Auckland Bioengineering Institute
Summer Research Scholarships

2026/2027 Projects

Project code:	ABI001
Project title:	**AI-driven Brain Tumor Segmentation in Pediatric MRI Images**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Dr Hamid Abbasi Supported by Nima Sadeghzadeh (PhD student)
Contact details	h.abbasi@auckland.ac.nz
Skills Needed	• REQUIRED: High Python proficiency and Shell programming. • Prior experience in machine learning, particularly supervised methods, such as PyTorch and/or TensorFlow. • Familiarity with scientific Python libraries (e.g. scikit-learn, SciPy, NumPy, Pandas, Matplotlib, Seaborn). • Interest in biomedical applications; prior knowledge/experience in medical data analysis and computational neuroscience is preferred but not necessary.

Project description

Pediatric brain tumors are one of the leading causes of cancer-related mortality in children. The lesions exhibit distinct biological, clinical, and imaging characteristics compared with adult tumors, rendering manual segmentation (i.e., delineation) particularly challenging. Magnetic resonance imaging (MRI) is the primary imaging modality used for their diagnosis and management, as well as longitudinal monitoring. Our recent deep-learning-based method, DeSURVAE [1], showed promising results in segmenting another type of brain tumors (meningiomas) in MRI, and the project here aims to evaluate its effectiveness in pediatric.

Aims

i. start by conducting a short survey of the literature on pediatric segmentation via modern deep neural networks;
ii. retrain and evaluate DeSURVAE on pediatric; and
iii. associate segmentation accuracy with meta-data, such as tumor size, tumor location, etc.

The dataset is the Brain Tumor Segmentation (BraTS) 2026's publicly available pediatric MRI dataset that contains 260 T1-weighted, contrast-enhanced T1-weighted, T2-weighted, and T2-FLAIR. The input images are available and already standardized, skull-stripped, and resampled to 1×1×1 mm3 isotropic space. It is expected that the student will create a reproducible pipeline with a written analysis proposing an evidence-based segmentation scheme, ideally in the form of journal article or manuscript for MICCAI in 2027.

[1] Sadeghzadeh, N., ..., & Abbasi, H. (2025). DeSURVAE: A Dual-Encoder Dual-Decoder Neural Network for GTV Semantic Segmentation of Meningioma Brain Tumor in Radiotherapy Planning. MICCAI 2025 (pp. 129-138). Springer Nature.

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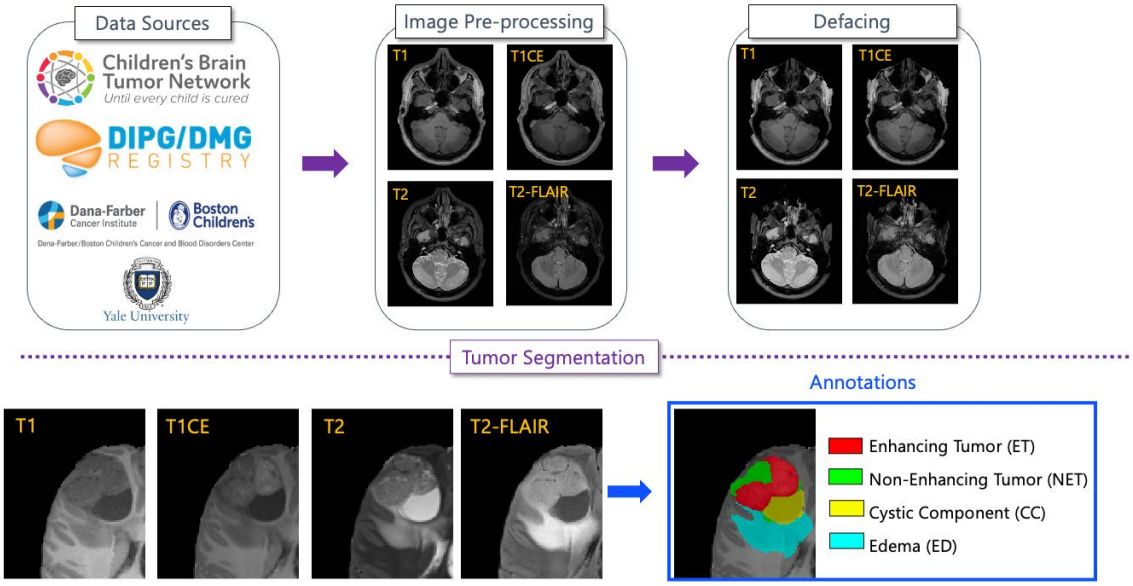

