2024 Summer Research Project

Project title:	**Deep learning-based myocardial tissue segmentation for diagnosing cardiac sarcoidosis in patients**
Project duration, hours of engagement & delivery mode	Project duration: 6 weeks. Hours of engagement: 36hrs per week Delivery mode: *The applicant is expected to be on-site for the project.*
Description:	The aim of this project is to employ deep learning methods for improved segmentation of cardiac muscle tissue in positron emission tomography/computed tomography (PET/CT) scans of patients with cardiac sarcoidosis (CS). In cardiac sarcoidosis tiny collections of immune cells form small clusters of inflammation in the heart tissue, which can interfere with normal functioning. As a result of this inflammatory condition, patients may experience abnormal heart rhythm and it can also lead to heart failure. PET/CT imaging is currently in routine clinical use for assessing the amount of inflammation in the heart in CS patients. For this purpose, a specific radiotracer (i.e., fluorodeoxyglucose (FDG)) is injected. The uptake pattern of FDG in different parts of the tissue forms a marker for glucose metabolism, potentially helping to identify any abnormalities. Literature suggests possible pitfalls of interpretation related to normal patterns of cardiac FDG uptake related to diet, which can change the way the heart metabolises simple sugars such as FDG (which is very similar to glucose). For example, guidelines recommend low carbohydrate high fat diets with fasting to suppress such uptake. However, adequacy of dietary preparation is often uncertain in clinical practice, particularly given concerns regarding the accuracy and reliability of food intake reported by the patients. This can lead to lower diagnosis confidence for the reporting clinicians when determining the presence or extent of cardiac inflammation. A previous clinical audit in cardiac sarcoidosis conducted at Royal Brisbane and Women's Hospital (RBWH) confirmed that the RBWH Nuclear Medicine Department's current protocol of preparing cardiac sarcoidosis patients for FDG-PET (with a specific diet and fasting instructions prior to scans) successfully suppresses physiological myocardial uptake in the majority of individuals, thus increasing diagnosis confidence for the physicians. However, this previous analysis was only based on visual assessment of the scans. Accurate quantification of the degree of FDG uptake in the myocardium is necessary to allow a more definitive diagnosis of cardiac sarcoidosis using PET imaging. In addition, it could play an important role in monitoring response to treatment and assessing disease recurrence. Accurate quantification of FDG uptake in the myocardium requires robust detection and segmentation of the myocardial tissue in PET/CT scans. However, the currently available software in the department of Nuclear Medicine at RBWH can only achieve an accurate tissue segmentation in

	~60% of cases. In the other 40%, the estimated myocardial tissue partially overlaps the lung or subdiaphragmatic contents, making the measurements unreliable. In this project, the summer scholar will employ deep learning methods to develop a robust myocardial tissue segmentation in PET/CT scans, which would ultimately lead to improved diagnosis confidence in cardiac sarcoidosis.
Expected outcomes and deliverables:	Scholars will have the opportunity to: • engage and interact with a multidisciplinary team of researchers with expertise in developing machine learning models, medical image analysis and computational neuroscience. • gain skills in medical image analysis and applied machine learning in medical imaging. • generate publications from their research. • learn about a wide range of other research projects that are undergoing at the Centre for Advanced imaging and identify the field of research they might be interested to follow. Students may also be asked to produce a report and present their work at the Centre for Advanced Imaging (CAI) at the end of their project.
Suitable for:	This project is open to applications from students with Python programming skills and experience in developing deep learning/machine learning applications. Previous experience in medical image analysis is an advantage.
Primary Supervisor:	Dr Shahrzad Moinian
Further info:	For more details about the project please contact Dr Moinian (s.moinian@uq.edu.au) For further information about the Summer Research Scholarship at the Centre for Advanced Imaging (CAI), please contact CAI's centre manager Ms Rachael Birks (r.birks@uq.edu.au)