THE UNIVERSITY OF SYDNEY

FACULTY OF ENGINEERING

Engineering Vacation Research Internship Program

DIGITAL SCIENCES INITIATIVE PROJECTS - WINTER 2023

SCHOOL OF PHYSICS - WINTER 2023

THE UNIVERSITY OF SYDNEY

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DIGITAL SCIENCES INITIATIVE PROJECTS

DSI2023/1 Accelerated Real-Time Image Processing Pipeline for Embedded Systems on Marine Robots

Supervisors: Dr. Stefan Williams, Dr. Gideon Billings

Eligibility: Coding proficiency (preferably C++), Experience with ML libraries like TensorFlow is a plus

Project Description:
The aim of this project is to develop an accelerated image processing pipeline, tailored for underwater scenes and capable of operating at real-time framerates on embedded systems. The project would explore the use of a Google Edge TPU combined with an NVIDIA Jetson device to accelerate an image feature encoding network that would pipe into a GPU accelerated feature extraction and matching stage. This accelerated image processing pipeline will be the backbone for visual methods, such as Simultaneous Localization and Mapping, semantic segmentation, and object detection, that will run onboard underwater vehicles.
The student will explore machine learning models that are optimized for edge devices in conjunction with GPU accelerated feature descriptors to determine a processing pipeline that balances computational performance and accuracy.

Requirement to be on campus: Yes **dependent on government's health advice*

DSI2023/2 Real-time anomaly detection in additive manufacturing processes using Artificial Intelligence

Supervisors: Dr. Xianghai An, Prof. Gwénaëlle Proust, A/Prof. Zhiyong Wang

Eligibility: High achievement in a relevant undergraduate engineering degree (a WAM of 75 or above). This project has the option to be combined with an honours project.

Project Description:
Additive manufacturing (AM) is revolutionizing manufacturing processes to build 3D parts by progressively adding thin layers of materials guided by digital models, enabling the fabrication of innovative structures, complex shapes, and customised parts. However, various anomalies commonly occur during manufacturing due to the improper settings of process parameters, and residual and thermal stresses. Insufficient quality assurance will create material waste, increase production time and prevent AM adoption in advanced fields that require quality-assured high-performance parts.
Current non-destructive defect detection techniques are post-production analysis that largely depends on the operator's experience, making the identification of defects inaccurate and inconsistent. To assess the printing condition and product quality efficiently and accurately, in-situ monitoring systems for detecting defects are highly needed. Although novel image processing methods demonstrate promising progress in real-time anomaly detection, they mainly depend on specific problems and cannot identify different types of defects simultaneously. It has increasingly realised that machine learning (ML) methods hold great promise in overcoming these problems as they could analyse underlying patterns and features within datasets. In this project, we will establish imaging systems for in-situ monitoring of the

fabrication process and develop new ML algorithms for solving multiple real-time anomaly detection problems with high accuracy.

Requirement to be on campus: Yes **dependent on government's health advice.*

SCHOOL OF PHYSICS

PHY2023/1 TOLIMAN space telescope development

Supervisors: Dr Peter Tuthill and Dr Chris Betters

Eligibility: WAM>75 and Undergraduate candidates must have already completed at least 96 credit points towards their undergraduate degree at the time of application.

Project Description:
The TOLIMAN space telescope is a Sydney University led initiative to detect and characterize Earth analog planets within the immediate solar neighbourhood. Our mission will exploit astrometric detection - the registration of the minute deflection of the star's position as it is perturbed by gravitational reflex motion due to a rocky planet in orbit in a temperate orbit. The primary target is our nearest stellar neighbour: the Alpha Centuri system. The project forms a key steppingstone in the audacious Breakthrough Starshot initiative which aims to send humanity's first high speed robotic probe to interstellar space. This year will see the major components of the spacecraft designed and fabricated. Your role will be to participate in flight design, hardware, and software for this audacious mission.

Requirement to be on campus: No