THE UNIVERSITY OF WESTERN AUSTRALIA

Summer Down Under Research Internship

18 Jan – 12 Mar 2021

2021 Projects

2021 UWA SUMMER DOWN UNDER: RESEARCH INTERNSHIP INFORMATION

Application Procedure

Application Dates:
First round: Early Oct - 6 Nov 2020
2nd round: 7 Nov - 22 Nov (some projects might not be available)

Review this list of projects and select up to 2 preferred projects

Use this link to apply: 2021 UWA Summer Down Under Research Internship Application or QR code

Application preparation:
You will need to attach the most up to date

- Transcript
- CV (no more than 1 page)
- English results (not required for native speakers)

You will also be required to answer the following questions:

- Explain why your previous experience makes you suitable for this project?
  In particular, address any prerequisites that have been outlined by the supervisor. (max 200 words)
- Outline any previous research or laboratory experience you have. Please name that research group and the leader of that research group at your home university or the institution that you participated in research. (max 100 words)
- Why are you interested in this program? (max 200 words)
- What are your future career plans? (max 200 words)

You may contact the supervisor(s) if you have questions regarding the project(s). Please note: as student selection is based on a competitive process, **please do not discuss acceptance.** Some projects are designed to be deliberately vague to suit the students' area of interest/specialty. Interested students are recommended to contact the supervisor to discuss the project.

If you plan to do this Research Internship for credit, contact your university's international/mobility office to let them know of your plans.

Please note:
This is an Online Summer Down Under Research Internship. It means that the program will be conducted online, during office hours, Australian Western Standard Time. This program has 2 components, the coursework component and the research internship component.
The Coursework component consists of lecture and tutorials. Students from different time zones may choose to watch the video recording and attend lectures "asynchronous-ly". Students will get most value by participating in tutorials (about 6) "in person" online.
The Research Internship component whereby students work directly with UWA supervisors, a mutually suitable time can be discussed. Students are encouraged to contact UWA supervisors to discuss the project and suitable time times. Please do not discuss acceptance.

Due to travel restrictions, if you are not located in Western Australia, need a VISA or cannot be in Perth(UWA) from 18 Jan - 12 Mar 2021, please select either "Online Only" or "Both Online and Face to Face" projects. You can do this Research Internship remotely (online).

If you are currently located in WA and can be in Perth(UWA) from 18 Jan - 12 Mar 2021, you may select "Online Only", "Face to Face Only" or "Both Online and Face to Face" projects.

Program details see Summer Down Under: Research Internship

Contents

UWA School of Agriculture and Environment

Faculty of Engineering and Mathematical Sciences

Engineering

Physics, Mathematics and Computing

Oceans Graduate School

FACULTY: Faculty of Arts, Business, Law and Education
SCHOOL: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :**

Project title:	Conflict and civility in public planning and governance in the post-pandemic city

Lab/Group: Geography and Planning

Project description:
Prospects for civility and human flourishing are in tension with rising incivility, inequality, and discord around present and future development of in the (post)pandemic city. In this context urban planning has helped define our inherited structures and functions in our cities. We witness the rise of health and wellbeing in urban planning and national accounts for present and future generations in pre-COVID times. Looking to the post-pandemic city, urban planning is well-placed to alter the socio-ecological determinants of health and wellbeing towards just and inclusive redevelopment. Conflict in planning is inevitable but too-often it is poorly or violently managed. Arguably there is under- examined democratic potential especially in socialising conflict transformation across multiple urban scales. COVID amplifies existing tensions from addressing climate change and large infrastructure projects, for example, where we see the need for health and wellbeing to include civility and collaborative solutions. Thus urban planners need to better understand the need for conflict transformation to manage injustice, resource conflict and trade-offs at all scales and across borders. We need to better learn how to disagree so communities and individuals can make better decisions towards achieving the places we need: restorative justice, sustainable development (SDG16 – Peace, Justice and Strong Institutions and SDG11 – Sustainable Cities and Communities).

This project aims to interrogate the democratic potential for re-orientating how local governments and planners deal with conflict in urban planning by drawing on insights from the resilient peace project and conflict transformation literature and divided societies/cities or other critical cases. The research will include a literature review, collection of critical case studies and policies as comparative exemplars, and possible adaptations into (West) Australian local government settings.

Required skills, knowledge or experience:

Postgraduate student or senior undergraduate preferred.

Suggested Undergraduate major in human geography, planning, politics or political science, law, environmental science, anthropology, sociology; qualitative/quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative data design, case study and data collection, analysis, research management, data entry and analysis, plus written and graphic communication of findings.

Keywords: Conflict transformation, urban planning, governance, social innovation, community

Supervisor Contact email: clare.mouat@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 5	**Total number of place(s) available with supervisor:** 5

FACULTY: Faculty of Arts, Business, Law and Education
SCHOOL: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :**

Project title:	Sustainable living and livelihoods for beekeeping in Western Australia

Lab/Group: Geography and Planning

Securing beekeeper livelihoods is under-examined despite the booming beekeeping industry of Western Australia and the changing climate. This project aims to identify and examine vital dimensions of sustainable beekeeper livelihoods that need to underwrite policy reforms and strategies towards improving the visibility and viability of beekeeping industry and their reliance on public lands in Western Australia. These public lands need to be better managed as commons (from an alterglobalisation rather than Ostrom's institutional perspective) with a range of stakeholders and across governance regimes and scales.

This project will quantify and improve understanding of a typology of professional beekeepers (to differentiate fully commercial from hobby or part-time beekeepers), and model key government apiary site frameworks/mechanisms that will allow beekeepers to appropriately use, value and protect apiary sites as public resources thereby securing commercial beekeeper livelihoods and the wider industry. Working towards such a model is needed to help professionalise the industry, allow differential access to apiary sites (avoiding blunt interventions and their perverse effects), and safeguard the landscape for present and future generations and multiple users.

Note that the beekeeping research project that I am proposing is distinct from but informed by my involvement with a broader research group (http://www.crchoneybeeproducts.com/) and I have a PhD student within that group (her original project description is seen at https://politicalecologynetwork.org/tag/beekeeping/) with whom we could collaborate. Following the summer school, should you be interested in developing a PhD project, there are plenty of real world problems that need to be addressed within the commons management and commercial beekeeping in WA and Australia (and internationally).

Required skills, knowledge or experience:
Postgraduate student or senior undergraduate preferred.

Suggested Undergraduate major in human geography, planning, politics or political science, law, environmental science, anthropology, sociology; qualitative/quantitative research skills training.

Student contribution: exact details of the student role will be worked out with the student. The student will likely be involved in qualitative data design, case study and data collection, analysis, research management, data entry and analysis, plus written and graphic communication of findings.

Helpful skills: knowledge of Qualtrics, NVivo, and ABS data

Project is adaptable to suit student interest and location.

Keywords: Beekeeping, sustainable livelihoods, resource conflict, public policy, commons

Supervisor Contact email: clare.mouat@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 5	**Total number of place(s) available with supervisor:** 5

FACULTY: Faculty of Arts, Business, Law and Education

SCHOOL: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :** Dr Kristian Ruming (Macquarie)

Project title: COVID-19 as a catalyst for planning system reform

Lab/Group: Geography and Planning

COViD-19 has amplified and accelerated the reform pressures on planning systems across contemporary Australia. Planning system reforms in play must now navigate the paradox where COVID-19 both represents an immediate crisis and an indefinite disaster. Previously, prolonged reform pressures were usually lead by developers, builders and their advocates who called for efficiencies. Across multiple jurisdictions, 'efficiency' means a streamlined, consistently-codified, automated and privatised regulatory function of the planning system. Broadly-speaking the call for a streamlined planning system has been supported by state governments who have proceeded to implement wide-ranging reform programs that also seek integrated and strategically-led planning, and improved community engagement. Nonetheless this on-going health crisis fundamentally challenges the conventional reform processes: from system resilience to priorities, to democratic foundations, and timelines. Thus, a critical witnessing of reform and COVID adaptations is imperative.

The radical disrupture of COVID-19 requires fresh ways of interrogating possible and foreclosed realities of reform and planning imaginaries more broadly. Conceptually the paper will use a grounded theory approach to sensitize governance and use theoretically-integrated analysis of planning and development. This paper will explore the diverse stakeholder objectives around COVID-related planning reforms and hypothesise about how this current reconfiguration of planning systems will shape planning and urban governance into the future.

The paper will build up a comparative case study approach, exploring the similarities and differences of reform objectives, strategies and policy approaches in NSW and WA. The paper will draw upon and analyse three data sets from original and secondary sources. The manuscript deadline is April 2021.

Required skills, knowledge or experience:
Postgraduate student or senior undergraduate preferred.

Suggested Undergraduate major in human geography, planning, politics or political science, law, environmental science, anthropology, sociology; qualitative/quantitative research skills training.

Student contribution: exact details of the student role will be worked out with the student. The student will likely be involved in qualitative data design, case study and data collection, analysis, research management, data entry and analysis, plus written and graphic communication of findings.

Helpful skills: knowledge of Qualtrics, NVivo, Urban planning systems

Keywords: Urban planning, planning regimes, reform, Australia, COVID-19, infrastructure

Supervisor Contact email: clare.mouat@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 5	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :**

Project title:	Illuminating Night Studies: the pathways, policies and priorities for planning healthy Local Urban Nightscapes and Regeneration (LUNAR) across Australasia

Lab/Group: Geography and Planning

Project description:
Many sustainability projects routinely focus on day-time conditions and activities in a climate of global change. Yet the way we plan, develop, and live in our cities and homes during the night needs our urgent attention. Responding to international calls for Night studies, this project focuses on planning for healthy Local Urban Nightscapes and Regeneration (LUNAR) across Australasia with lessons from and for international areas.

The project task requires interns to help advance policy responses for healthy LUNAR by exploring how artificial lighting regimes (ALR) affect (more-than-) human and ecological health and the politics of light in cities via

1. Building understanding how communities and stakeholders understand ALR in terms of commons and ecological light pollution in local urban places, and
2. Developing ways to examine the multi-scale regenerative potential via planning policies and practices.

