# Section A: Overview of the Research Project Proposal

**1. Title of research project:** Radio astronomy integrated filter and antenna for RFI mitigation

**2. Broad area of research:** Engineering

**3. Academic Level of research project:** M.Eng

**4. Primary supervisor's details:**


a. Full name: Dr Leanne Bodenstein

b. Email address: ljohnson@sun.ac.za

c. University: Stellenbosch University


**5. Co-supervisor's details:**


a. Full name: Dr Jacki Gilmore

b. Email address: jackivdm@sun.ac.za

c. University: Stellenbosch University


**6. Research project abstract/summary**:


Radio Frequency Interference (RFI) is a key limiting factor in the performance of modern radio telescopes supported and hosted by SARAO. Strong out-of-band and in-band interferers can drive analogue receiver components into non-linear operation, degrading sensitivity and scientific data quality. While digital mitigation techniques are effective post-detection, front-end analogue filtering remains essential for protecting low-noise amplifiers and improving overall system robustness.

This Masters project aims to design, simulate, manufacture, and experimentally validate a low-loss integrated filter and antenna suitable for integration into a radio astronomy receiver front end prior to the first amplification stage. The focus will be on achieving high selectivity and minimal noise impact while remaining compatible with the bandwidth and sensitivity requirements of SARAO-supported instruments. The project will deliver a validated integrated filter and antenna design and a quantified assessment of its impact on receiver performance.

# Section B: Details of Research Project

**1. Scientific/engineering merit: describe the objectives of the research project, placing them in the context of the current key questions and understanding of the field. Link the proposed project to one or more of the SARAO research priority areas for 2027 (refer to section 4), and explain in some detail how the proposed research will contribute to the priority area(s).**

Radio Frequency Interference (RFI) remains a significant challenge at the SKA Karoo site, where both in-band and out-of-band interferers reduce the effective signal-to-interference ratio of highly sensitive radio astronomy receivers. As receiver bandwidths increase and systems operate closer to their theoretical noise limits, strong interfering signals entering the analogue front end can cause saturation, reduced dynamic range, and degradation of scientific data quality. While digital signal processing provides effective post-detection mitigation, analogue-domain RFI suppression remains essential to protect receiver front ends and ensure robust telescope operation.

The primary objective of this Master's research project is to design, simulate, manufacture, and experimentally validate an integrated filtering antenna capable of suppressing dominant RFI components prior to the first amplification stage. By incorporating a band-pass filtering function directly into the antenna structure, the project aims to reduce the impact of strong out-of-band interferers, lower the risk of low-noise amplifier saturation, and improve overall system linearity. Integrated filtering antennas further provide a compact and space-efficient solution that can simplify receiver front-end integration.

A key engineering challenge addressed in this project is achieving effective RFI suppression while maintaining the low insertion loss required for radio astronomy applications. Low-loss filtering solutions will therefore be investigated to minimise the impact on system noise figure. Suitable integrated filter–antenna configurations will be evaluated in terms of bandwidth, selectivity, gain, and noise-related performance.

The minor contribution of this project is a structured review and comparative assessment of existing integrated receiver and filtering antenna topologies, with emphasis on figures of merit such as operational bandwidth and system noise temperature. The major contribution will be the development and experimental validation of an integrated filtering antenna structure suitable for radio astronomy receiver front ends. Where appropriate, emerging manufacturing approaches for highly integrated RF structures may be explored to assess their suitability for radio astronomy instrumentation.

This research aligns directly with the following SARAO research priority areas for 2027:

- Antenna, receiver, (analogue and digital) signal processing, data analysis and data recording systems associated with radio telescopes and geodesy instruments supported and hosted by SARAO.
- Hardware and data analysis systems for detecting, monitoring and locating sources of Radio Frequency Interference (RFI).

**2. Feasibility: outline the methods that will be used to achieve the objectives.**

The proposed research project is technically feasible within the scope and time frame of a Master's degree and will be carried out using established RF and microwave engineering methodologies supported by existing facilities and expertise at Stellenbosch University. The project will be executed through the following stages:

1. **Literature Review and Problem Definition**
   A focused literature review will be conducted to establish current approaches to integrated filtering antennas and analogue RFI mitigation in radio astronomy receivers. Particular attention will be given to performance requirements relevant to SARAO-supported instruments, including bandwidth, selectivity, insertion loss, and noise-related considerations. This review will be used to define realistic design targets and constraints for the proposed filtering antenna.

2. **Concept Selection and Filter–Antenna Synthesis**
   Suitable filter and antenna topologies will be identified based on the literature review and system requirements. The student will perform analytical synthesis and preliminary design calculations to select an appropriate integrated filter–antenna configuration that balances RFI suppression with low loss and practical manufacturability.

3. **Electromagnetic Simulation and Design Optimisation**
   The selected design will be modelled and analysed using full-wave electromagnetic simulation tools such as Altair FEKO, CST Microwave Studio, and Ansys HFSS. Key performance metrics, including return loss, insertion loss, gain, bandwidth, and selectivity, will be evaluated. Design parameters will be iteratively optimised to meet the defined performance objectives while considering fabrication tolerances.

