# Candidate information

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| **SURNAME,** Name | Tallack, Sarah |
| **PeopleSoft Employment ID** | 1687759 |
| **Student number** | TLLSAR002 |
| **ORCID number** | 0000-0002-1725-8353 |
| **Degree programme** | MSc(Eng) Electrical Engineering by Dissertation (180 credit) |
| **First year of registration** | 2023 |
| **Intended submission date** | 2025 |
| **Supervisor** | Robyn **Verrinder** Department of Electrical Engineering,  University of Cape Town |
| **Co-supervisor 1** |  |
| **Co-supervisor 2** |  |
| **Co-supervisor 3** |  |

# Project details

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| * Please complete this document and upload it to the PeopleSoft MoU/PPA Attachment section under Thesis Information * Once you have completed your detailed research proposal please attach this. |

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| **Provisional project title** | Photo-synthetically available radiance (PAR) measurement in Antarctic Marginal Ice Zone (MIZ) |  |
| **Project aim** | **Develop a low-cost reliable solution for the measurement of PAR through sea-ice in the Antarctic MIZ** |  |
| **Project abstract**  **(~200 words)**  (May use a graphical abstract format if appropriate) | The distribution of sea ice in the Marginal Ice Zone (MIZ) in the Southern Ocean (SO) has a significant effect on global climate patterns, but our understanding of this unique region suffers from a lack of Antarctic seasonal in situ measurement data, especially over the winter season (Kennicutt II et al., 2019; Parkinson, 2004). Sea ice acts as a physical and reflective boundary between the atmosphere and ocean, which influences heat transfer to the ocean and energy budget available to phyto-plankton below the ice. There has been limited measurement of solar radiative transfer through sea ice in different seasons in the polar regions (Katlein et al., 2020), with virtually no in situ measurements in the Antarctic. Recent studies by Hague and Vichi (2020) show phytoplankton growth under sea ice during late winter which indicates that there is radiative transfer through the sea ice even in seasons of highest ice cover. Photo-synthetically Active Radiation (PAR) sensors are traditionally very expensive, making these measurements difficult. Robust and affordable radiative sensors would improve our ability to quantify radiative transfer through sea ice. Katlein et al. (2020) developed a radiative sensor chain based on off-the-shelf photo diode sensors for the Arctic region and the goal of this project is to extend this work for an Antarctic implementation. |  |
| **Significance statement** **(~200 words)**  Explain the purpose of your research to a non-expert | Studies have found that phytoplankton growth is occurring during late winter, which indicates that more solar radiation is transferring through the sea-ice in the MIZ than previously thought. There is a lack of year-round in-situ measurements in the Antarctic region. Conditions in the Antarctic have an impact on the global system, therefore it is important to gather data in this region. The sensors available for the measurement of photosynthetic active radiation (PAR)– the part of light that allows photosynthesis to occur – are generally expensive. However, there has been research in measuring PAR using off-the-shelf components. The development of a low-cost PAR measurement system would allow the measurement of the radiative transfer of light through sea ice in various locations in the MIZ. |  |

## Logistics

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| **Equipment requirements** |
| * To be arranged when needed and funded by project if included and agreed to in the research proposal. |
| **Laboratory requirements** |
| * Formal experiments will be outlined in the research proposal. * Desk space is available to the student in the ARU and MARIS hub. * Prototyping facilities are available in the workshop space in the Mechatronics Lab for building/hardware work. |
| **Fieldwork requirements** |
| * To be arranged when needed and funded by project, if included and agreed to in the research proposal |
| **Facilitation** |
| * Facilitate communication with external parties to gather data or other resources required for successful implementation of the project. |

## Proposed timeline

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| **Please outline your proposed timeline for the project** (you may attach a Gannt chart) |
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| **Agreed broad timeline** |
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# Student’s progress (if not first-time registration

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| **Progress to date and key results**  (Include figures where appropriate) |
| - Sensor selection: found two multi-channel spectral sensors. These were ordered to JLCPCB and I designed a PCB for each sensor.    - Sensor chain consideration: since the sensors found use I2C communication, I found an I2C multiplexer. This allows up to 8 devices with the same address to be connected to one device. I designed a PCB for this chip as well.    - Consolidated all code for various aspects of the project. Previously this code had been on two separate microcontrollers, however it now runs on one microcontroller and allows control via UART.  - Designed a simple python GUI to send commands via UART.  - Began design on a more robust testing rig, to characterise the sensors.  - Began research and considerations for waterproofing methods for the sensor chain. |
| **Student’s evaluation of progress to date** |
| The main components for the sensor chain design have been chosen. The chosen sensor has been characterised, although more tests may still be necessary.  Although I could not get the one sensor working, it was still a valuable design experience. |
| **Agreed plan** |
| * The main tasks to be completed are as follows:   + PCB design for sensor chain   + Sensor chain testing and further characterisation   + Waterproof testing and characterisation   + MARiS Polar Lab testing |

## Outputs

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| **Publications** (peer-reviewed journal or conference proceedings, include DOI) |
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| **Posters/presentations** |
| -Annual presentation to ARU and MARiS groups |
| **Field trips or research visits** |
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| **Datasets generated and how are they stored** (include link to GitHub repository) |
| https://github.com/SarahTallack/PAR-Measurement |
| **Other not listed above** |
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## Achievements/highlights

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| **Use this space to note any additional achievements/highlights not listed above** (optional) |
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## Obstacles

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| **Use this space to note any obstacles to your research this year** (optional) |
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## Supervisor’s comments on the proposal/progress and plans

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| **Supervisor’s comments on proposal/progress** |
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| **Supervisor’s comments on proposed timeline for the year** |
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# Student’s expectations and commitments