Urban nightscapes have ALR that dramatically and variably affect economic, social, and ecological sustainability. ALR are regulated systems of night lighting – permanent and temporary – including streetlights; lighting from industrial, residential, civic, commercial, festival, and construction sources. While lighting at night offers many benefits (productivity, safety, and entertainment, for example), it can also cause problems for human and non-human health through light and ecological pollution. Light pollution includes sky glow from ALR sources that obscure the night sky (today more than one third of humanity cannot see the Milky Way). More broadly, ecological light pollution disrupts ecological health of humans and non-humans (plants, animals, and insects) in a wide variety of ways.

Wise cities, not smart cities, are needed to balance urban development, ecological wisdom, and planning practices. The project may use surveys and policy review/reform development to explore the range of healthy and unhealthy ALR to find ways for communities to appreciate and create healthier and more regenerative ALR in their local and significant places across Australasia. Consequently, communities can collaborate with local councils and developers to better inform how we plan, promote, and develop safe and healthy cities (SDG11). For healthy urban development, planners need a better understanding about how communities relate to the night sky and nightscapes of their urban places, and communities need to better understand the technologies and systems that offer or restrict lighting innovations. In so doing, communities and planners can better appreciate the trade-offs and effects of ALR and the wise city imperatives for healthy and sustainable nightscapes. *The project outcome is to a peer-reviewed research manuscript submission in April 2021*.

Required skills, knowledge or experience:
Suggested undergraduate major in human geography and planning, environmental science, anthropology, sociology, public health; qualitative or quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry, analysis, plus written and graphic communication of findings.

Project is adaptable to suit student interest and location.

Keywords: Artificial lighting, urban planning, health, community governance, regenerative su

Supervisor Contact email: clare.mouat@uwa.edu.au

Project supervised: Online/Face to Face (fieldwork TBA)	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 5	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Arts, Business, Law and Education
School: School of Social Sciences

Main Supervisor : Dr Clare Mouat	**Co-supervisor(s) :** Dr Katie McClymont

Project title:	Challenging geographies of super-rich urban development by championing an ethics of care over time and place

Project description:

Dr Clare Mouat (UWA) and Dr Katie McClymont (University of the West of England, Bristol, UK) are the chief investigators in an ongoing project mapping the contours and curation of an ethics of care: reorientating critical infrastructure planning in super-prime development of Nine Elms, London, UK. Nine Elms is a £15 billion multi-level governance partnership project; the package (including a London Underground Northern Line extension) is currently one of Europe's largest regeneration schemes. We are keen to develop projects which explore the tensions and opportunities evidenced in this project either in the same location or in others globally which can deepen, extend or challenge our conceptualisations.

The project task is to assist in exploring the vital need to better recognise how place and cultural heritage is- or could be differently- co- opted as a critical infrastructure and postsecular ethics of care. This is especially where such super-rich urban development threatens to displace or impoverish existing communities. Addressing the subthemes below, we aim to witness the contours and curation of an ethics of care by secular and postsecular actors as noted in the ongoing regeneration of the Vauxhall Nine Elms Battersea Opportunity Area in London, UK ("Nine Elms"). Several key Opportunity Areas are nominated along the Thames within the Diocese of Southwark. The Diocese represents a significant participatory curator of care by invoking history and heritage, through non-financial notions of ownership and belonging. Moreover, their strategic planning and ambitions for #AGoodCity create a paradoxical tension with secular local governments democratically- sanctioned strategic spatial frameworks seek to promote community health and wellbeing.

A range of qualitative data collection techniques will capture and chart the distinctive heritage and future development of Faith-based organisations and actors using a postsecular lens and grounded theory. We aim to provoke deeper inquiry and assess actual and potential planning implications in and beyond this extraordinary postsecular situation. *The project outcome is to a peer-reviewed research manuscript submission in April 2021.*

As the project can be tailored to student needs, the relevant research sub-themes to be considered are:

- Resilience, place and place-making:
  What is the role of care and wellbeing in identity and ontological security? Who are the champions of care? What are the postsecular conditions and places of care that are key to regenerative planning?
- Contested urban spaces: How can critical infrastructure be extended to include place and cultural heritage in supporting healthy, inclusive, and just (re)development in urban public space for emerging communities?

Required skills, knowledge or experience:

Undergraduate major in human geography and planning, politics, anthropology, sociology, history, qualitative or quantitative research skills training.

Student contribution: the exact details of the student's role will be worked out in consultation with the student. The student will likely be involved in qualitative and/or quantitative data collection and analysis, including individual and focus group interviews, data entry and analysis and report writing.

We are open to student-initiated projects in a range of different geographical locations which pick up on the key concerns raised by our project but explore how these play out elsewhere.

Keywords: Urban regeneration/renewal, ethics, care and wellbeing, heritage, postsecular

Supervisor Contact email: clare.mouat@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 5	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Arts, Business, Law and Education **School:** School of Social Sciences	
Main Supervisor: Dr Glenn Savage (UWA)	**Co-supervisor(s):** Jessica Gerrard (University of Melbourne)
Project title:	Parents, communities and public schools

Project description:

This three-year Australian Research Council project aims to examine the impact of Australian state and federal school autonomy policies on how public secondary schools engage with parents in disadvantaged communities. Through policy analysis and case studies in schools, the project seeks to advance policy and conceptual knowledge about how school autonomy reforms are potentially reshaping meanings and practices associated with public schooling. Expected outcomes include enhanced knowledge about the shifting nature of schooling reform in Australia's federal system and insights into evolving relationships between governments and citizens in public service delivery. Intended benefits include insights to inform future policy design and implementation at school and system levels.

Required skills, knowledge or experience:
A background of study in either sociology, politics, public policy or education is highly recommended. Students who have experience conducting qualitative research would be especially well-placed.

Keywords: public policy, sociology, schooling reform, education policy, autonomy, parents, public schooling, federalism, social and economic disadvantage

Supervisor Contact email: glenn.savage@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

FACULTY: Faculty of Arts, Business, Law and Education **SCHOOL:** Law School	
Main Supervisor : Prof Erika Techera	**Co-supervisor(s) :**
Project title: Oceans governance	
Project description: The project will explore international environmental law that addresses the problem of marine invasive species. The focus will be on exploring the different pathways for introduction of species and in particular ballast water and bio-fouling of ships. Whilst there is a new treaty on ballast water, there is no binding international law directly addressing bio-fouling. The research will involve collating literature on the extent of the marine invasive species challenge and its causes, examining existing international law that addresses these causes, analysing in detail the specific laws for ballast water and bio-fouling, and identifying some potential ways forward to improve oceans governance.	
Required skills, knowledge or experience: Knowledge of international environmental law. The student need not be a law student, but if not, s/he must have studied international environmental law. It is possible that a law student who has studied public international law, but not international environmental law, may be suitable depending upon other subjects undertaken.	
Keywords: International environmental law, oceans, biodiversity conservation, governance, invasive species	
Supervisor Contact email: erika.techera@uwa.edu.au	
Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Arts, Business, Law and Education
School: Law School

Main Supervisor : Dr Jade Lindley	**Co-supervisor(s) :**

Project title: Optimising Compliance with Recreational Fisheries

Project description:

The intern would be joining a team of experts from around Australia (Western Australia, South Australia and Victoria) to progress research on understanding how to optimise compliance among recreational fishers in the Blue Swimmer Crab fishery in Western Australia and South Australia. This research is planned to be extended Australia-wide at the end of this pilot project.

Project Task

One or two interns are required to assist with this novel Australian research of which the outcomes will shape the way in which recreational fisheries are managed in Western Australia and South Australia directly, and other Australian jurisdictions indirectly.

There are two primary research elements of this project: Focus groups and analysis of government held data. This intern(s) would work alongside the team during the **focus groups** aspect of the project. Two remote focus groups (via Zoom) will be planned in January/February 2021 (to be scheduled approx. 2-3 weeks into the internship). The first in Western Australia, the second in South Australia. The intern(s) will assist with activities before (planning, arranging calendar invitations); during (note taking); and after (thematic analysis of notes, other related activities as required) both the focus group sessions. A **Steering Committee meeting** will be held after the focus groups to share results and directions, which the intern will also be involved in to assist with similar activities.

Thematic analysis of notes will be written up and form part of the final project report and it is intended that these outcomes will lead to a separate academic publication. The intern(s) will be vital in assisting the team in developing the notes into a publishable form, suited to the 'results' section of a journal article. Further assistance with the necessary literature review and other sections of the academic paper such as proofreading and referencing, and depending on the quality and quantity of the contribution, it is intended that the **intern(s) may be invited to be named as author(s).**

Required skills, knowledge or experience:

Ability to work well on a new topic with minimal supervision; provide weekly progress updates; organisation skills, especially when working independently; work well in a diverse team; ability to upload and clearly name academic references in Dropbox; familiarity with, or ability to learn referencing tool EndNote; proficient in English writing.

Keywords: Recreational fisheries; cross-disciplinary research; Law, crime and compliance; fisheries compliance; Australian fisheries; environmental research.

Supervisor Contact email: jade.lindley@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 1 to 2

Faculty: Faculty of Arts, Business, Law and Education
School: Law School

Main Supervisor : Dr Jade Lindley	**Co-supervisor(s) :**

Project title: Support for law PhD students

Project description:

This project follows on from research conducted in 2018 and published in 2020 as to understanding what institutional and personal factors lead to Australian law PhD students completing successfully. This project intends to further the results found in that research, namely understanding what aspects of law PhD supervision are most critical and how to train law academics to best support their students. This will occur through (1) a **literature review; and (2) an online survey**. The results of this will be finalised as an academic journal article.

Project Task

The intern(s) will be tasked to support the development of the literature that will form the basis of the project. Online literature gathered will be organised following an agreed naming convention and uploaded to a shared Dropbox folder. The intern(s) will analyse themes and write results in a publishable format. The literature will inform the survey questions. The survey questions will be devised in conjunction with the supervisor, drawing on the abovementioned original study and this project's literature review. The intern(s) will work with the supervisor to develop the Human Research Ethics Application for approval prior to the survey being made live online. Other intern tasks include: Managing invitations to conduct the survey; after the close of the survey, analysing themes; writing results; proofreading and referencing; and other related tasks as required for this and related projects.