4. **Prototype Fabrication**
   Based on the optimised design, a prototype integrated filtering antenna will be manufactured using available in-house or partner fabrication facilities. Where appropriate, different manufacturing approaches may be evaluated to assess their suitability for highly integrated RF structures.

5. **Experimental Measurement and Validation**
   The fabricated prototype will be experimentally characterised using available RF measurement equipment, including vector network analysers and antenna measurement facilities. Measured results will be compared against simulated performance to validate the design and identify any discrepancies.

6. **Analysis and Documentation**
   The final stage will involve detailed analysis of the simulation and measurement results, evaluation of the effectiveness of the proposed RFI mitigation approach, and documentation of the work in a Master's dissertation.

The use of well-established design tools, accessible fabrication techniques, and existing RF measurement infrastructure ensures that the project objectives can be realistically achieved within the allocated time and resources.

**3. Skills development: Describe the skills the student will develop from the research project.**

Through the completion of this research project, the student will develop a range of technical and research skills that are critical to radio astronomy and geodesy instrumentation.

Technical and Engineering Skills

- RF and microwave filter design, including band-pass filter synthesis and performance evaluation.
- Antenna engineering principles and the integration of filtering functions into antenna structures.
- Full-wave electromagnetic simulation using commercial tools such as CST Microwave Studio, Altair FEKO, and Ansys HFSS.
- RF front-end performance analysis, including assessment of insertion loss, bandwidth, selectivity, and noise-related impacts.
- Practical RF measurement techniques using vector network analysers and antenna measurement facilities.
- Interpretation and comparison of simulated and measured RF performance data.

Research and Analytical Skills

- Critical review and synthesis of technical literature relevant to radio astronomy receiver systems and RFI mitigation.
- Problem formulation and translation of system-level radio astronomy requirements into engineering design constraints.
- Engineering trade-off analysis between performance, complexity, and manufacturability.
- Data analysis and technical reporting of experimental results.

Professional and Transferable Skills

- Independent engineering design and analysis within a structured research framework.
- Technical writing and preparation of a Master's dissertation.
- Oral presentation of technical work to academic and engineering audiences.
- Project planning and time management within a defined research timeline.

The skills developed through this project are directly applicable to the design, development, and operation of radio telescope instrumentation and align with SARAO's objectives for developing engineering capacity in radio astronomy.

**4. Provide details (and confirmation) on the availability of required data / access to required equipment / availability of research facilities and other resources required.**

The proposed research project is technically feasible within the scope and time frame of a Master's degree and will be undertaken using established RF and microwave engineering methodologies supported by existing infrastructure at Stellenbosch University.

The integrated filtering antenna will be designed using commercial electromagnetic simulation software, including CST Microwave Studio, Altair FEKO, and AWR Microwave Office. These tools will be used for full-wave electromagnetic analysis, circuit-level co-simulation, and performance optimisation of the proposed filter–antenna structure. Design targets will be defined based on radio astronomy receiver requirements, with particular emphasis on insertion loss, selectivity, bandwidth, and impact on system noise performance.

Following simulation and optimisation, a prototype of the integrated filtering antenna will be manufactured using available in-house fabrication facilities. Experimental validation will be conducted using the Department of Electrical and Electronic Engineering's RF and antenna measurement infrastructure, including vector network analysers and a well-equipped antenna test range. An established workshop with qualified technical staff is available to support fabrication and assembly, ensuring that prototype development and testing can be completed within the project timeline.

To support computationally intensive full-wave simulations and parametric optimisation studies, the project will have access to a dedicated high-performance workstation. The proposed computing platform consists of a modern multi-core CPU and GPU-accelerated architecture suitable for large-scale electromagnetic simulations, enabling efficient handling of high-resolution models and iterative design processes. This computational capability significantly reduces simulation turnaround time and mitigates risks associated with limited computing resources.

The combination of commercial simulation tools, in-house fabrication and measurement facilities, experienced technical support, and adequate computational resources ensures that the project objectives can be realistically achieved. The proposed methodology relies on proven engineering practices and does not require access to external or experimental infrastructure, making the project well suited to completion within a Master's research framework.

**5. Include expected milestones and associated time-frames towards attaining the overall objectives of the project.**

The proposed research project will be conducted over the standard duration of a Master's degree.

2027 - Semester 1

- Comprehensive literature review on radio astronomy receiver front ends, RF filter design, and integrated filtering antenna concepts.
- Definition of system requirements and performance targets relevant to SARAO-supported instruments.
- Selection of suitable filter and antenna topologies.

**Milestone:** Written literature review and clearly defined design specifications.

2027 - Semester 2

- Analytical synthesis and preliminary design of the integrated filtering antenna.
- Full-wave electromagnetic simulation using CST, FEKO, and HFSS.
- Initial optimisation of key performance parameters, including bandwidth, insertion loss, and selectivity.

**Milestone:** Validated simulated design meeting initial performance targets

2028 - Semester 3

- Detailed design refinement incorporating fabrication constraints.
- Prototype fabrication and assembly.
- Experimental characterisation using RF and antenna measurement facilities.

