9:3-124.
4. Woodfield T SA, Schon B, Schrobback K, Hooper. . 2012. Novel Imaging Methods For Detecting Cartilage Tissue Quality Via Mars-Micro Computed Tomography. *J Bone Joint Surg,* 94-B (SUPP XLI)::122
5. Adams JE. 2013. Advances in bone imaging for osteoporosis. *Nature reviews. Endocrinology* 9:28-42

Location: MARS Research Laboratory in Rutherford Building, University of Canterbury (other is in UOC building)