It is expected that the results of the study will form an academic publication. The literature review along with the survey results will form various sections of a journal article. Participation will be encouraged and depending on the quality and quantity of the contribution, it is intended that the **intern(s) may be invited to be named as author(s).**

Required skills, knowledge or experience:

Ability to work well on a new topic with minimal supervision; provide weekly progress updates; organisation skills, especially when working independently; work well in a diverse team; ability to upload and clearly name academic references in Dropbox; familiarity with, or ability to learn referencing tool EndNote; proficient in English writing.

Keywords: post-graduate research; academic research; support for law PhD students

Supervisor Contact email: jade.lindley@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 1-2

Faculty: Faculty of Arts, Business, Law and Education
School: Law School

Main Supervisor : Dr Renae Barker	**Co-supervisor(s) :**

Project title:	Refusal of Life Saving Medical Treatment by Minors

Project description:

The Australian Courts have consistently overruled the wishes of parents and children to refuse lifesaving medical treatment on the basis of their religious beliefs. This project will take a fresh look at the Australian case law on this topic using a combination of legal and social science techniques including Systematic Content Analysis to better understand the factors considered by the courts and the extent to which the court's decision is influenced by the family's religious beliefs.

Required skills, knowledge or experience:

Familiarity with case law analysis OR Systematic Content Analysis using Nvivo or similar. Students from a common law background (or will experience in a common law jurisdiction) will be preferred.

Keywords: law and religion; children; refusal of medical treatment

Supervisor Contact email: renae.barker@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science **School:** School of Biological Sciences	
Main Supervisor : Prof David Edwards	**Co-supervisor(s) :** Dr Philipp Bayer
Project title: Applied bioinformatics	
Lab/Group: UWA applied bioinformatics group **Lab/Group Link:** http://www.appliedbioinformatics.com.au/ **Publications:** https://scholar.google.com.au/citations?user=AxsOkqYAAAAJ&hl=en	
Project description: We develop custom projects in the area of applied bioinformatics depending on the student's interests and experience. Projects mostly align with ongoing activities in plant genomics, applying big data to understand plant evolution and crop performance using high performance computing and diverse approaches including machine and deep learning.	
Required skills, knowledge or experience: Students require an understanding of biology and experience of working in a Linux environment. Coding may be required for some projects.	
Keywords: Genomics, plants, bioinformatics, machine learning, evolution	
Supervisor Contact email: Dave.Edwards@uwa.edu.au	
Project supervised: Face to Face only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Science
School: School of Biological Sciences

Main Supervisor : Prof Jacqui Batley	**Co-supervisor(s) :**

Project title: Genomics of Plant Pathogen Interactions

Lab/Group: Batley Lab
Lab/Group Link: www.batleylab.net

Project description:

Research on the interactions between plants and pathogens has become one of the most rapidly moving fields in the plant sciences, findings of which have contributed to the development of new strategies and technologies for crop protection. A good example of plant and pathogen evolution is the gene-for-gene interaction between the fungal pathogen Leptosphaeria maculans, causal agent of Blackleg disease, and Brassica crops (canola, mustard, cabbage, cauliflower, broccoli, Brussels sprouts). The aim of this project is to use whole genome sequencing technologies to characterise the diversity and evolution of these genes in different wild and cultivated Brassica species. This will involve phenotypic analysis of the disease in a variety of cultivars and species and genetics to link to the phenotype.

Required skills, knowledge or experience:
Keen interest in plant biology, with knowledge of DNA and genetics

Keywords: Genome sequencing, plant pathogen interactions, crop protection, evolution, food security

Supervisor Contact email: Jacqueline.batley@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 3

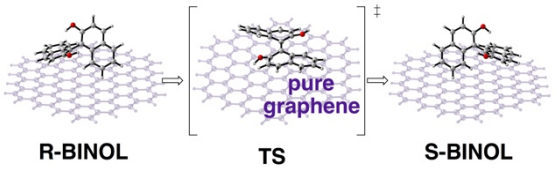
Faculty: Faculty of Science
School: School of Molecular Sciences

Main Supervisor: Prof Amir Karton	**Co-supervisor(s): N/A**

Project title: Computational Design of Next Generation 2D Catalysts

Lab/Group: Computational and Theoretical Chemistry Lab
Lab/Group Link: https://www.chemtheorist.com

Project description:



During the past decade computational chemistry has had an unprecedented impact on almost all branches of chemistry as a powerful approach for designing new molecules and materials. The increasing computational power provided by supercomputers and the emergence of highly accurate theories make contemporary computational chemistry one of the most powerful "microscopes" currently available for examining the atomic and electronic details of molecular processes. In my lab we use powerful supercomputers in conjunction with highly accurate theoretical methods to design functional molecules and materials. In this project you will use density functional theory to design two-dimensional nano-materials with tailored properties for catalysis, hydrogen storage, and molecular sensing. For further details see recent papers from our lab:

- A. Karton. Catalysis on Pristine 2D Materials via Dispersion and Electrostatic Interactions. *J. Phys. Chem.* A, 124, 6977 (2020). https://doi.org/10.1021/acs.jpca.0c05386
- A. Kroeger, J. F. Hooper, A. Karton. Pristine graphene as a racemization catalyst for axially chiral BINOL. *ChemPhysChem*, 21, 1675 (2020). https://doi.org/10.1002/cphc.202000426
- T. Hussain, M. Sajjad, D. Singh, H. Bae, H. Lee, J. A. Larsson, R. Ahuja, A. Karton. Sensing of Volatile Organic Compounds on Two-Dimensional Nitrogenated Holey Graphene, Graphdiyne, and Their Heterostructure. *Carbon*, 163, 213 (2020). https://doi.org/10.1016/j.carbon.2020.02.078
- A. Kroeger, A. Karton. Catalysis by pure graphene – From supporting actor to protagonist through shape complementarity. *J. Org. Chem.*, 84, 11343 (2019). https://doi.org/10.1021/acs.joc.9b01909
- K. Alhameedi, T. Hussain, D. Jayatilaka, A. Karton. Reversible hydrogen storage properties of defect-engineered C4N nanosheets under ambient conditions. *Carbon*, 152, 344–353 (2019). https://doi.org/10.1016/j.carbon.2019.05.080
- S. Sun, T. Hussain, W. Zhang, A. Karton. Blue Phosphorene Monolayers as Potential Nano Sensors for Volatile Organic Compounds Under Point Defects. *Appl. Surf. Sci.*, 486, 52 (2019). https://doi.org/10.1016/j.apsusc.2019.04.223
- T. Hussain, B. Mortazavi, H. Bae, T. Rabczuk, H. Lee, A. Karton. Enhancement in Hydrogen Storage Capacities of Light Metal Functionalized Boron–Graphdiyne Nanosheets. *Carbon*, 147, 199 (2019). https://doi.org/10.1016/j.carbon.2019.02.085

Required skills, knowledge or experience:
1) We are looking for highly motivated students interested in computational chemistry
2) A strong background in chemistry is an advantage
3) Basic background in UNIX is an advantage

Keywords: Computational Chemistry, Catalysis, 2D materials, Density Functional Theory

Supervisor Contact email: amir.karton@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science

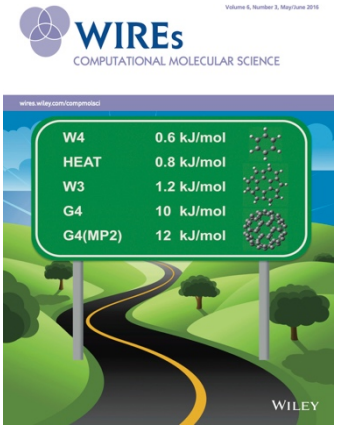
School: School of Molecular Sciences

Main Supervisor: Prof Amir Karton	**Co-supervisor(s): N/A**

Project title:	Development of Economical Quantum Chemical Methods

Lab/Group: Computational and Theoretical Chemistry Lab
Lab/Group Link: https://www.chemtheorist.com

Project description:



Quantum chemistry composite ab initio methods are the most accurate methods in contemporary computational chemistry. First-principles thermochemical methods, such as Weizmann-n theories, combine large-scale electronic structure calculations with sophisticated extrapolation techniques to achieve unprecedented accuracies in thermochemical, kinetic and spectroscopic predictions. The recently developed explicitly-correlated (F12) techniques extend the applicability of these theories to larger systems. This project will explore the combination of these theories as well as other avenues for reducing the computational cost of ab initio procedures in order to extend their applicability to medium-sized biomolecules. For further details see recent papers from our lab:

- A. Karton. Effective basis set extrapolations for CCSDT, CCSDT(Q), and CCSDTQ correlation energies. *J. Chem. Phys.*, 153, 024102 (2020). https://doi.org/10.1063/5.0011674
- A. Karton. Highly accurate CCSDT(Q)/CBS reaction barrier heights for a diverse set of transition structures: Basis set convergence and cost-effective approaches for estimating post-CCSD(T) contributions. *J. Phys. Chem. A*, 123, 6720 (2019). https://doi.org/10.1021/acs.jpca.9b04611
- B. Chan, A. Karton, K. Raghavachari. G4(MP2)-XK: A Variant of the G4(MP2)-6X Composite Method with Expanded Applicability for Main Group Elements up to Radon. *J. Chem. Theory Comput.*, 15, 4478 (2019). https://doi.org/10.1021/acs.jctc.9b00449
- A. Karton. Post-CCSD(T) contributions to total atomization energies in multireference systems. *J. Chem. Phys.*, 149, 034102 (2018). https://doi.org/10.1063/1.5036795
- A. Karton. A computational chemist's guide to accurate thermochemistry for organic molecules. *Wiley Interdiscip. Rev. Comput. Mol. Sci.*, 6, 292 (2016). http://dx.doi.org/10.1002/wcms.1249

Required skills, knowledge or experience:
1) We are looking for highly motivated students interested in computational chemistry
2) A strong background in computational/theoretical chemistry is an advantage
3) Basic background in UNIX and/or programming is an advantage

Keywords: Ab Initio Methods, Coupled Cluster Theory, Basis Set Extrapolations

Supervisor Contact email: amir.karton@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science
School: School of Molecular Sciences

Main Supervisor : Dr Keith Stubbs	**Co-supervisor(s) :**

Project title:	Development of scaffolds to inhibit carbohydrate-processing enzymes involved in biological processes

Lab/Group: Stubbs
Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/keith-stubbs

Project description:

The enzymes that regulate the structures of glycans (carbohydrates) are extremely important and have been implicated in a wide variety of diseases and thus are targets for therapeutics. The laboratory studies a wide variety of enzymes that have been implicated in a wide variety of diseases and biological processes. The project will be to design and synthesize a new inhibitor, that can then be used to investigate the role of a new carbohydrate-processing enzyme

Required skills, knowledge or experience:

Students interested in synthetic chemistry or synthetic chemistry & biochemistry are ideal for this project.