**Milestone:** Fabricated prototype with measured RF performance data

2028 - Semester 4

- Comparison of simulated and measured results.
- Evaluation of RFI mitigation effectiveness and system-level impact.
- Final documentation and writing of the Master's dissertation

**Milestone:** Submission of the Master's dissertation.

**6. If relevant, describe any qualifications, academic abilities, skills and/or experience that a student should have to successfully deliver on the objectives of the research proposed.**

N/A

# Leanne Bodenstein

LECTURER

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Department of Electrical and Electronic Engineering
Bosman St, Stellenbosch Central Stellenbosch,
Western Cape, 7600

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+277 949 55244

## Summary

Dr. Leanne Bodenstein is a microwave engineer and lecturer at Stellenbosch University, specializing in the design, optimization, and statistical modelling of advanced RF and microwave components. Her work focuses on high-performance filters, antennas, and emerging microwave sensing technologies, with particular expertise in stochastic modelling, optimization methods, and machine-learning-assisted design workflows. She completed a joint PhD on substrate integrated waveguide (SIW) waveguide filters and went on to a Postdoctoral Research Fellowship at Stellenbosch University, contributing to a European EUREKA consortium with Chalmers University, Aalto University, and Tampere University. Her postdoctoral work centered on yield optimization of millimeter-wave antennas using NLPLS-based polynomial chaos expansion. She is currently involved in research on new manufacturing techniques for microwave devices, and is expanding into microwave sensors for biomedical applications.

## Career History

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|---|---|
| 01/01/2024 - present | **Lecturer**<br>Electrical and Electronic Engineering<br>Stellenbosch University |
| 01/01/2023 - 31/12/2023 | **Junior Lecturer**<br>Electrical and Electronic Engineering<br>Stellenbosch University |
| 01/03/2022 - 31/12/2022 | **Postdoctoral research fellow**<br>Electrical and Electronic Engineering<br>Stellenbosch University |
| 01/09/2021 - 31/12/2021 | **Internship**<br>Reutech Radar Systems, Stellenbosch, South Africa |

## Education

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|---|---|
| 2017 - 2022 | **Joint PhD. in Electrical and Electronic Engineering from Stellenbosch University and Universitie de Bretagne Occidentale**<br>Dissertation: "Advances in Pedestal Surface Integrated Waveguide Filters" |
| 2013 - 2016 | **B.Ing**<br>Electrical and Electronic Engineering (Cum Laude)<br>Fields: Electromagnetics, Telecommunication, High Frequency Techniques, Microwave Filters. |

## Grants

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| 2023 - 2025 | **Early Career Academic Development program**<br>ZAR 15 000 p.a. |
| 2023 - 2028 | **nGap pragram**<br>(NEW GENERATION OF ACADEMICS PROGRAMME)<br>ZAR 932 799,60 |
| 2025 - 2027 | **NRF Thuthuka grant**<br>ZAR 230 000 p.a. |
| 2023 - 2025 | **Subcommittee B project funding**<br>Institutional funds<br>ZAR 65 000 p.a. |

## Teaching experience

Teaching experience includes lecturing second-year Systems and Signals, coordinating postgraduate training in stochastic modelling and optimization, and delivering specialized content in RF and microwave engineering. Responsibilities cover course design, assessment development, and academic administration, as well as supervising PhD, master's, and undergraduate final-year research projects. Additional teaching activities involve mentoring students, guiding independent research, and contributing to curriculum development within the department.

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|---|---|---|
| **Systems and Signals 244** | 2024 – 2025 | Coordinator |
| **Systems and Signals 214** | 2024 – 2025<br>2023 | Coordinator<br>Lecturer |
| **Computer Programming 143** | 2023 | Lecturer |
| **Microwave Networks 814** | 2024 – 2025 | Lecturer |

## Research experience

Research focuses on the design, modelling, and optimization of advanced RF and microwave components, including high-Q resonators, SIW filters, waveguide transitions, and integrated filtering-antenna structures. Expertise includes stochastic modelling, yield optimization, and machine-learning-assisted design methods, supported by experience in both academic research and international industry-aligned collaborations. Current work explores new manufacturing techniques for millimeter-wave structures and the development of microwave sensors for biomedical applications, alongside the supervision of PhD, master's, and undergraduate final-year research students.

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| 01/01/2023 - 31/12/2025 | **Doctoral Student:** Ketshabile Nfanyana<br>Primary supervisor<br>Project: "Statistically Optimized Antenna Arrays for the SKA Mid-Frequency Aperture Array (MFAA)" |
| 2024 - present | **Doctoral Student:** Steven Watts<br>Primary supervisor<br>Project: "Machine Learning- Enabled Design of Microwave Components for astronomy applications" |
| 2023 - present | **Doctoral Student:** Thom van Zeijl - Eindhoven University of Technology<br>External collaborator<br>Project: "Miniaturized antenna with configurable radiation pattern based on pedestal loaded cavity resonator" |
| 2023 - present | **Masters Student:** Franco Hill<br>Primary supervisor<br>Project: "Design and optimization of novel filtering antenna" |
| 2024 - present | **Masters Student:** Roche Faure<br>Primary supervisor<br>Project: "Design and optimization of electromagnetic sensors" |
| 2025 | **Final year student:** Viva Rattue<br>Primary supervisor<br>Project: "A Wearable Flexible Energy-Autonomous Filtenna for Ethanol Detection at 2.45 GHz" |
| 2025 | **Final year student:** Pierre Louis Dupr´e Fourie<br>Primary supervisor<br>Project: "A Two-port Microwave Sensor for Liquid Fertilizer Concentration Measurement" |
| 2025 | **Final year student:** Ayrton Pask<br>Primary supervisor<br>Project: "Sensitivity and Yield Analysis of an Electromagnetic Sensor Using PCE" |
| 2025 | **Final year student:** KK Poonasamy<br>Primary supervisor<br>Project: " Microwave Sensor Loaded with Complementary Curved Ring Resonator for Material Permittivity Detection " |
| 2024 | **Final year student:** GE Mudau<br>Primary supervisor<br>Project: "Innovative Material Characterization: Statistical modelling of electromagnetic sensors" |

