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 Tim Woodfield, Naveen Vijayan Mekhileri	
Department: Department: Dept Orthopaedic Surgery and Centre for Bioengineering	Institution: UOtago Christchurch
Phone: 3641086	E-mail: tim.woodfield@otago.ac.nz
Mailing Address: 3rd Floor, Parkside. PO Box4345. Christchurch 8140	

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

Project Title (20 words MAXIMUM):

3D Printing system for cartilage tissue engineering

Project Description:

One of the aims of the Christchurch Regenerative Medicine and Tissue Engineering (CReaTE) group is to repair damaged or diseased human musculoskeletal tissues such as cartilage or bone by combining patients' cells (e.g. stem cells) with degradable biomaterials in order to generate new functional tissues. Porous biomaterial scaffolds are central to tissue engineering strategies since they provide a carrier for cells, and are responsible for promoting reparative tissue formation.

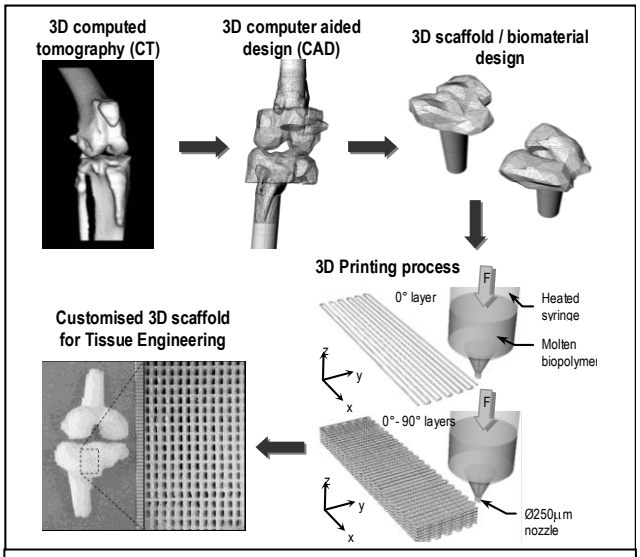

Figure 1 | Example of the 3D Printing process for producing customized 3D scaffolds for cartilage and bone Tissue Engineering

The CReATE group has developed cutting edge 3D Printing technologies. Their in-house and commercial 3D Printing machines are capable of printing by melt-extrusion of biodegradable polymers. To plot micro-tissues into the printed polymer scaffold, a prototype micro-tissue handling system has been set-up and tested. However, the 3D printing machine and the micro-tissue handling system has not yet been integrated together. This project focuses on understanding the current micro-tissue handling set-up and the 3D printer and subsequently integrating the handling system with the in-house 3D printer.

This project will assist orthopaedic surgeons and improve clinical success for patients by providing a route to 3D Print tissue engineered implants with organized architecture to better mimic native tissue and enhance repair.

Aim:

The aim of this project would be to translate an existing LabView based control system to a hardwired micro-controller based system that can communicate with the 3D printer. This will be followed by testing and optimizing the system extensively.

Methods:

The main focus of this project will be to translate an existing LabView based control system that handles the singularisation and injection system to a hardwired micro-controller based system. To start with, an appropriate micro-controller platform would be chosen, after which the electronic circuit (including power electronics) will be designed and implemented. The design will not only incorporate the control system features currently present, but would also incorporate other feature like two-way communication with the 3D printer, micro-tissue sensing and culture media level control. This will be then followed by testing the software and electronics for bugs and also optimizing the system for efficient operation.

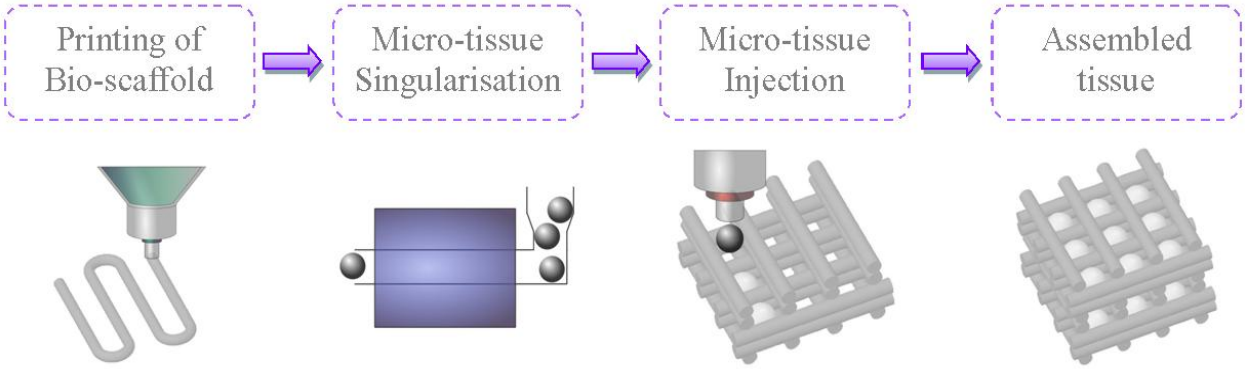

Figure 2 | Flow diagram and schematic overview of the steps involved in the automated tissue assembly system.

Benefits to the student in completing this project include:

- Background knowledge and practical experience in 3D printing in tissue engineering
- Practical experience in the operation of dispensing systems, fluidic based system, control systems and electronic and mechanical systems.
- Practical experience with Lab/View, CAD/CAM, 3D manufacturing processes, designing and assembling a printed circuit board (PCB).

Significance:

Tissue Engineering and Regenerative Medicine holds promise as a strategy for repair of otherwise intractable damage to bone and cartilage tissues. This project represents a step along the path towards this goal, and will give the participating student experience with developing and setting up a control system, and with 3D Printing and tissue engineering approaches.