Image source: https://challenges.synapse.org/Challenges/DetailsPage/Task2?id=syn74274097

Auckland Bioengineering Institute
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Project code:	ABI002
Project title:	**Mapping the Sheep Skull: MRI Segmentation for Large-Animal Brain Registration**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Jiantao Shen Hamid Abbasi Maryam Tayebi
Contact details	jiantao.shen@auckland.ac.nz
Skills Needed	• Basic knowledge of brain anatomy • Interest in animal brain anatomy, especially large-animal models • Willingness to learn MRI image segmentation tools • Attention to detail and patience with manual image analysis • Basic computer skills and ability to follow structured workflows • Interest in neuroimaging, image processing, or computational neuroscience • Optional: interest in deep learning or automated image segmentation

Project description

This project will focus on segmenting the skull from sheep brain MRI scans to support improved brain registration methods in large-animal neuroimaging. Accurate access to the skull is essential for optimising registration pipelines, particularly in large-animal models where anatomical structures differ from human brain imaging.

The student will work with MRI data from seven sheep, each with two or three brain scans. The main task will be to perform skull segmentation from these MRI scans using established segmentation tools. Training and support will be provided by the supervisory team, including guidance on how to use the segmentation software and how to identify relevant aspects of sheep brain and skull anatomy.

This project is suitable for a 10-week Summer Research Scholarship and will give the student practical experience in neuroimaging, anatomical segmentation, and large-animal brain research. If time allows and the student is interested, there may also be an opportunity to explore training a deep learning algorithm to automate skull segmentation in future datasets.

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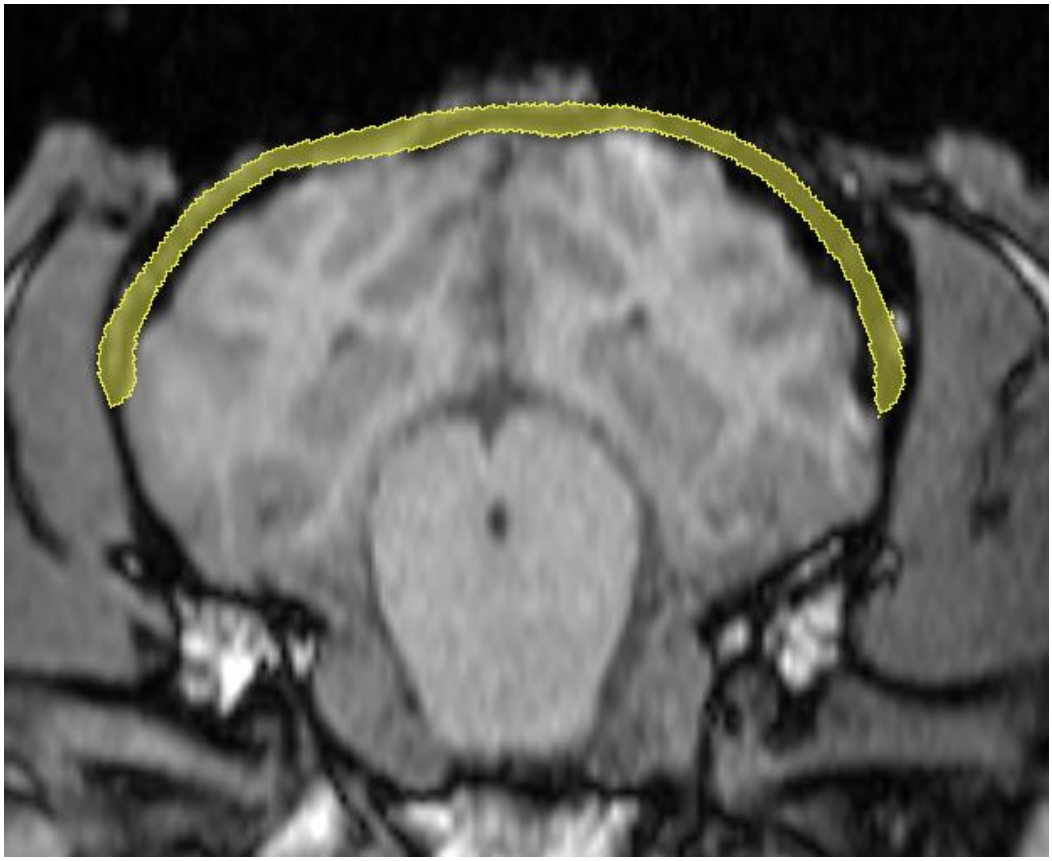