Keywords: Carbohydrates, Synthesis, Inhibitors, Disease, Biological Function

Supervisor Contact email: keith.stubbs@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Science
School: School of Psychological Science

Main Supervisor : Dr Darja Kragt	**Co-supervisor(s) :**

Project title: The future of leadership in the age of AI

Lab/Group: Psychology at Work Lab

Project description:
Project 1

This project aims to investigate how the advancement of artificial intelligence (AI) systems will change the nature of the workplace and, specifically, what impact this will have on leaders and managers. Anecdotal evidence suggests that managers are not fully prepared to integrate decision-making algorithms into their work practices, that is, managers refuse to take into account information and suggestions offered by algorithmic output, if it contradicts manager's own stance. This project hopes to investigate the different types of joint decision making and its impact on managerial decision making. Furthermore, personal and contextual characteristics that might impact manager's openness to AI input will be considered.

The student(s) will be involved in data collection and analysis.

Required skills, knowledge or experience:

Undergraduate major in psychology, business, engineering, computer science; quantitative research skills training.

Keywords: Leadership, artificial intelligence, decision making

Supervisor Contact email: Darja.kragt@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science
School: School of Psychological Science

Main Supervisor : Dr Darja Kragt	**Co-supervisor(s) :**

Project title: Leadership Behaviours and Outcomes

Lab/Group: Psychology at Work Lab

Project description:

Project 1

This project aims to identify emergent leadership behaviours, that is, behaviours that distinguish individuals who are acting as leaders versus non-leaders in groups. We have videotaped groups working on shared tasks and seek to understand which micro- and macro-behaviours help to identify leaders. The student will assist with rating the videos based on a pre-developed coding template.

Project 2

Leadership is seen as more challenging in volunteering context, because volunteers are free to leave organisation without penalty. Hence, leadership behaviours have different impact on outcomes in the volunteering context. In an attempt to better understand these behaviours and outcomes, we seek to conduct a systematic literature review on the topic. The student will assist with locating the relevant literature, and extracting information needed for the literature review.

Required skills, knowledge or experience:

Undergraduate major in psychology, sociology, business, etc.; qualitative or quantitative research skills training.

Keywords: Leadership behaviour, emergent leadership, volunteering

Supervisor Contact email: Darja.kragt@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Science
School: UWA School of Agriculture and Environment

Main Supervisor : Dr Dominique Blache	**Co-supervisor(s) : Prof Shane Maloney**

Project title: Getting to know flies

Project description:

Drosophila melanogaster, the common fruit fly, is used as a model to study many biological processes. In our lab, we use *Drosophila* to study whether food supplements can mitigate the negative effects of high temperature on their reproduction, their activity, and their preference for different food supplements. Each experiment uses a large number of individual flies, and data acquisition and analysis by humans is very time consuming. This project aims to generate analytical tools to measure the activity of the flies across multiple days and nights, their preference for different foods, and the characteristics of their gametes. You will develop new algorithms to extract relevant data from a database of video recordings of flies and / or still photos of the gut content of flies, and their reproductive organs.

Required skills, knowledge or experience:

Image processing, programming language such as Python or C. Knowledge of image analysis software such as Fiji would be useful. No prior knowledge of Drosophila biology needed.

Keywords: Image processing, Data science

Supervisor Contact email: dominique.blache@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School: UWA School of Agriculture and Environment

Main Supervisor : Dr Judith Lichtenzveig	**Co-supervisor(s) :** Dr Janine Croser Dr Maria Pazos-Navarro

Project title: Phenology of wild relatives of chickpea

Lab/Group: Lichtenzveig & Croser

Project description:
Chickpea, *Cicer arietinum*, evolved under domestication as a spring crop [1]. The closest wild relatives of chickpea, *C. reticulatum* and *C. echinospermum*, are adapted to autumn germination and spring/summer maturity. The project aims at evaluating the phenology (*i.e.* the life cycle) of wild *Cicer* in response to changing growth conditions (*e.g.* temperature, photoperiod, light quality). The project builds upon the team's expertise in accelerated single seed descendant platforms [2].

The project provides opportunities to develop skills in plant science, physiology, genetics, data mining and statistical analysis. The outputs of this project will benefit the agriculture industry and will enhance the collective understanding of crop evolution.

1) Abbo S., Shtienberg D., Lichtenzveig J., Lev-Yadun S. and Gopher A. (2003) The chickpea, summer cropping, and a new model for pulse domestication in the ancient Near East. The Quarterly Review of Biology 78(4):37-50.
2) Ribalta, F. M., Pazos-Navarro, M., Nelson, K., Edwards, K., Ross, J. J., Bennett, R., Munday, C., Erskine, W., Ochatt, S. J. & Croser, J. S., Precocious floral initiation and identification of exact timing of embryo physiological maturity facilitate germination of immature seeds to truncate the lifecycle of pea. Plant Growth Regulation, 81(2): 345-353.

Required skills, knowledge or experience:

Strong interest in genetics and/or plant sciences demonstrated by having completed units in biology, genetics, botany and/or agriculture.

Keywords: Evolution, Adaptation, Genetics, Legume Crops

Supervisor Contact email: Judith.Lichtenzveig@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School: UWA School of Agriculture and Environment

Main Supervisor : Dr Parwinder Kaur	**Co-supervisor(s) :**

Project title: DNA Zoo Australia – Mapping Australia's Biodiversity

Lab/Group: DNA Lab @UWA
Lab/Group Link: https://www.youtube.com/watch?v=9PniPYb2zsI&t=17s

Project description:
Project 1

With the climate emergency exacerbating natural disasters, as evidenced by the Australian wildfires having killed >1 billion animals, we have a very short time to characterize, record and support our unique biodiversity.

The project aims to:
- Contribute significantly to conservation of ecosystems under rapid environmental change, with unique 3D genomics to complete chromosome-genome assemblies critical for gene regulation studies, the key to understanding all species – plants, animals

- Develop an integrated system for data production and analysis and train scientific leaders with diverse skillsets that blend biology, applied mathematics, computational linear algebra and algorithm design

- Accelerate fundamental research with genomics to meet critical needs of conservation management of biodiversity, as identified by society, government and industry

Living on an island continent, Australian biota have evolved in isolation, which has given rise to Australia's unique biodiversity. All three lineages of mammals are found on the continent including monotremes (egg-laying), marsupials (pouched) and eutherians (placental) (Woinarski et al., 2015). Monotremes were the earliest diverging mammalian lineage and it is estimated marsupials and eutherians diverged ~150mya. Marsupials have a unique biology, giving birth to extremely under-developed young and having a complex lactation system. Genomic studies of marsupials are limited compared to eutherians. However, given their phylogenetic position and unusual biological features, genomic studies of marsupials have provided important insights into mammalian evolution, disease and development.

Remarkably, it is approximated that 87% of Australian terrestrial mammals are endemic. However, Australia has one of the highest recent rates of mammalian extinction in the world. Since European settlement over 10% of the 273 endemic terrestrial mammals have become extinct, with particularly high losses of marsupial species. A major driver of the decline of Australian mammals is thought to be the introduction of non-native species (Woinarski et al., 2015).

Required skills, knowledge or experience:

Advanced molecular biology OR bioinformatics skills are required

Keywords: Biodiversity, 3D Genomics, HiC, DNA Zoo

Supervisor Contact email: Parwinder.kaur@uwa.edu.au

Project supervised: Face to Face only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Science
School: UWA School of Agriculture and Environment

Main Supervisor : Dr Parwinder Kaur	**Co-supervisor(s) :**
Project title:	Exploration of alternative synthetic production platforms for bio-synthetic pathways using microbial cell factories
Lab/Group: DNA Lab @UWA **Lab/Group Link:** https://www.youtube.com/watch?v=9PniPYb2zsI&t=17s	
Project description: **Project 2** An increasing world population augmented with fast industrialisation has significantly increased global energy consumption per capita. This increasing energy demand is being fulfilled by conventional non- renewable energy sources such as fossil fuels, which have limited untapped reservoirs, and are associated with environmental degradation and health issues. Many studies recently estimated that the demand for energy at its current speed is going to escalate 50% by 2030, demonstrating the urgent need for non-conventional, renewable and sustainable energy resources. Moreover, the demand for pharmaceutical proteins and other high value products is being fulfilled by industrial biotechnology by employing yeast, mammals and insects. Concepts and technologies provided by synthetic biology and biotechnology are inspiring and encouraging researchers to re-imagine bio-based materials.	
Required skills, knowledge or experience: Advanced molecular biology and microbiology skills are required	
Keywords: Microbiology, Synthetic Biology, Cell factories	
Supervisor Contact email: Parwinder.kaur@uwa.edu.au	
Project supervised: Face to Face only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Gia Parish	**Co-supervisor(s) :** A/Prof Adrian Keating / Prof Murray Baker

Project title: A new material for energy conversion; nanoporous gallium

Lab/Group: Advanced Quantum and Sensing Technologies/Microelectronics Research Group
Lab/Group Link: https://www.uwa.edu.au/research/advanced-sensing-and-quantum-technologies

Project description:
Project 1

Hydrogen generation from sunlight is of great interest to address climate change and energy security concerns. Gallium nitride (GaN) is a material that has been commercially applied to light emitting diodes, lasers, and high power transistors, but also has the ideal energy band and chemical stability properties for zero-bias hydrogen generation from solar energy applications and water splitting using sunlight (photoelectrolysis). Fabrication of nanoporous (NP) GaN allows for a tremendous increase in surface-to-volume allowing for much higher energy conversion efficiency of PEC reactions.