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| 2024 | **Final year student:** Hamida Mustapha<br>Primary supervisor<br>Project: "Design and Optimization of a Microstrip Image Rejection Filter Centered at 11.85 GHz" |
| 2024 | **Final year student:** Astha Sirothia<br>Primary supervisor<br>Project: "Microstrip Phased Array Antenna Design and Performance Analysis for Non-Invasive Biomedical Applications" |
| 2024 | **Final year student:** Reece Van Woerkom<br>Primary supervisor<br>Project: "Design and Implementation of a Filtenna for Sub-6 GHz 5G Radio Frequency Front-Ends" |
| 2024 | **Final year student:** M Engelbrecht<br>Primary supervisor<br>Project: "Anti-Aliasing Band-Pass Filter" |
| 2023 | **Final year student:** Victor Ndhabambi<br>Primary supervisor<br>Project: "Design, Simulation, and Optimization of Ka-Band Double Ridged Rectangular Waveguide Filter" |

## Publications

**Journal publications**

Meyer E, Vertegaal C, Johnson L, Meyer P, Johannsen U. Substrate integrated waveguide pedestal filtering-antenna and -arrays for 5G radio frequency front-ends. International Journal of Microwave and Wireless Technologies. 2023;15(8):1283-1290. doi:10.1017/S175907872300034X

L. Johnson et al., "Novel High-Q Partially Air-Filled Pedestal Resonator and Filter Integrated in a Printed Circuit Board (PCB)," in IEEE Access, vol. 10, pp. 101160-101167, 2022, doi: 10.1109/ACCESS.2022.3208351.

L. Johnson, P. Meyer and E. Meyer, "Pedestal substrate integrated waveguide filter with both electric and magnetic cross-couplings," in SAIEE Africa Research Journal, vol. 111, no. 1, pp. 36-43, March 2020, doi: 10.23919/SAIEE.2020.9007883.

**Journal papers in review**

K. Nfanyana, L. Bodenstein, and P. Meyer, "Yield Optimization of a KA Band Ridge Waveguide Filter by Feature-Based Non-Linear Partial Least-Squares Polynomial Chaos Expansion Surrogates and Particle Swarm", Submitted to: IEEE Access

K. Nfanyana, L. Bodenstein, and P. Meyer, "Parametric Tolerance Optimization of a Ka Band Ridge Waveguide Filter Using Feature-based Non-Linear Partial Least-Squares Polynomial Chaos Expansion Surrogates and Particle Swarm", Submitted to: IEEE Access

S.Watts, RP. Theart, and L Bodenstein, "Simulated Scattering Parameter Dataset for a Randomly Generated Non-Parameterized Microstrip Bandpass Filter between 1 and 10 GHz". Submitted to: Data in Brief

**Conference papers** (Peer - reviewed)

L. Bodenstein, P. Meyer, "Filtenna Based on a Ridged Waveguide Filter Integrated with a Vivaldi Antenna for 5G Applications", IEEE APWC IEEE-APS ,Italy, Palermo, 2025.

K. Nfanyana, L. Bodenstein, P. Meyer, V. Viikari, J. Bergman and J. A. Laurinaho, "Swarm Intelligence Parametric Yield Optimization of Microwave Devices Using the Non-Linear Partial Least-Squares Polynomial Chaos Expansion Technique," 2025 19th European Conference on Antennas and Propagation (EuCAP), Stockholm, Sweden, 2025, pp. 1-5, doi: 10.23919/EuCAP63536.2025.10999511.

L. Johnson, D. Klink, W. Steyn and P. Meyer, "Efficient yield optimization of a 100 GHz filter using the novel combination of a performance guided random walk and NLPLS-based PCE," 2024 54th European Microwave Conference (EuMC), Paris, France, 2024, pp. 1008-1011, doi: 10.23919/EuMC61614.2024.10732390.

L. Johnson et al.," Non-Linear Partial-Least- Squares-based Polynomial Chaos Expansion (NLPLS-based PCE) approach for global sensitivity analysis of a High-Q Partially Air-Filled Pedestal Resonator Integrated in a Printed Circuit Board (PCB)", CIRP CMS 2023.

E. Meyer, C. Vertegaal, L. Johnson, P. Meyer and U. Johannsen, "Substrate Integrated Waveguide Pedestal Filtenna for Sub-6 GHz 5G Radio Frequency Front-Ends," 2022 16th European Conference on Antennas and Propagation (EuCAP), Madrid, Spain, 2022, pp. 1-5, doi:10.23919/EuCAP53622.2022.9769565.