Auckland Bioengineering Institute
Summer Research Scholarships

2026/2027 Projects

Project code:	ABI003
Project title:	**No-Code AI Platform for Medical Image Segmentation and Classification**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Alan Wang
Contact details	alan.wang@auckland.ac.nz
Skills Needed	• Python programming; • Basic deep learning experience; • Web/app development interest; • Medical image processing interest; • Good problem-solving skills

Project description

This project will develop a prototype no-code web platform to help medical imaging students understand how deep learning models are trained and applied to medical image segmentation and classification. The platform will allow users to upload or select example 2D medical image datasets, choose from several pre-defined models, adjust simple training parameters, and visualise the training process through loss curves, accuracy/Dice metrics, and prediction outputs. The aim is to create an educational tool where students can explore AI workflows without needing to write code or set up GPU resources. After training, users should be able to test the model on new images and view segmentation masks or classification results. The summer student will help build the web interface, connect it with simple deep learning models, prepare demonstration datasets, and implement visualisation functions. This project is suitable for a student interested in AI, medical imaging, web development, and educational technology.

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2026/2027 Projects

Project code:	ABI004
Project title:	**From Imaging to CFD Simulation: Fluid Dynamics of the Human Lymph Node**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Tharanga Don Hayley Reynolds
Contact details	t.jayathungage-don@auckland.ac.nz
Skills Needed	• Background in computational fluid dynamics (CFD) • Experience with ANSYS Fluent (or similar CFD software)

Project description

This summer project will investigate fluid flow inside the human lymph node using high-resolution 3D geometries already generated from imaging data. Complete male and female lymph-node models are available, providing accurate vascular, lymphatic, and cellular architecture. Students will focus on the full computational pipeline in ANSYS Fluent, including:

- Geometry processing of GLB files (smoothing, cleaning, and compartmentalisation)
- High-quality meshing of complex anatomical structures
- Setting up and running steady/transient CFD simulations to quantify flow patterns, wall shear stress, pressure gradients, and transport of soluble factors
- Estimating functional parameters (e.g., permeability, flow resistance) directly from the imaging data The ultimate aim is to generate design principles for an artificial lymph node or implantable microfluidic device.

Ideal for students interested in biomedical engineering, fluid dynamics, or computational modelling who want hands-on experience with real anatomical geometries and translational medical-device applications.

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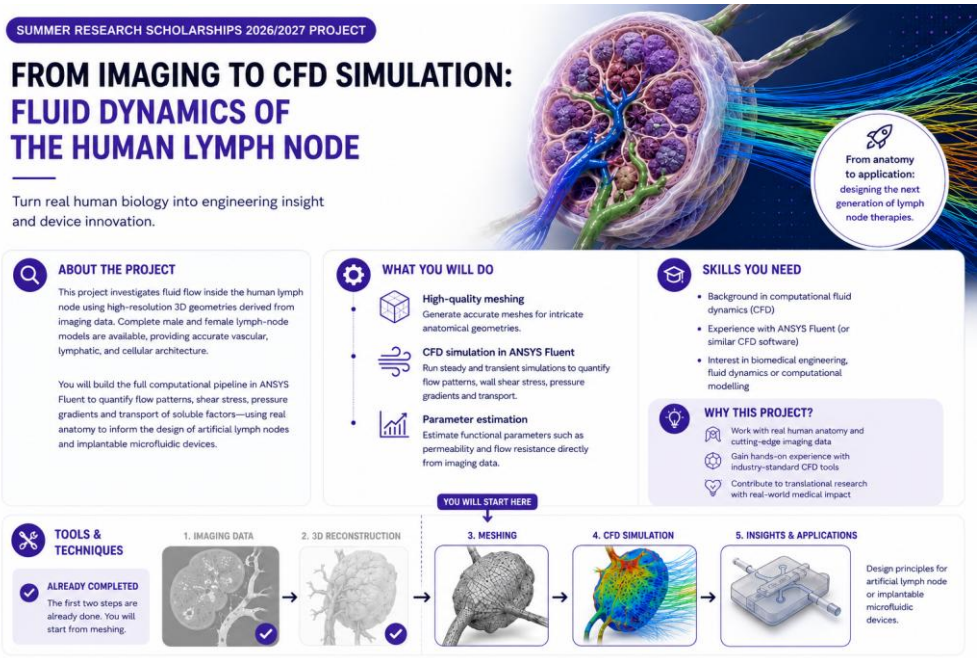