This project will assist in the development of a photoelectrochemical (PEC) etching process to fabricate NP-GaN from thin films, for future application to water splitting. The project is multi-faceted and you may work on aspects such as:

- Literature survey of published NP-GaN fabrication methods particularly for water splitting
- Consideration of safety aspects for undertaking PEC of GaN to create NP-GaN
- Adaptation of existing PEC equipment in our lab to fabricate NP-GaN OR building an entirely new PEC setup
- Implementing PEC of GaN to create NP-GaN
- Microscopy and optical measurement techniques to characterise the etched GaN.

Required skills, knowledge or experience:
Students are sought with backgrounds in chemistry, materials science, nanotechnology/nanoscience, electronic engineering, materials engineering, chemical engineering or physics.

Keywords: electrolysis, porous materials, nanotechnology, water splitting, hydrogen generation

Supervisor Contact email: giacinta.parish@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Gia Parish	**Co-supervisor(s) :** Prof Brett Nener / Prof Murray Baker / Dr Matthew Myers (CSIRO)

Project title: Transistor-based chemical sensors for monitoring water contaminants

Lab/Group: Advanced Quantum and Sensing Technologies/Microelectronics Research Group
Lab/Group Link: https://www.uwa.edu.au/research/advanced-sensing-and-quantum-technologies

Project description:
Project 2

Reliable, economically accessible technology for in-situ monitoring of contaminants in water has the power to transform health, industry, and society the world around. Applications of such monitoring range from process control monitoring and optimisation for industry, to water supply quality and wastewater monitoring, to environmental monitoring for resource extraction, and beyond. One example is contamination of environmental water bodies with heavy metal pollutants which are known to be extremely toxic metals and can lead to an irreversible damage to the health of humans and animals. In pursuit of miniaturised, robust, and ultrasensitive sensors, we are developing ion-selective field effective transistors (ISFETs) for various chemical sensing applications. . We have demonstrated various sensors (pH and nitrate, mercury and calcium ions) and are currently investigating different methods to improve the sensitivity by varying the ion-selective functionalisation layer. We are also currently investigating ways to improve reliability by modifying packaging and measurement conditions. Elimination of drift will enable in situ, real-time contaminant monitoring that is accurate, reliable and low-cost.

Places are available for multiple students to work on one or more of the following integrated project components:

1. Physical, chemical, and materials characterisation of functionalisation methods for nitrates and heavy metals
2. Electrical, chemical, and physical characterisation and optimisation of functionalised sensors
3. Mechanical, electrical and chemical characterisation and optimisation of packaging techniques

Required skills, knowledge or experience:
Students are sought with backgrounds in electrical/electronic engineering, materials engineering, chemical engineering, chemistry, physics, materials science or nanotechnology/nanoscience. Prior studies/experience in semiconductor device technology or chemical sensors is desirable though not essential.

Keywords: Sensors, Transistors, Water, Environment, Chemical

Supervisor Contact email: giacinta.parish@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Hui Tong Chua	**Co-supervisor(s) :** Prof Andy Fourie

Project title: Bauxite residue remediation through centrifugation

Lab/Group Link: https://research-repository.uwa.edu.au/en/persons/hui-chua

Project description:

This project is in collaboration with a local company, South32, which has kindly provided confidential data of the bauxite residue from Worsley alumina refinery, and bauxite residue for the experiments. The student will assist with conducting the experiments and analyse the data. The student will also participate in reporting to the company as to the implication to the refinery in terms of remediation of the bauxite residue, which is a huge liability to the industry.
The student is required to sign a deed poll with UWA as he/she will be given access to confidential information.

Required skills, knowledge or experience:
The student should be from Mechanical or Chemical Engineering background and is familiar with using Excel spreadsheet.

Keywords: Mechanical, Chemical, Engineering, Heat and Mass Transfer, Thermodynamics

Supervisor Contact email: huitong.chua@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 6

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Dr Sally Male	**Co-supervisor(s) :**

Project title: Accountability and Record-Keeping in Engineering Practice

Lab/Group: Engineering and Society Education, Society and Work Research Cluster

Project description:

As recent as five years ago, in Australia at least, engineers were commonly expected to keep records of conversations, observations, concepts and calculations in notebooks. These notebooks provided records for numerous purposes from reminders to evidence. With technological changes, practices for record-keeping have changed. This project will explore current practice within a single selected sector and industry, using interviews. The project is part of a larger project considering practice in diverse organizations. A description of current practice will be significant for updating engineering education, and identifying strengths and weaknesses to ensure processes support engineering practice in which society can trust.

Required skills, knowledge or experience:

This project would be suitable for an engineer with an interest in practice and strong written and interpersonal communication skills.

Keywords: engineering, accountability, notebooks, education

Supervisor Contact email: sally.male@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Engineering and Mathematical Sciences
School: Engineering

Main Supervisor : Prof Thomas Braunl	**Co-supervisor(s) :**

Project title: Autonomous Driving

Lab/Group: Renewable Energy Vehicle Project (REV)
Lab/Group Link: http://revproject.com

Project description:
We are working on a new autonomous vehicle, based on an electric shuttle bus. It is equipped with several sensor systems, including GPS, camera, Lidar, IMU (inertial measurement unit) and wheel encoders. The project operates as a student led team with support and mentorship from faculty, PhD students and industry professionals and has a strong history of academic publication.
We are using the latest automotive control hardware with an Nvidia Jetson AGX Xavier system which provides real-time sensor processing and accelerated deep learning capabilities and currently utilise a Robot Operating System (ROS) based software stack with C++ and Python nodes. This project also includes high-reliability embedded systems and a hardware-in-the-loop simulation system for software development.

Required skills, knowledge or experience:
- Good programming experience in C++ or Python is required
- Experience in Robot Operation System (ROS) is desirable

Keywords: Autonomous driving, software design

Supervisor Contact email: tb@ee.uwa.edu.au

Project supervised: Face to Face only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 4

Faculty: Faculty of Engineering and Mathematical Sciences **School:** Physics, Mathematics and Computing	
Main Supervisor : Prof Enrico Valdinoci	**Co-supervisor(s) : Prof Serena Dipierro**
Project title:	Nonlocal Equations
Project description: Understanding the regularity theory of nonlocal equations possibly in nonlinear cases. Detecting original boundary behaviours induced by the mass at infinity. Students will get acquainted with a hot and difficult topic of contemporary mathematical research. Students will enhance skills in mathematical analysis, differential equations and differential geometry. This project could lead to Honours/Master/PhD projects and potential publications.	
Required skills, knowledge or experience: Calculus and Mathematical Analysis	
Keywords: integrodifferential equations, regularity theory	
Supervisor Contact email: enrico.valdinoci@uwa.edu.au	
Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences **School:** Physics, Mathematics and Computing	
Main Supervisor : Prof Enrico Valdinoci	**Co-supervisor(s) :** Prof Serena Dipierro
Project title:	From discrete to continuous equations
Project description: Recover partial differential equations and integrodifferential equations as a limit of discrete models (spin systems, games of life, etc.). Students will analyse the relations and differences between discrete and continuous models and transfer knowledge from one to the other. These type of problems are relevant also in the analysis of population dynamics and atom dislocation in crystals. Students will enhance skills in mathematical analysis, differential equations, mathematical biology and mathematical physics. This project could lead to Honours/Master/PhD projects and potential publications.	
Required skills, knowledge or experience: Calculus and Mathematical Analysis	
Keywords: Discrete and continuous mathematical models	
Supervisor Contact email: enrico.valdinoci@uwa.edu.au	
Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Chunnong Zhao	**Co-supervisor(s) :** Prof. Li Ju / Dr. Xu Chen

Project title:	Optical Springs and Optical Dilution —Beating the Standard Quantum Limit

Lab/Group: Gravitational Wave Detector Instrumentation Group, Physics
Lab/Group Link: http://gravity.uwa.edu.au

Project description:

Gravitational wave instrumentation research in Australia began at UWA, where we pioneered one of the world's first high sensitivity resonant mass gravitational wave detectors. Today our research is focused on the development of advanced techniques to improve the sensitivity of gravitational wave detectors.

Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves. We are part of the ARC centre of Excellence for Gravitational Wave Discovery (OzGrav). Our research areas include precision measurement, quantum optics, high optical power suspended cavities, advanced vibration isolation techniques and control systems. The research is exploring exciting new physics phenomena and techniques that have applications beyond gravitational wave detectors, including quantum measurement technologies and airborne exploration devices.

A specific area of research explores new concepts in amplification and measurement based on the interactions between optical photons and acoustic phonons. Devices based on this frontier of measurement technology require very low loss opto-mechanical systems in which light and sound (or mechanical vibration) interact very strongly without being contaminated by thermal fluctuations. We are testing and inventing many novel opto-mechanical resonators, including nano-scale optical pendulums made from synthetic crystalline mirrors, others made from photonic and phononic crystals, and some made from ultrapure crystals of quartz. With these devices we observe and predict many new phenomena such as optical springs, optical dilution, optomechanically induced transparency, frequency dependent optical squeezing, negative dispersion and white light resonance. The phenomenon of white light resonance (that violates the normal theory of resonance) offers enormous opportunities for improving the sensitivity of gravitational wave detectors, which in turn will allow new astrophysical phenomena to be explored.

This project will involve simulating various mechanical micro-resonators using Finite Element Modelling software (ANSYS or COMSOL), characterising the mechanical and optical properties of the micro-resonators, as well as tuning and testing the opto-mechanical interactions with the resonators inside an optical cavity.

We are a vibrant, friendly and international group. We welcome highly motivated students to join us.