B. Wessels, K. Kotze, L. Johnson, W. Steyn and P. Meyer, "Optimization-Based Multimodal Characterization of Waveguide Transitions," 2022 International Conference on Electromagnetics in Advanced Applications (ICEAA), Cape Town, South Africa, 2022, pp. 343-348, doi: 10.1109/ICEAA49419.2022.9899884.

L. Johnson; H. Bouazzaoui; E. Meyer; P. Meyer; B. Potelon; C. Quendo; R. Allanic; A. Manchec, "R'esonateur SIW partiellement vide en technologie PCB multicouche innovante", (INM 2022)

**Conference papers in review**

T.P. van Zeijl, P. Meyer, L. Bodenstein, U. Johannsen, and E. Meyer, "Miniaturized Antenna with Configurable Radiation Pattern Based on SIW Pedestal Loaded Cavity Resonator", submitted to: EuCAP 2026

## Presentations and invited lectures

2024

**Paper Presentation**
"Swarm Intelligence Parametric Optimization of Microwave Devices using the Non-Linear Partial-Least Squares Polynomial Chaos Expansion Technique", The 9th European Congress on Computational Methods in Applied Sciences and Engineering ECCOMAS Congress 2024, 3 – 7 June 2024, Lisboa, Portugal

2024 - 2025

**Workshop**
Microwave Networks – Stellenbosch University

## Professional training

2024

**Grant proposal writing workshop**
Stellenbosch University, Stellenbosch

**Research Development of Engineering Academics in Higher Education (REACH)**
Stellenbosch University, Stellenbosch

2023

**Professional Educational Development of Academics (PREDAC)**
Stellenbosch University, Stellenbosch

**Workshop on communication by Elsibe Daneel (DRD)**
Stellenbosch University, Stellenbosch

**Postgraduate Supervisor Training Course (PGSkillsDev)**
Stellenbosch University, Stellenbosch

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| | | **Workshop on Recent Advances in Topologies, Technologies and Practical Realizations of Microwave Sensors**<br>European Microwave Week, France, Paris, 2024 |
| | 2018 | **CST workshop**<br>Stellenbosch University, Stellenbosch |
| | | **Article Writing Workshop (DRD)**<br>Stellenbosch University, Stellenbosch |
| | | **Workshop on Creating a Thesis (DRD)**<br>Stellenbosch University, Stellenbosch |
| | 2014 - 2015 | **CHPC winter school**<br>Cape Town and Nelspruit, South Africa |

## Professional Organizations

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| 2025 - present | **Professional Engineer**<br>ECSA - Engineering Council of South Africa<br>202503915 |
| 2017 - present | **IEEE member**<br>96276303 |

## Languages

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| Afrikaans | Native language |
| English | Advances speaking, reading and writing |
| French | Beginner |

## Skills

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| Technical Skills | CST Microwave Studio, Microwave Office, Matlab, Python, Linux, Bash OPENMPI, Programming (C/C++/Java), GIT, Circuit designing, Electrical measurements, RF measurements, Spice, LATEX. |
| Soft Skills | Problem solving, teamwork, verbal and literate communication, time management, project management. |

## References

| | |
|---|---|
| Prof. P Meyer | Electrical and Electronic Engineering<br>Stellenbosch University,<br>pmeyer@sun.ac.za,<br>+27 (021) 808 4322 |
| Prof. JAA Engelbreght | Electrical and Electronic Engineering<br>Stellenbosch University,<br>jengelbr@sun.ac.za,<br>+27 21 808 4334 |
| Dr. E Meyer | Assistant Professor<br>Department of Electrical Engineering,<br>Electromagnetics Group Eindhoven University of Technology,<br>e.meyer@tue.nl,<br>+31 (0) 40 247 8890 |

# Jacki Gilmore

*Curriculum Vitae*

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jackivdm@sun.ac.za

## Personal Information

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|---|---|
| Surname | Gilmore |
| First Names | Jacki |
| Maiden Name | Van der Merwe |
| Nationality | South African |
| Gender | Female |

## Education

2013 – 2015 **PhD (Electronic Engineering)**, *Stellenbosch University*
Graduated March 2016

2008 – 2009 **MScEng (Electronic) Cum Laude**, *Stellenbosch University*
Graduated March 2010

2004 – 2007 **BEng (Electrical & Electronic)**, *Stellenbosch University*

### PhD Dissertation

title *Design of a Dual-Polarized Dense Dipole Array for the SKA Mid-Frequency Aperture Array*
supervisor Prof DB Davidson

### Master's Thesis

title *The Effect of Mutual Coupling on the Noise Performance of Large Antenna Arrays*
supervisor Prof KD Palmer

### Additional Postgraduate Courses and Short-courses attended

2016 **Antennas for Radio Telescopes**, *Stellenbosch University*
European School of Antennas

2013 **Radio Astronomy for Engineers**, *Stellenbosch University*
By Prof DB Davidson

2009 **Multi-field and Multi-beam science with the SKA**, *University of Oxford*
MCCT-SKADS Workshop

2008 **Antennas**, *Stellenbosch University*
By Prof KD Palmer

2008 **Radio-Astronomy: Fundamentals and New Instruments**, *University of Alcala*
MCCT-SKADS Workshop