Auckland Bioengineering Institute
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Project code:	ABI005
Project title:	**Automated Segmentation of Placental Vasculature Using Machine Learning**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Sahan Jayatissa Alys Clark
Contact details	sahan.jayatissa@auckland.ac.nz
Skills Needed	• Python programming skills (Required), • Machine learning and deep learning (Preferred)

Project description

The placenta is a vital organ that supports fetal development during pregnancy by supplying oxygen and nutrients through a complex network of blood vessels. Understanding how blood flows through this vascular network can provide important insights into pregnancy complications such as fetal growth restriction and preeclampsia. In this project, you will develop a machine learning-based image segmentation tool to automatically identify the placental outline and surface blood vessels (known as chorionic vessels) from photographs of delivered placentae. You will work with a dataset of placental images and segmentations that, including the placental outlines, chorionic blood vessels, and a scale bar. Using these labelled images, you will train, validate, and evaluate deep learning models capable of segmenting previously unseen placentae. The project is a great opportunity to work with a team of engineering and biology researchers. The segmentations produced by your model will form the foundation for downstream computational modelling currently being used by the group in multiple projects. They will be used to reconstruct the placental vascular network and simulate blood flow through the placenta. Further work includes incorporation of the trained network into current computational modelling pipelines in the group.

Auckland Bioengineering Institute
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2026/2027 Projects

Project code:	ABI006
Project title:	**The cardiovascular system in babies born too small**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Alys Clark Sahan Jayatissa
Contact details	alys.clark@auckland.ac.nz
Skills Needed	• Mathematical models (differential equations) • Python programming • Interest in physiological systems

Project description

Babies born with fetal growth restriction (too small) have life-long elevated risk of heart disease compared to babies born of average size. One reason for this is that the heart connects differently to the circulation before birth, e.g. the fetus doesn't use its lungs prior to birth to gain oxygen, and so the right heart feeds more of the body than it does after birth. Instead, the fetus 'breathes' through a temporary organ – the placenta. Babies that are too small have different circulatory system characteristics but at birth this is typically subclinical – the system is 'different' but not dysfunctional. However, later in life these babies have higher risks of cardiovascular disease. This project will aim to provide mathematical models of how the anatomical changes in key fetal organs seen in fetal growth restriction may impact remodelling within the fetal circulatory system. The project will require a proficiency in programming, specifically python. Given the duration of the project, the student will use mathematical modelling techniques in simplified geometries, and so we do not anticipate use of commercial software in this project, however, we would expect the student to review more complex models of similar systems.

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2026/2027 Projects

Project code:	ABI007
Project title:	**Developing a Clinical Decision-Support Python Interface for Personalised Lung Modelling**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Behdad Shaarbaf Ebrahimi (Primary) Ho-Fung Chan (Secondary)
Contact details	behdad.shaarbaf.ebrahimi@auckland.ac.nz
Skills Needed	• Programming (preferably Python) • Basic engineering understanding

Project description

The Auckland Bioengineering Institute's Lungs and Respiratory System group has developed several computational modelling workflows that use medical imaging data (e.g. CT and MRI) to create personalised models of lung physiology and disease. These tools have been used to investigate respiratory diseases and have the potential to become valuable clinical decision-support systems. This project aims to develop a user-friendly software interface that enables clinicians and researchers to configure patient-specific model parameters, launch computational simulations through a graphical user interface (GUI), and monitor simulation progress without requiring direct interaction with underlying code. The platform will automate the execution of Python-based modelling workflows in the background and generate personalised clinical reports that integrate simulation outputs, medical images, and relevant clinical measurements. The resulting tool will provide a prototype framework for translating advanced computational modelling into clinical practice, allowing healthcare professionals to run simulations and obtain patient-specific reports in a streamlined and accessible manner. The project offers opportunities to gain experience in Python software development, graphical user interface design, medical image analysis, computational physiology, and clinical translation.

Auckland Bioengineering Institute
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2026/2027 Projects

Project code:	ABI008
Project title:	**Heart infarct detection using vector field coherence**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Martyn Nash George Harpur Vicky Wang
Contact details	martyn.nash@auckland.ac.nz
Skills Needed	• Python • Mechanics courses (BME, EngSci) • Interest in medical imaging.