Required skills, knowledge or experience:
Student should have
-Basic knowledge of optics, such as Gaussian beams, optical cavities. Many of the basic concept of the optics could be easily found online.
-Mechanical resonator, frequency domain
-Some skill of comment computer software such as Matlab, and a fast learner to use different computational package.

Keywords: Optical Experimentation and simulation

Supervisor Contact email: li.ju@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Li Ju	**Co-supervisor(s) :** Prof. Chunnong Zhao

Project title: Simulation of Parametric Instability for advanced Gravitational Wave Detectors

Lab/Group: OzGrav Instrumentation
Lab/Group Link: https://www.gravity.uwa.edu.au/ https://www.ozgrav.org/

Project description:

Since the first detection of the gravitational wave in 20-15, there are great effort to make the detectors more sensitive. High laser power inside the detector optical cavities will reduce the shot noise but would have the potential of causing parametric instability. The UWA team has been investigating methods for controlling parametric instability. This project is to use computer simulation tools (such as finite element modelling, cavity analysis and MatLab) to study the effect of parametric instability for the proposed upgrade of the advanced gravitational wave detectors.

Required skills, knowledge or experience:
Skills: be able to use the below software or a fast, confident learner for software operation

- Finite element modelling (Comsol)
- MatLab

General knowledge:

- optical cavity and cavity resonant modes
- normal modes of a mechanical object/system

Keywords: gravitational wave detector techniques, finite element modelling

Supervisor Contact email: li.ju@uwa.edu.au

Project supervised: Online	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor: 8**

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof. Li Ju / Dr John Winterflood	**Co-supervisor(s) :** Prof. Li Ju and Mr Joshua McCann (PhD student)

Project title: Tilt/Rotation Sensor

Lab/Group: Gravitational Wave Detector Instrumentation Group
Lab/Group Link: http://www.gravity.uwa.edu.au
https://www.ozgrav.org/

Project description:
The detection of gravitational waves started a new era of gravitational wave astronomy. It is the fastest growing field of astronomy as we discover more and more sources of gravitational waves across the universe. The improvement of detectors, and development of new detectors is crucial for the field to continue to advance.

We are building a very sensitive tilt/rotation sensor and feedback systems to actively suppress the ground tilts to improve the low frequency performance of gravitational wave detectors. Traditional inertial sensors could not distinguish tilt and horizontal motion. Our tilt/rotation sensor incorporate many innovative design such as cross flexure to enable arbitrary mounting angle, magnetic anti-spring to reduce the resonant frequency and precision optical walk-off interferometric readout system. The student will participate in the characterisation of the instrument (both mechanical system and optical readout system), as well as any upgrade/improvement design.

This project suits both Physics students and Engineering students. We are part of the national ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav). Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves. We are a vibrant, friendly and international group. We welcome highly motivated students to join us.

Required skills, knowledge or experience:
-Basic vibration isolation knowledge
-Some CAD drawing skill would be preferable

Keywords: Precision sensing, vibration isolation

Supervisor Contact email: li.ju@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 8

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof. Li Ju / Dr Joris van Heijningen	**Co-supervisor(s) :** Prof. Li Ju

Project title: Generating error signals for cavity mode matching

Lab/Group: Gravitational Wave Detector Instrumentation Group
Lab/Group Link: http://gravity.uwa.edu.au

Project description:

The theory of General Relativity, published by Albert Einstein in 1915, describes gravity as the curvature of space-time. Einstein realised soon after publishing that his theory produces wave solutions. Gravitational waves (GW) are minute ripples in the curvature of space-time that are produced by violent astrophysical events. They propagate through space at the speed of light like the waves in a pond after a pebble is thrown onto its surface. Because the curvature of space-time and gravity are interconnected, a gravitational wave will change the way freely falling objects fall with respect to each other. We can therefore measure gravitational waves by accurately monitoring the apparent motion of suspended test masses, which is done by using kilometre-scale laser interferometers. After the first detection in September 2015, we are now detecting GW on a weekly basis. The study of gravitational waves has opened up a whole new window on the Universe and we are discovering something new almost on a weekly basis!

Part of the instrumentation section of our group focuses on the high frequency part of improvements to the overall sensitivity curve of the detector collaboration we are a part of: LIGO, two 4-km-arm interferometers in the USA. The strain sensitivity to be reached at design sensitivity of Advanced LIGO nears the 1×10-24 1/√Hz level in the most sensitive frequency range. Minimising any optical losses in a gravitational wave detector is important if advanced techniques, such as squeezing or the white light cavity, are to be fruitful. When input beam waist position and/or size are not matched to those of the cavity, we speak of mode mismatch. Mode mismatch is a source of optical loss and therefore we need error signals to control it to a minimum.

This project combines optical design and experiment towards a novel mode matching control technique, which could be used in GW detectors all around the world in the future. You will simulate the proposed set-up in Finesse, an optical simulation tool used in the GW community. In this simulation you will, for instance, will determine the position and preferred characteristics of all optical components. You will then help build this optical set-up to validate its performance.

Learning goals:
- How GW are measured and why mode matching is necessary;
- Advantages and limitations of the proposed solution;
- Design of optical systems and subsequent simulation of these designs;
- Characterisation of prototype optical systems.

Required skills, knowledge or experience:
General data analysis tools, e.g. Python, Matlab, Mathematica or similar.

Keywords: Gravitational Waves, Optical experiment, Optical simulation

Supervisor Contact email: li.ju@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 8

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Li Ju	**Co-supervisor(s) :** Dr. Carl Blair, Harmid Satari PhD Candidate

Project title: Seismic Imaging Array

Lab/Group: Gravitational Wave Detector Instrumentation Group
Lab/Group Link: http://www.gravity.uwa.edu.au
https://www.ozgrav.org/

Project description:

The detection of gravitational waves started a new era of gravitational wave astronomy. It is the fastest growing field of astronomy as we discover more and more sources of gravitational waves across the universe. The improvement of detectors, and development of new detectors is crucial for the field to continue to advance.

To improve the low frequency sensitivity, it is necessary to study the seismic environment around the detectors. We are building a seismic array network around our Gingin research centre where we have an 80m long suspended high power optical cavity. By correlate array data, we could get information about surface wave direction, speed ect, and would help to create the seismic waves "image". This information could be used either in feedback control of the vibration isolation system for the detectors, or in detector signal data analysis. This project will involve deploy low frequency seismometers, collect and analyse array data.

This project suits both Physics students and Engineering students. We are part of the national ARC Centre of Excellence for Gravitational Wave Discovery (OzGrav). Our team is part of the LIGO Scientific Collaboration (LSC) and contributed some key technologies towards the first detection of the gravitational waves.

We are a vibrant, friendly and international group. We welcome highly motivated students to join us.

Required skills, knowledge or experience:
-Basic vibration isolation knowledge
-Some knowledge on data analysis such as cross correlation, Fourier analysis

Keywords: Seismic motion, Data Analysis

Supervisor Contact email: li.ju@uwa.edu.au

Project supervised: Face to Face Only (85% on campus and a few days at Gingin site)	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 8

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Kenji Bekki	**Co-supervisor(s) :**

Project title:	Deep learning for classifying the synthesized images of galaxies from computer simulations

Project description:

Learning is classifying. Therefore, classifying galaxies can lead us to learn important aspects of galaxy formation and evolution. In this project, students will try to develop a new convolution neural network (CNN) to classify the synthesized images of galaxies produced by high-resolution computer simulations of galaxies. First, students in this project will use a million of synthesized galaxy images to train the CNN for an automated classification of galaxies. Then they will classify the observed images of galaxies from telescopes using the trained CNN in an automatic way. This novel galaxy classification scheme will be able to be used for real scientific research to discover something new (e.g., new discovery of hidden spiral arm structures, massive black holes, and dark matter etc).

Required skills, knowledge or experience:
Programming skills of Python and Keras/Tensorflow (AI libraries) and some basic knowledge / about deep learning are required.

Keywords: Artificial intelligence (AI), astronomy, computer simulations

Supervisor Contact email: kenji.bekki@uwa.edu.au

Project supervised : Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Linqing Wen	**Co-supervisor(s) :**

Project title: Pre-merger detection of gravitational waves

Project description:

The project aims at detecting and localising gravitational waves from the inspiral of two compact objects before their final merger for early warnings of gravitational wave events. The students will help with the implementation and testing of the search methods.

Required skills, knowledge or experience:
Proficient in C or Python programming language

Keywords: gravitational wave, astronomy, detection, data analysis, signal processing, early warning, multi-messenger, simulation

Supervisor Contact email: linqing.wen@uwa.edu.au

Project supervised : Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences **School:** Physics, Mathematics and Computing	
Main Supervisor : Prof Linqing Wen	**Co-supervisor(s) :**
Project title:	Search for Electromagnetic Counterparts of Gravitational Wave Events
Project description: The project aims searching for electromagnetic counterparts of gravitational wave events. The students will conduct searches in available astronomical databases for fast radio bursts (and possibly gamma-ray burst) counterparts of gravitational waves.	
Required skills, knowledge or experience: Astronomy, comfortable with writing C/python/Unix-shell scripts	
Keywords: gravitational wave, astronomy, detection, data analysis, signal processing, early warning, multi-messenger, simulation	
Supervisor Contact email: linqing.wen@uwa.edu.au	
Project supervised : Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences **School:** Physics, Mathematics and Computing		
Main Supervisor : Prof Linqing Wen		**Co-supervisor(s) :**
Project title:	Using Gravitational Wave Events to Probe our Universe	
Project description: The project aims at a feasibility study of using detected GW events to probe our Universe. The students will use available GW database and simulations to measure the spatial distribution of GW sources and then study its implications to our understanding of the matter distribution and geometry of our Universe.		
Required skills, knowledge or experience: Astronomy, comfortable with Bayesian statistics and with writing C/python/Unix-shell scripts		
Keywords: gravitational wave, astronomy, data analysis, signal processing, simulation		
Supervisor Contact email: linqing.wen@uwa.edu.au		
Project supervised: Both online and Face to Face		**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1		**Total number of place(s) available with supervisor:** 1

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Dr Luca Cortese	**Co-supervisor(s) :** A/Prof. Barbara Catinella, Dr. Amelia Fraser-McKelvie

Project title: A panchromatic view of galaxy evolution

Lab/Group: International Centre for Radio Astronomy Research
Lab/Group Link: https://www.icrar.org/
https://corteseluca.wordpress.com/

Project description:

One of the most outstanding challenges in extragalactic astronomy is to identify the astrophysical processes responsible for transforming simple dark matter haloes into the heterogeneous population of galaxies inhabiting today's Universe. How did different morphological types form and evolve? Does the environment where a galaxy lives influence its evolution? Inevitably, the answers to these questions entail a detailed investigation of all the components of the interstellar medium (gas, dust, metals) and their relation to stellar properties, kinematics and environment. This clearly requires multi-frequency information (e.g., including ultraviolet, optical, infrared and radio observations) for statistically significant samples of galaxies across the cosmic web, which are becoming available only now.