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| * The student must set out in detail what they expect of the supervisors, department, faculty and university in terms of reaching certain milestones or goals during the research for the degree. |

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| **Student’s expectations of the supervisor for the project** | **Student’s expectations of the supervisor for the project** |
| * Regular meetings to report progress and get feedback/assistance. * Assistance with ensuring the project is being taken in the right direction. * Guidance should there be any large roadblocks to the progress of the project.   Feedback on written drafts of final thesis. |  |
| **Student’s expectations of the Department, Faculty and University** | **Student’s expectations of the Department, Faculty and University** |
| * Access to a workspace on campus. Additionally, access to lab equipment for testing and developing electronics.   Access to ordering and manufacturing facilities for project related items. |  |
| **Student’s employment and teaching commitments** | **Student’s employment and teaching commitments** |
| * Work no more than 20 hours a week, as per the NRF guidelines. |  |
| **Student’s leave arrangements** | **Student’s leave arrangements** |
| Up to one month leave, likely at the end of the year or beginning or during the mid-semester vacation. |  |

# Supervisor’s expectations and commitments

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| * The supervisor must set out what they expect of the student in terms of reaching certain milestones or goals during the research for the degree. |

## Supervisor’s expectations

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| **Supervisor’s expectations of the student for the project** |
| * Prepare a research proposal at the start of the project outlining the problem statement/research questions, background, aims and objectives and timeline. * Keep a lab notebook detailing day-to-day work (this may be electronic) * Keep up to date with the relevant literature associated with the project. * Ensure all data/simulations/hardware produced are in a suitable format for further use in the research group. * Ensure all data/simulations/hardware are catalogued and backed up in an appropriate format. * Detailed documentation for handover of the project of all the above * Good coding practice, with migration of code base to ARU/MARIS GitHub repository at end of project. * Attend weekly individual meetings with supervisor(s) to discuss project, progress, roadblocks etc. * Attend research group meetings (UCT African Robotics Unit and MARIS) * Present a Research Proposal seminar to the research group at the start of the project (~ 1 month in) * Present a Work in Progress seminar to the research group bi-annually based on a published lab schedule. * Be prepared to present work to Funder’s (if or where applicable) * Prepare and write an annual progress report for the project and funders. * Ensure that all project members are up to date with the project status and progress. * Submit drafts timeously so that the supervisor(s) can give feedback in time. * Where applicable, write up their work as a conference paper/journal paper for publication |
| **Supervisor’s additional expectations of the student** |
| * Ensure that their workspace, laboratory, and shared facilities are kept in a clean, tidy and orderly state. This includes participating in quarterly lab clean-ups. * Comply with all laboratory policies and standard operating procedures as detailed on the lab wiki. * Comply with all access control and security requirements of the laboratory. * Ensure that all equipment used off site is booked out and looked after. * Comply with all Health and Safety requirements when conducting research/work at UCT, remotely or in the field. * Comply with the Ethics in Research as outlined by the EBE faculty and the University of Cape Town. Ethics approval must be obtained before the start of any experimental work or data collection. * Where possible apply for a Teaching Assistant or tutor position in the Department (for at least one semester during the degree). * Volunteer to assist at the annual UCT Open day (usually held in April). |
| **Skills/courses/classes that the student is expected to learn or take** |
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| **Student’s presence on campus** |
| * Work hours: ~40 hours per week * Flexible work arrangements possible with at least 2 days per week required at the university. * Remote communication will take place on MS Teams and student’s must be available during overlapping hours of 10h00 to 15h00 Monday to Friday * Annual leave of 1 month per year (excluding public holidays, conference, or research travel) * Let the supervisor know if they are to be away for periods of time greater than 3 days (this includes annual leave, illness, family responsibility, field work etc.) |

## Supervisor’s commitments

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| **Supervisor’s commitments to the student and project** |
| * Advise on the nature and standard of work expected by the candidate at postgraduate level. * Advise on work planning and scheduling for the completion of successive work stages. * Provide technical and scientific advice on the project. * Read through the final dissertation draft before submission, provide constructive and timeous feedback. * Contribute to and read through any conference/journal papers produced during this work. |
| **Supervisor’s leave arrangements for the year** |
| * R.A. Verrinder will be on Sabbatical leave from 1 February to 30 June 2025, but will still be available for regular in person supervisory activities * R.A. Verrinder has 26 days of annual leave per year. This is typically taken during late December/early January and in September. * The supervisor will notify the student in advance if they are away for periods of more than 3 days. (this includes annual leave, conference travel, illness, family responsibility, field work etc.) * Remote communication will take place on MS Teams during overlapping hours of 10h00 to 15h00 Monday to Friday |
| **Supervisor’s role** |
| Primary academic point of contact for the work. |
| **Co-supervisor 1’s role** |
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| **Co-supervisor 2’s role** |
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| **Co-supervisor 3’s role** |
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## Funding arrangements

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| **Project and research cost arrangements** |
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| **Bursary funding arrangements** |
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## Third-party data

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| **Are third-party data used in this project?** |  |
| **If yes, note the agreements between the party and the University** |  |

## Publications

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| **Authorship** |
| Only those significantly contributing to the research will be identified as potential authors. This includes idea conceptualisation, experimental design, data collection and analysis. The person(s) making the largest contribution will be given the choice to be first author(s). If they decline, the supervisor(s) have the option to consolidate the work and write the manuscript. |

# Data Management

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| Please compile a data management plan for your project using the UCT library tools found here <https://dmp.lib.uct.ac.za/> and attach your plan here. This must link into the larger project data management plan. |

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# Ethical Clearance

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| * Upload proof of ethical clearance, if available. |

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| **Have you submitted an ethics application?** |  |
| **Have you received ethics approval?** |  |
| **Ethics reference number** |  |