Project description

Displacement-encoded magnetic resonance imaging (MRI) is a novel, advanced, and developing method for measuring heart motion over the cardiac cycle. Displacement-encoding allows for pixel-wise motion to be encoded in the MRI signal, providing regionally varying fields of material point tracking, which is an improvement over existing routine clinical methods that only use surface features. Tools have been developed here at the Auckland Bioengineering Institute for fitting high-order finite element (FE) models to these rich data, enabling local and regional estimates of cardiac strains that provide clinically useful diagnostic information. In patients who have experienced a heart attack (myocardial infarction), a change in regional motion, local to the affected region, can be observed. It has been hypothesised that, with high-order FE model fitting, these changes can be detected in the model-fitting error field, whereby vector field coherence analysis can characterise the shape and extent of the diseased muscle (infarct) in patients' hearts. Students will develop an understanding of clinical image analysis, handle and process advanced displacement-encoded MRI data from cardiac patients, and extend world-leading locally developed software tools to include vector field coherence analysis.

Auckland Bioengineering Institute
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2026/2027 Projects

Project code:	ABI009
Project title:	**Respiration-based biofeedback to optimise acquisition of free-breathing cardiac MRI**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Martyn Nash (ABI co-main) Beau Pontre (FMHS co-main) George Harpur (ABI)
Contact details	martyn.nash@auckland.ac.nz
Skills Needed	• Hardware development (e.g. BME courses) • Python • Interest in medical imaging

Project description

Cardiac MRI is the gold standard for diagnostic imaging of the heart owing to its high image quality and versatile image contrast. Scanning on a highly dynamic organ like the heart is challenging, requiring strategies to manage and compensate for cardiac and respiratory motion. The most common approach is to have patients hold their breath for short periods of time to minimise the effects of breathing motion and use an echocardiogram (ECG) to synchronise MRI scanning with the heartbeat. Some new cardiac MRI techniques are being developed that allow patients to continue breathing while collecting images and automatically tracking the location of the diaphragm during scanning. However, these techniques still require patients to breathe in a steady and controlled manner and typically take a longer time than standard approaches. This project will explore the use of respiration-based biofeedback to help patients with their breathing during the scans. The student will implement a method of providing visual feedback of their breathing to patients during an MRI scan. The use of this method will be tested on volunteers and compared to scans performed without feedback to evaluate the impact on scan time, image quality, and patient experience.

Auckland Bioengineering Institute
Summer Research Scholarships

2026/2027 Projects

Project code:	ABI010
Project title:	**Real-Time Web-Based Visualisation for Electromagnetic Tracking of Feeding Tubes**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Recep Avci
Contact details	recep.avci@auckland.ac.nz
Skills Needed	• Experience in web development (HTML, CSS, JavaScript or equivalent frameworks) • Familiarity with real-time data streaming (WebSockets or similar) • Interest in medical devices and biomedical engineering • Basic understanding of 3D visualisation (e.g. Three.js or WebGL is a plus)

Project description

Feeding tubes are commonly inserted without visual guidance, which can result in life-threatening misplacements. We are currently developing an electromagnetic (EM) tracking system that localises a magnetic field sensor attached to a feeding tube in real-time, eliminating the need for X-ray confirmation. The tracking system captures raw magnetic field data at the bedside and streams it to localisation engine, which computes the sensor position by solving an inverse problem. The computed location must then be displayed to the operator/clinician in an intuitive, real-time interface. The student will develop a web-based visualisation application that receives live position data from the localisation engine and renders the sensor trajectory onto a 3D anatomical model of the human torso. The application will display real-time updates as the tube is advanced along with reference landmarks and alert the operator if the trajectory deviates from expected pathways. The project will be developed and tested using simulated position data before integration with the full EM tracking system.

Auckland Bioengineering Institute
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Project code:	ABI011
Project title:	**Hermetic Feedthroughs for Active Implants**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Quinn Boesley Daniel McCormick David Budgett
Contact details	quinn.boesley@auckland.ac.nz
Skills Needed	• An interest in medical devices, particularly active implants. • Experience with CAD software e.g. Solidworks. • Some knowledge of mechanical design and electrical engineering concepts. • Some experience with or desire to improve hands on engineering work and process development and validation.

Project description

In the Implantable Devices Group, we are developing an ACL reconstruction button that can measure the loads on the tissue graft as it heals after surgery. This device needs to function both mechanically and electrically, to support the graft tissue as it heals and measure the strain the tissue experiences over time. One of the key features of the device are the electrical feedthroughs between the internal electronics and the outside surface. These enable the wireless power and data transfer systems to function but must be a hermetic seal to protect the patient from the device contents and the device from the patient bodily fluids. This Summer Research project will develop the laser-welding process to secure the feedthroughs in the ACL button, and to seal the internal electronics cavity. This will involve finding suitable parameters for the laser welder and making jigs to securely hold and manipulate the device during the welding process. Process validation is also necessary.