## Languages

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| Afrikaans | Native/Bilingual Ability | |
| English | Native/Bilingual Ability | |
| German | Conversational | *Goethe-Zertifikat Level B2 Passed in 2009* |

# Experience

## Lecturing Experience

2021 – 2023 **Senior Lecturer**, *Stellenbosch University*

**Undergraduate teaching responsibilities and approximate class sizes:**
Systems and Signals 214 (Lectures, Practicals and Tutorials for 160 students)
Design E314 (Practicals for 220 students)
Electro-Techniques 143 (Module Convenor for 1000 students)
Electronics 365 (Lectures, Practicals and Tutorials for 100 students)
Electromagnetics 344 (Lectures, Practicals and Tutorials for 130 students)
Supervision of final-year projects.
**Other undergraduate teaching-related experience and projects:**
Took part in the restructuring of the module chain for Electronics. Was responsible for defining the module content for Systems and Signals 214
Ran various "Blended-Learning" projects.
**Postgraduate Teaching:**
Postgraduate Antenna Course
Postgraduate HF Simulation and Measurements Course
Research supervision of masters and doctoral students

2016 – 2021 **Lecturer**, *Stellenbosch University*

2015 – 2016 **Junior Lecturer**, *Stellenbosch University*

## Research

2019 – 2023 **Associate Editor**, *URSI Radio Science Letters*

2017 – 2023 **Early Career Representative**, *International Union of Radio Science (URSI)*
Commission J - Radio Astronomy

2015 – present **Reviewer for International Journals**
IEEE Transactions on Antennas and Propagation
URSI Radio Science
URSI Radio Science Letters

2015 – present **Reviewer for International Conferences**
European Conference on Antennas and Propagation (EuCAP)
URSI General Assembly (GASS)
URSI Atlantic Radio Science Meeting (AT-RASC)
URSI Pacific Radio Science Meeting (AP-RASC)

## Industry Experience

January 2013 – March 2013 **Consultant (Part Time)**, *Shrike Marine*, Cape Town
Oversee environmental qualification tests and compile configuration documentation for a military project.

October 2011 – December 2012 **Development Engineer**, *Shrike Marine*, Cape Town
Design and build electronic equipment for military applications. Write development specifications and compile and maintain other relevant configuration documentation.

June 2011 – October 2011 **Technical Support Engineer**, *Kathrein South Africa*, Stellenbosch
Provide technical support to sales personnel and clients on Kathrein products. Source products and suppliers for products outside the standard Kathrein portfolio. Provide technical insight into competitor products for comparison.

November 2009 – May 2011 **Researcher/Engineer**, *Stellenbosch University*, Stellenbosch
Design and build electronic equipment for medical applications.

## Journal Publications

2025 V. V. Tonder, L. Schwardt, A. Faustmann, J. Gilmore, S. Büchner and M. Geyer, "Increasing Pulsar SNR by Using Spectral Kurtosis as a Radio Frequency Mitigation Technique", Journal of Astronomical Instrumentation (accepted)

2023 A Faustmann, L Schwardt, V van Tonder, J Gilmore, S Buchner, "Investigating the high time-resolution statistics of pulsar radio signals using spectral self-noise", Monthly Notices of the Royal Astronomical Society

2021 C. R. Wilke, S. J. Wijnholds and J. Gilmore, "Calibratability of Mid-Frequency Aperture Arrays with Self-Holography," in Journal of Astronomical Telescopes, Instruments, and Systems

2021 C. R. Wilke, S. J. Wijnholds and J. Gilmore, "Calibratability of Aperture Arrays Using Self-Holography," in IEEE Transactions on Antennas and Propagation

2020 A. Faustmann, J. Gilmore, V. van Tonder, M. Serylak, "A Bispectral Analysis of the Radio Emissions of Pulsar J0437-4715", Journal of Astronomical Instrumentation

2015 J. Gilmore and D.B. Davidson, "Suppressing Undesired Common-mode Resonances in Connected Antenna Arrays", IEEE Transactions on Antennas and Propagation

## Conference Publications

September 2025 J. Gilmore, "Determining Uniform Planar Array Mutual Coupling Terms Through Multi-Exponential Analysis," 2025 International Conference on Electromagnetics in Advanced Applications (ICEAA), Palermo, Italy, 2025, pp. 0173-0177

August 2025 J. Gilmore, "Determining Uniform Linear Array Mutual Coupling Terms Through Multi-Exponential Analysis," 2025 URSI Asia-Pacific Radio Science Meeting (AP-RASC), Sydney, Australia, 2025, pp. 1-4

August 2025 A. Bothma, J. Gilmore and P. G. Wiid, "Expanding the Lowest Usable Frequency of Reverberation Chambers Through Stirrer Design," 2025 URSI Asia-Pacific Radio Science Meeting (AP-RASC), Sydney, Australia, 2025, pp. 1-4

August 2025 A. Bothma, J. Gilmore, P. G. Wiid and S. Tshongweni, "Reverberation Chamber Design Optimization," 2025 International Symposium on Electromagnetic Compatibility – EMC Europe, Paris, France, 2025, pp. 1142-1147

