Project Title: Machine-learning-based MRI for the precise treatment of cancers with radiotherapy	**Code: CCS8**

Host School / Institute: Central Clinical School	**Address:** ACRF Image X Institute, Biomedical Building (C81), Australian Technology Park, 1 Central Ave, Eveleigh NSW

Certificates & Clearances required: No

Primary Supervisor: Dr David Waddington

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Co-Supervisor/team: The summer research student will be involved in day to day activities at the ACRF Image X Institute and collaborate with an experienced, multidisciplinary team of medical physicists, engineers and clinicians. The project will be completed under the direct supervision of Dr David Waddington (institute leader of MRI development), Prof Paul Keall (Director of the ACRF Image X Institute) and Dr Paul Liu.

Project Type: Data Analysis; Design; Qualitative Analysis

Project Category: Cancer; Imaging

Skills / Attributes of a successful student: The successful student should have a keen interest in medical imaging and cancer treatment. Students with experience in data analysis using Python, MATLAB or other programming languages would be well placed for this opportunity. Training in specific computational techniques will be provided.

Project Keywords: MRI; Radiotherapy; Cancer; Imaging; Machine learning

Project Description: Aim: This study will investigate the feasibility of using machine learning based techniques to image tumour movement with MRI data acquired during radiotherapy treatment.

Background: X-rays used by modern radiotherapy systems to kill tumours do significant damage to surrounding healthy tissue. MRI-Linacs are cutting-edge treatment machines that use MRI to image tumour anatomy with unrivalled quality while radiation therapy is performed with X-rays from a linear accelerator (linac). For cancers that move during radiotherapy (e.g. lung tumours that move as a patient breathes), MRI-Linacs could enable the use of narrower radiation beams that image and dynamically track moving tumours during treatment, minimizing damage to surrounding anatomical structures.

However, the precision of MRI-Linac-based tumour tracking is limited by the inherently slow acquisition of MRI data and the sensitivity of MRI to motion artefacts. New developments in machine-learning-based reconstruction of MRI data promise to address both these challenges, potentially enabling a new standard of precision radiotherapy.

Project Scope: The student will be involved in the training and testing of machine learning tools developed for generating images from raw MRI data. The primary goal of this project will be to quantitatively compare our machine-learning-based MRI techniques to conventional MRI techniques in terms of accuracy, speed and motion sensitivity.

The successful candidate will acquire highly transferrable skills in image analysis and machine learning techniques. The project is based at the ACRF Image X Institute and is part of the Australian MRI-Linac Program, an NHMRC-funded research program that has built the Southern Hemisphere's first MRI-Linac in Sydney. Potential project outcomes include Masters/PhD research study as well as conference presentations and journal publications.