Auckland Bioengineering Institute
Summer Research Scholarships

2026/2027 Projects

Project code:	ABI012
Project title:	**Guiding biopsy for breast cancer diagnosis**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Robin Laven Thiranja Prasad Babarenda Gamage Martyn Nash Poul Nielsen
Contact details	r.laven@auckland.ac.nz
Skills Needed	• Python programming • machine learning • any experience in image analysis is a bonus

Project description

When suspicious breast lesions are only visible on an MRI, diagnosing them requires complex, expensive MRI-guided biopsies that limit patient access and delay care. To overcome this critical barrier, the Auckland Bioengineering Institute is developing an innovative approach to map lesions identified on diagnostic MRIs directly onto affordable, widely available ultrasound images. By creating a reliable bridge between these two imaging modalities, we aim to provide a cheaper, far more accessible way to accurately target these elusive lesions. This summer project contributes to tackling this challenge by investigating how state-of-the-art neural networks, such as Meta's CoTracker3, and/or physics-informed modelling can support mapping spatial information from MRI to ultrasound. You will leverage our existing pipeline that generates synthetic ultrasound images from breast MRI data, providing a controlled environment with known ground-truth mappings to test and refine your algorithms. Supported by a multidisciplinary team of engineers and clinicians, you will advance your skills in scientific programming, computer vision, and AI development. Ultimately, your work will contribute to a groundbreaking clinical tool that empowers more women to receive rapid, accurate diagnoses, bypassing costly MRI procedures and accelerating their path to life-saving treatment.

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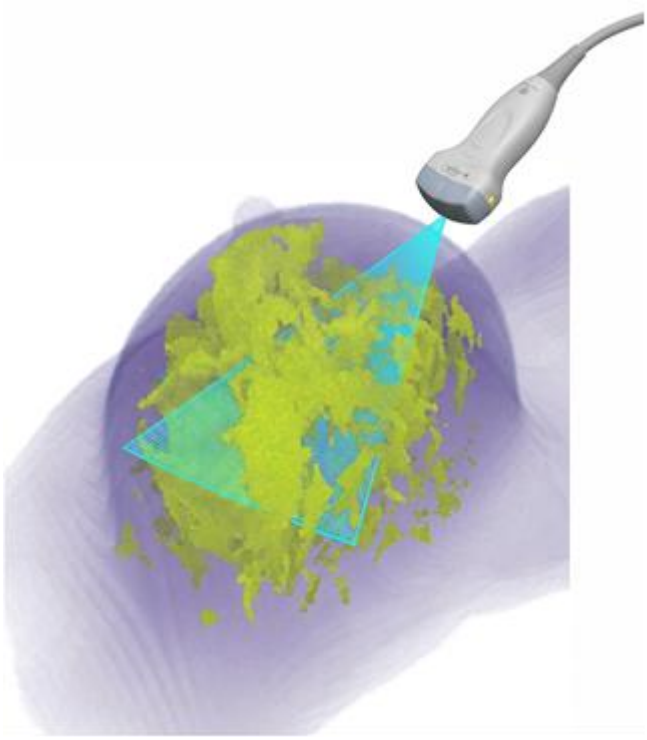

Auckland Bioengineering Institute
Summer Research Scholarships

2026/2027 Projects

Project code:	ABI013
Project title:	**Co-designing an interactive digital storybook for advancing breast health awareness**
Discipline:	Auckland Bioengineering Institute
Supervisor(s)	Thiranja Prasad Babarenda Gamage Alex Trevarton
Contact details	tp.babarendagamage@auckland.ac.nz
Skills Needed	• Good communication skills

Project description

Breast cancer affects 1 in 9 women in Aotearoa New Zealand. Raising awareness of breast cancer issues and educating all women about breast health is vitally important and can contribute to early detection and outcomes. The overall goal of this project is to co-design an interactive digital storybook with the community to communicate key concepts for advancing breast health awareness. This information resource will integrate visualisations from breast cancer research to help communicate information to a range of audiences including the general public, patients, and whanau. You will join a multi-disciplinary team of community engagement specialists, web application developers, bioengineers, clinicians, and nurse educators from the New Zealand Breast Cancer Foundation. This project will suit students with an interest in community engagement, design, and communication.