July 2024 S. Manas and J. Gilmore, "Measuring the Noise Figure of Active Integrated Receivers Inside a Reverberation Chamber," 2024 IEEE International Symposium on Antennas and Propagation and INC/USNC-URSI Radio Science Meeting (AP-S/INC-USNC-URSI), Firenze, Italy, 2024, pp. 2565-2566

October 2023 S. Snyman and J. Gilmore, "Wideband Antenna Design for Time Domain RFI Measurements," 2023 International Conference on Electromagnetics in Advanced Applications (ICEAA), Venice, Italy, 2023, pp. 399-402

August 2023 V. van Tonder, L. Schwardt, A. Faustmann, J. Gilmore and S Büchner, "Spectral Kurtosis applied to tied-array beamformer for pulsar observations," URSI GASS 2023 XXXVth General Assembly and Scientific Symposium, 2023, pp. 1-4

March 2023 S. Manas and J. Gilmore, "Using a Reverberation Chamber to Estimate the Noise Figure of Integrated Low Noise Amplifiers," 2023 17th European Conference on Antennas and Propagation (EuCAP), Florence, Italy, 2023, pp. 1-4

May 2022 V. van Tonder, L. Schwardt, A. Faustmann and J. Gilmore, "Bispectra of simulated GPS data for potential RFI mitigation," 2022 3rd URSI Atlantic and Asia Pacific Radio Science Meeting (AT-AP-RASC), 2022, pp. 1-4

May 2022 A. Faustmann, L. Schwardt, V. van Tonder, J. Gilmore and S. Buchner, "A Short-Time Stationarity Test of Radio Signals From the Vela Pulsar Using Polyspectra," 2022 3rd URSI Atlantic and Asia Pacific Radio Science Meeting (AT-AP-RASC), 2022, pp. 1-4

March 2022 S. Manas, J. Gilmore and E. Meyer, "A Local Hot-Cold Antenna Measurement System," 2021 51st European Microwave Conference (EuMC), 2022, pp. 510-513

March 2021 Alexander Faustmann, Jacki Gilmore, Vereesè van Tonder, Maciej Serylak, "Higher-Order Spectral Analysis of Radio Pulsar Bursts Using MeerKAT", 2021 15th European Conference on Antennas and Propagation (EuCAP), Online

August 2020 C. R. Wilke, S. J. Wijnholds and J. Gilmore, "Self-Holography- Slimming Down Calibration of Large Aperture Arrays," 2020 XXXIIIrd General Assembly and Scientific Symposium of the International Union of Radio Science, Rome, Italy

August 2020 A. Faustmann, J. Gilmore "An Investigation of Nonlinear Adaptive Space-Time Processing for the Real-Time Detection of Extraterrestrial Transients",2020 XXXIIIrd General Assembly and Scientific Symposium of the International Union of Radio Science, Rome, Italy

September 2019 Helgard Oosthuizen, Jacki Gilmore "SLM 3D-Printed Active Phased Array for X-Band Satellite Communications",2019 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (APWC), Granada, Spain

September 2019 Kobus Kotzé, Jacki Gilmore "SLM 3D-Printed Horn Antenna for Satellite Communications at X-band",2019 IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications (APWC), Granada, Spain

September 2019 Kristian Zarb Adami, Andrew Faulkner, Eloy de Lera Acedo, Nima Razavi-Ghods, Hardie Pienaar, Jens Abraham, Edgar Colin-Beltran, Keith Grainge, Anthony K Brown, David Zhang, Laith Rashid Danoon, David Prinsloo, Rui Cao, Dirk de Villers, Jacki Gilmore "The Mid-Frequency Aperture Array", 2019 International Conference on Electromagnetics in Advanced Applications (ICEAA), Granada, Spain

March 2019 C.R. Wilke, S.J. Wijnholds, J. Gilmore "Performance Improvement of Self-Holography Based Aperture Array Station Calibration", 2019 13th European Conference on Antennas and Propagation (EuCAP), Krakow, Poland

October 2018 D.B. Davidson, A. Sutinjo, R. Wayth, D. Ung, D.I.L. de Villiers, J.G. bij de Vaate, R. Baelemans, A.B. Smolders "Recent Progress on the Design of Aperture Arrays for Radio Astronomy", 2018 IEEE Radio and Antenna Days of the Indian Ocean (RADIO), Grand Port, Mauritius

May 2018 C. R. Wilke, J. Gilmore "Quantization and Mutual Coupling Effects on Beamforming in Dense Phased Arrays", 2nd URSI Atlantic Radio Science Meeting (URSI AT-RASC), Gran Canaria, Spain

May 2018 C.J Smale, J. Gilmore "Thermal Analysis of a Dense Dipole Array for the SKA Mid-Frequency Aperture Array", 2nd URSI Atlantic Radio Science Meeting (URSI AT-RASC), Gran Canaria, Spain

September 2017 C. R. Wilke, J. Gilmore and D. B. Davidson "Reducing the maximum quantization scan error in dense phased arrays", 2017 International Conference on Electromagnetics in Advanced Applications (ICEAA), Verona, Italy

June 2017 J. Gilmore, K.E. Wolff and M. Bladergroen "The night before the test: Electrical engineering students' use of online resources to prepare for assessment", 4th Biennial Conference of the South African Society for Engineering Education (SASEE), Cape Town, South Africa

April 2017 J. Gilmore, C.R. Wilke and D.B. Davidson "Calculating the maximum quantization scan error in dense phased arrays", European Conference on Antennas and Propagation (EuCAP), Paris, France

April 2016 J. Gilmore, D. B. Davidson and J. G. B. de Vaate, "Progress on the development of a dual-polarized dense dipole array for the SKA mid-frequency aperture array," 2016 10th European Conference on Antennas and Propagation (EuCAP), Davos, 2016, pp. 1-2.