Our research group investigates the physical properties of galaxies and their dependence on redshift and environment using large, multi-wavelength datasets. The multi-wavelength approach is at the foundation of our research, as it is the only way to trace all the baryonic constituents of galaxies and to reveal how the Universe formed and evolves.

We offer projects spanning a wide range of topics, and taking advantage of observations obtained with state-of-the-art ground- and space-based facilities. The expectation is that, during this internship, the student will gain the ability of handling and analyzing multi-frequency observations of galaxies, with specific focus on state-of-the-art integral field spectroscopic observations, providing a 3D view of the distribution and kinematics of stars, gas and metals in galaxies (e.g., SAMI, MANGA). S/he may also be involved in the publications of the project results on refereed journals in the field. In particular, the student will have the opportunity to work on on-going projects aimed at understanding the physical processes regulating the star formation activity of galaxies and the interplay between galaxy kinematics and visual morphology.

Required skills, knowledge or experience:
Basic knowledge of observational extragalactic astronomy (e.g., completion of introductory unit to galaxies). Basic experience in handling astronomical observations (e.g., use of ds9/SAOImage and knowledge of FITS format). Basic programming knowledge with Python or R (i.e., ability to produce plots). Basic knowledge of statistical methods and their application to large datasets.

Keywords: Galaxies, Star formation, Telescopes, Big data

Supervisor Contact email: luca.cortese@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Prof Jingbo Wang

Project title: Logic via Quantum Computing

Lab/Group: Quantum information simulation and algorithms Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/quantum-information-simulation-and-algorithms

Project description:

Can quantum computers calculate anything faster than classical computers? A famous result from 1994 shows that theoretically they can factor integers exponentially faster than any known classical algorithm. But that does not prove that classical computers are slower: there might be classical methods as yet unknown which solve this problem.

A new 2018 result from an IBM research lab finds a class of problems and shows that a certain type of quantum algorithm, fixed circuit depth ones, can solve such problems. However, no fixed circuit depth classical algorithm can solve the problems.

See the blog and video at https://www.ibm.com/blogs/research/2018/10/quantum-advantage-2/

One important fixed circuit depth problem is 3-SAT which is a famous NP-complete decision problem. This is the problem of determining whether a Boolean, or classical propositional logic formula (in a certain restricted format) is satisfiable, or could be made true by choice of truth values of its propositional atoms.

This project aims to see if any speed-up can be hoped for in using Quantum Computing on related propositional logic search algorithms.

Required skills, knowledge or experience:
Good linear algebra skills

Keywords: Quantum Computing, Logic, Algorithms, Complexity

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: Road Puddle and Splash Identification in Video

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:

Implement image processing algorithms for the automatic detection of hazardous and nuisance amounts of water splashing on to a major Perth road from a fixed traffic camera video.

There is an area of one of the busy main Perth freeways that is along a river and is susceptible to getting river water splashed on to it from waves and wind. This causes issues for motorists and could be hazardous. There is a fixed video traffic camera trained on this location providing a constant stream of image frames.

This project will use current UWA CSSE video processing techniques and machine learning identification algorithms to attempt to automate the detection of when splash situations are occurring in real-time. There is separate data from on road water detectors which can be used to judge the effectiveness of the detection.

The team works closely with Main Roads WA on traffic image processing and this project fits in as part of that work.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Image Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: Bat Call Identification via Machine Learning

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:

Bats are useful indicator species in ecological surveys. Typically a device will record ultrasonic echolocation calls in the field and the subsequent data will be analysed to identify the bat species present. This is a laborious process that is amenable to machine learning. One such proprietary system has been used successfully to classify several years of calls in the South Coast region of WA.

However, some bat species, especially of the genus nyctophilus, are not amenable to the zero crossing techniques commonly used. McKenzie and Bullen (2003, 2009, 2012) have shown that the sharpness quotient, Q, of the fundamental harmonic and the characteristic frequency of the bat call cluster rather distinctly between different species of bats including nyctophilus.

The aim of this project is to examine whether similar techniques might be used for machine learning of call identification for the bats of the South Coast region.

You would be provided with full spectrum recordings covering several years in WAC/WAV files plus zero crossing analysis data and probable bat identification.

There would be a requirement to complete a Bush Heritage Australia research project form which details IP and the like.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Signal Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisors: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Mark Reynolds	**Co-supervisor(s) :** Dr Du Huynh

Project title: Bee Identification and Tracking in Video

Lab/Group: Systems for Knowledge Discovery from Data, Research Cluster
Lab/Group Link: https://www.uwa.edu.au/research/systems-for-knowledge-discovery-from-data

Project description:

Understanding bee behaviour is important for ecological and economic reasons. In the Australian Government funded Cooperative Research Centre (CRC) for Honey Bee Products, researchers record videos of bee activities near flowers in the Australian bush.

Currently useful information such as bee species identification, bee numbers and bee movement between flowers is extracted from the recording by human observers.

This project will use current UWA CSSE video processing tracking techniques and machine learning identification algorithms to attempt to automate most of the information extraction. Related work will explore the geographical spatial distribution of bee activities in the areas under study.

The student will work closely with CRC scientists.

Required skills, knowledge or experience:
Good Python programming knowledge

Keywords: Machine Learning, Image Processing, Data Science

Supervisor Contact email: mark.reynolds@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 4	**Total number of place(s) available with supervisor:** 5

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Michael Small	**Co-supervisor(s) :** Dr Correa, Dr. Zaitouny

Project title: Machine learning and predictive maintenance

Lab/Group: Complex Systems, ARC Training Centre of Transforming Maintenance through Data Science.
CSIRO

Project description:
Project 1:

This proposal can accommodate multiple students

Machine learning and dynamical systems techniques will be applied to study and augment predictions of failure of machinery. Specifically, predictive maintenance is the schedule of maintenance tasks based on predictions of imminent or likely failure. Machine learning based on historical data will be applied to augment this. Dynamical systems techniques based on the ideas of tipping points will be used to quantify likely onset of failure.

Required skills, knowledge or experience:
Advanced mathematics (dynamical systems, complex systems, topology, would all be advantageous), scientific programming (at least one of Julia, python, Matlab, Mathematica or R).

Keywords: Complex Systems, Dynamical Systems, Chaos, Topology

Supervisor Contact email: michael.small@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4(2 for this project)

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Michael Small	**Co-supervisor(s) :** Dr Walker

Project title: Persistent homology of complex networks

Lab/Group: Complex Systems

Project description:
Project 2:

This proposal can accommodate multiple students

Techniques exist to represent dynamical systems observed through time series data as complex networks. These networks have a complicated variegated structure which encodes specific features of the underlying deterministic dynamics. The aim of the project is to apply techniques from computational topology to quantify these features and thereby link that quantification to the original (and interesting) dynamics. For example, chaotic dynamics generates particular structures in the network and persistent homology is to be employed to characterise the scale-dependent features of those structures. This will link quantities such as Lyapunov exponents and entropy to the rate of growth of topological properties.

Required skills, knowledge or experience:

Advanced mathematics (dynamical systems, complex systems, topology, would all be advantageous), scientific programming (at least one of Julia, python, Matlab, Mathematica or R).

Keywords: Machine Learning, Dynamical Systems, Predictive Maintenance

Supervisor Contact email: michael.small@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4(2 for this project)

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Michael Tobar	**Co-supervisor(s) :**

Project title: Investigation of 3D printed and taped superconducting resonators

Lab/Group: Centre of Excellence for Engineered Quantum Systems
Lab/Group Link: https://equs.org/fml

Project description:
Project 1

The aim of this project is to advance the new discipline of 3D Printed superconducting technologies. Currently, the application of advanced superconductors is being hampered by our inability to produce complex geometries from materials with adequate superconducting properties. The intended outcome of this project is the ability to design the next generation of superconductors, along with the knowledge of how to produce them using metal 3D Printing. The ability to manufacture geometric complex, bulk superconducting structures with tuneable magnetic characteristics will lead to significant advances in many practical applications including dark matter detection and quantum computing. In particular this project will test various resonant structures, at 4K and mK and test the response to external magnetic fields. There is also the possibility we will implementing resonators with surfaces made from superconducting tape.

Required skills, knowledge or experience:
Physics or Electrical Engineering Major

Keywords: Superconductors, 3D printing, Low temperature physics

Supervisor Contact email: michael.tobar@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Michael Tobar	**Co-supervisor(s) :**

Project title: Search for Axion Dark Matter

Lab/Group: Centre of Excellence for Dark Matter
Lab/Group Link: https://www.darkmatter.org.au/ and https://equs.org/fml

Project description:
Project 2

This project will assist the research group in the quest to search for axion dark matter. The axion is a particle that is believed to exist to solve the strong CP problem on why the neutron has no dipole moment even though it is made of charged quarks. The axion should also be produced in the early universe, and because it interacts very weakly with matter, the particle is a leading candidate to explain cold dark matter. To try and detect the axion we use the weak coupling to photons and novel microwave resonators and electronics at low temperatures to enhance the signal. This project will involve contributing to developing these devices under the umbrella of the ORGAN experiment which will search for cold dark matter in a range predicted by theorists.