July 2015 J. Gilmore and D.B. Davidson, J.E. Noordam "A Dense Dipole Array for Mid-Frequency Aperture Arrays", 2015 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting, Vancouver, Canada

April 2014 J. Gilmore and D.B. Davidson, "A Review of Full-Wave and Reduced-Order Modelling Methodologies for Dense Aperture Arrays", European Conference on Antennas and Propagation (EuCAP), The Hague, Netherlands

## Postgraduate Supervision

### Doctoral Students

| Name of student | Nationality | Starting Date | Graduation Date (Projected if unfinished) | Project Title | Co-Supervisor |
|---|---|---|---|---|---|
| Cornelis Wilke | South African | January 2018 | December 2021 | Efficient Multi-Beam Calibration of Antenna Arrays | Prof. Stefan Wijnholds (ASTRON) |
| Lanche Grootboom | South African | February 2020 | March 2027 | Development of an Integrated Array Receiver for Radio Astronomy | Prof. Petrie Meyer |
| Alexander Faustmann | South African | January 2021 | March 2023 | Detection of Weak Radio Pulsars Using Non-Gaussian Statistics | Dr. Ludwig Schwardt (SARAO) |
| Vereese van Tonder | South African | January 2021 | December 2024 | Radio Frequency Interference Mitigation for Pulsar Pipelines using Higher Order Statistics | Dr. Ludwig Schwardt (SARAO) |
| Sean Manas | South African | March 2021 | March 2027 | Using a Reverberation Chamber as an Evaluation Tool for Integrated Receiver Systems | |

### Masters Students

| Name of student | Nationality | Starting Date | Graduation Date (Projected if unfinished) | Project Title | Co-Supervisor |
|---|---|---|---|---|---|
| Cornelis Wilke | South African | January 2016 | March 2018 | Quantization Effects on Beamforming in Dense Phased Arrays | Prof. David Davidson |
| Corey Smale | South African | January 2017 | March 2019 | Thermal Analysis of a Dense Dipole Array for the SKA Mid-Frequency Aperture Array | |
| Helgard Oosthuizen | South African | January 2018 | March 2020 | Active Antenna Array Design using Additive Manufacturing Techniques | |
| Sean Manas | South African | January 2019 | March 2021 | Design of a Hot/Cold Antenna measurement facility | Dr Elmine Meyer (TU/e) |
| Dylan Fry | South African | January 2019 | December 2021 | Differential LNA Design for the SKA Mid-Frequency Aperture Array | Dr Elmine Meyer (TU/e) |
| Alexander Faustmann | South African | January 2019 | PhD Upgrade: November 2020 | Higher-Order Spectral Analysis of Radio Pulsar Bursts | |
| Millicent Mguni | South African | January 2019 | March 2022 | Portable RFI Detection System | Dr Gideon Wiid (CPUT) Dr Arno Barnard |
| Aneshka Bothma | South African | January 2020 | March 2025 | Reverberation chamber stirrer design | Dr Gideon Wiid (UCT) |
| Shane Hattingh | South African | January 2020 | March 2023 | Design of an Active Dense Dipole Array for the SKA Mid-Frequency Aperture Array | |
| Sandra Snyman | South African | January 2022 | December 2023 | Wide-Band Antenna Design for Time-Domain Measurements in a Reverberation Chamber | |
| Daniël Theron | South African | January 2025 | December 2026 | Design of a Patch Antenna Array for Satellite Communications | |
| Roche Faure | South African | January 2025 | December 2026 | Sensitivity analysis of CSRR sensor based on polynomial chaos expansion | Dr Leanne Bodenstein |
| Zulfik Salie | South African | January 2026 | December 2027 | Reconfigurable Planar Filtenna for Sub-Array Applications | Dr Leanne Bodenstein |

Electrical & Electronic Engineering
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26 February 2026

To whom it may concern

**Confirmation of Data Collection Facilities for Postgraduate Research**

This letter is to confirm that the Department of Electrical and Electronic Engineering at Stellenbosch University has the following software licences and data collection facilities available for postgraduate research.

Software Licences for Full-Wave Electromagnetic Simulations:

- Altair Feko
- CST Microwave Studio
- Ansys HFSS

Software Licenses for RF system design:

- AWR Microwave Office
- Keysight ADS

Software License for Asymptotic Electromagnetic Analysis:

- GRASP by TICRA

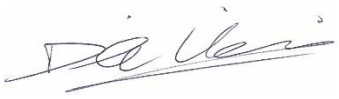
Software License for Data Analysis and Mathematical Modelling:

- MATLAB

RF Measurement Equipment and Facilities

- Vector Network Analysers
- Spectrum Analysers
- RF Signal Generators
- Oscilloscopes
- Anechoic Antenna Measurement Range
- Reverberation Chamber

Kind regards,



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