Required skills, knowledge or experience:
Physics and Electrodynamics

Keywords: Axion, Dark Matter, Precision Measurements, Low Temperature Physics

Supervisor Contact email: michael.tobar@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Michael Tobar	**Co-supervisor(s) :**

Project title: Cryogenic Crystal for the Detection of WIMP Dark Matter

Lab/Group: Centre of Excellence for Engineered Quantum Systems
Lab/Group Link: https://equs.org/fml; https://www.darkmatter.org.au/

Project description:
Project 3

Weakly interacting massive particles (WIMPs) are hypothetical particles that are thought to constitute dark matter. Broadly, a WIMP is a new elementary particle which interacts via gravity and any other force (or forces), potentially not part of the standard model itself, which is as weak as or weaker than the weak nuclear force, but also non-vanishing in its strength. A WIMP must also have been produced thermally in the early Universe, similarly to the particles of the standard model according to Big Bang cosmology, and usually will constitute cold dark matter. Typically experiments to detect WIMP dark matter are at energy/mass scales of 100 GeV, however due to the lack of success in detection experiments are expanding towards techniques to search for lower energy particles. This project will focus on new methods to implement crystal detection technology.

Cryogenic crystal detector techniques are currently used by a range of experiments, including the Cryogenic Dark Matter Search (CDMS) detector at the Soudan Mine. This detector relies on multiple very cold germanium and silicon crystals. The crystals (each about the size of a hockey puck) are cooled to about 50 mK. A layer of metal (aluminium and tungsten) at the surfaces is used to detect a WIMP passing through the crystal. This design hopes to detect vibrations in the crystal matrix generated by an atom being "kicked" by a WIMP. The tungsten transition edge sensors (TES) are held at the critical temperature so they are in the superconducting state. Large crystal vibrations will generate heat in the metal and are detectable because of a change in resistance. CRESST, CoGeNT, and EDELWEISS run similar setups but with a range of different crystals.

This project will cool such detector crystals to low temperatures, to study the electromagnetic properties at microwave frequencies from room temperature to low temperatures. It is envisaged by measuring the properties of the crystal that heating and phonon effects may be measured more accurately than before, allowing a breakthrough in improved sensitivity. At low temperatures a range of very interesting condensed matter physics also occurs. The project will include the investigation of this physics.

Required skills, knowledge or experience:
Physics or Electrical Engineering Major

Keywords: WIMPs, Crystal resonators, Low Temperature Physics, Dark Matter

Supervisor Contact email: michael.tobar@uwa.edu.au

Project supervised: Face to Face Only	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 3	**Total number of place(s) available with supervisor:** 3

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Serena Dipierro	**Co-supervisor(s) :** Prof Enrico Valdinoci

Project title: Isolated singularities for (non)local minimal surfaces

Project description:

Understanding under which conditions (non)local minimal surfaces can be smoothly extended beyond possible singularities.

Classical works have been done in E. De Giorgi, G. Stampacchia [Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Nat. 38 (1965), 352–357] and, for the planar case, in J. Nitsche [Bull. Amer. Math. Soc. 71 (1965), 195-270].

Understanding the formation of singularity in geometric objects is one of the most challenging topics in mathematics and the project will aim at discovering new features also related to the nonlocal character of the minimisers of the fractional perimeter.

Students will enhance skills in mathematical analysis, differential equations and differential geometry. This project could lead to Honours/Master/PhD projects and potential publications.

Required skills, knowledge or experience:
Calculus and Mathematical Analysis

Keywords: (non)local minimal surfaces, regularity theory

Supervisor Contact email: serena.dipierro@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Prof Serena Dipierro	**Co-supervisor(s) :** Prof Enrico Valdinoci

Project title: Biological models in environments with climate change

Project description:

Understanding the dynamics of biological populations when the corresponding environmental niche is changing with time. Finding sufficient conditions for the survival of the population and determine precise asymptotic regimes.

The problem is motivated by concrete applications related to climate change and conservation biology.

Students will enhance skills in mathematical analysis, differential equations, mathematical physics and mathematical biology. This project could lead to Honours/Master/PhD projects and potential publications.

Required skills, knowledge or experience:

Calculus and Mathematical Analysis

Keywords: Mathematical biology, population dynamics

Supervisor Contact email: serena.dipierro@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Physics, Mathematics and Computing

Main Supervisor : Dr. Zijun C. Zhao	**Co-supervisor(s) :** Prof. Michael E. Tobar

Project title: Low temperature electromagnetic characterization of crystals and defects

Lab/Group: The Quantum Technologies and Dark Matter Lab

Project description:

Students will help analyse data used to characterise resonance systems based on novel crystals and their defects. This includes but is not limited to pre-obtained temperature dependent transmission data, along with the development and improvement of algorithms (possibly via machine learning) to auto fit Fano resonance and find the temperature dependent quality factor for characterising properties of crystals. The student also will get a chance to model the novel cavity in COMSOL and measure the cavity experimentally depending on the progress of the project.

Students will enhance skills in Python programming for data analysis and instrument control, Finite element simulation in COMSOL, microwave measurements in room temperature and cryogenic temperature. This project could lead to Honours/Master/PhD projects and potential publications.

Required skills, knowledge or experience:
Students major in physics, engineering, or math with strong programming skills and persistent interest in science

Keywords: low-temperature measurement, finite element simulation, microwave properties, machine learning

Supervisor Contact email: cindy.zhao@uwa.edu.au, *michael.tobar@uwa.edu.au*

Project supervised: Both online and Face to Face (preferred)	**Length of project:** 8 weeks
Total number of project(s) offered by supervisor: 1	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences
School: Oceans Graduate School

Main Supervisor : Dr Arnold van Rooijen	**Co-supervisor(s) :** Prof Ryan Lowe, Mario Conde-Frias

Project title: Wave and current dynamics in submerged vegetation canopies

Lab/Group: Coastal and Offshore Engineering Laboratory
Lab/Group Link: https://www.uwa.edu.au/ems/centres/coel

Project description:

It is well known that marine ecosystems (e.g., seagrass meadows, mangrove forests etc.) can cause substantial dissipation of energy of waves travelling towards the coast, and slow down currents driven by wind, tide and river flows. However, some of the detailed physical processes around the interaction between waves and vegetation canopies are relatively poorly understood and will be investigated in this project.

Project 1 (experimental, back-up: numerical)
Many marine ecosystems are situated in areas with not only wave influences but also currents (e.g. generated by the tide or river flow). Researchers have found that an underlying current can have great effects on how much wave energy is dissipated, but measurements have been very scarce. Therefore, this project aims to collect measurements of wave heights across a submerged canopy with and without an underlying current. The student will have a leading role in an experiment in the recently established Coastal and Offshore Engineering Lab. It is envisioned this project will be mainly carried out in the laboratory, but if physical experimentation is not feasible (e.g., due to the student being overseas), the work will be carried out using a detailed numerical model (SWASH).

Project 2 (numerical)
The presence of a vegetation canopy has a great influence on the transport of sediment (e.g. sand). One of the reasons is that the flow dynamics near the bottom are expected to change. In this project, the student will use a detailed numerical model (SWASH) to study the flow in the area close to the bottom (boundary layer) and how this changes for different vegetation canopies. It is expected that the results will provide important insights into how sediment may be eroded, deposited and transported within marine ecosystems.

Required skills, knowledge or experience:

- Basic programming skills (e.g., MATLAB, Python)
- Background in wave dynamics / coastal engineering (preferred)
- Experience with numerical modelling (preferred if using SWASH)

Keywords: Coastal engineering, nature-based solutions, waves, numerical modelling

Supervisor Contact email: arnold.vanrooijen@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 2

Faculty: Faculty of Engineering and Mathematical Sciences **School:** Oceans Graduate School	
Main Supervisor : Prof C Pattiaratchi	**Co-supervisor(s) :**
Project title:	Ocean drifter data analysis
Lab/Group: Coastal Oceanography **Lab/Group Link:** https://www.web.uwa.edu.au/coastal-oceanography	
Project description: The Coastal Oceanography have been deployed surface current drifters along the West Australian coast over the past 12 months more than 50 drifters have been deployed. Ocean drifters have a GPS locator that transmits their location every 5 minutes and from this information, we can track the paths of the drifters and calculate velocities. Surface drift patterns are used to define ocean circulation at the surface and used to define pathways of buoyant material such as plastics. The student(s) will be able to use selected ocean drifter data to identify and document different flow features in the surface ocean such as eddies and fronts.	
Required skills, knowledge or experience: Experience with programming languages such as MATLAB or Python is essential.	
Keywords: ocean drifters, surface currents, eddies, dispersion	
Supervisor Contact email: chari.pattiaratchi@uwa.edu.au	
Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4 **(** 2 for this project)

Faculty: Faculty of Engineering and Mathematical Sciences
School: Oceans Graduate School

Main Supervisor : Prof C Pattiaratchi	**Co-supervisor(s) :** Dr Paul Thomson, Dr Mun Woo

Project title: Ocean glider data analysis

Lab/Group: Coastal Oceanography
Lab/Group Link: https://www.web.uwa.edu.au/coastal-oceanography

Project description:

Ocean gliders are autonomous underwater vehicles that propel themselves with changes in buoyancy, ascending and descending through the water column. The gliders are relatively cheap, reusable and can be remotely controlled, making them a relatively cost-effective method for collecting repeat subsurface ocean observations. They also allow for the acquisition of data under inclement weather conditions. Equipped with a variety of sensors, the gliders are designed to deliver ocean profile data. Furthermore, the unique design of the gliders enables them to move horizontally through the water while collecting vertical profiles. We are closely approaching the 300th mission and there are data extending over a decade for analysis of coastal ocean processes.

Required skills, knowledge or experience:
Experience with programming languages such as MATLAB or Python is essential.

Keywords: ocean gliders, temperature, chlorophyll, underwater light

Supervisor Contact email: chari.pattiaratchi@uwa.edu.au

Project supervised: Both online and Face to Face	**Length of project:** Standard 8 weeks
Total number of project(s) offered by supervisor: 2	**Total number of place(s) available with supervisor:** 4 (2 for this project)

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Global Engagement Office (GEO)

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