

Cover Page

Title of the research project

Antenna Beam and Geometry Estimation

Broad area of research:

Engineering

Academic level of research project:

Doctoral

Primary supervisor's details:

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Abstract of research project

Radio astronomy antennas must almost always be extremely carefully characterized to understand the beam on the sky as well as possible. Additionally, knowledge of the antenna beam can sometimes be used to infer geometric perturbations of the antenna structure, which provide valuable insight into the system performance (or lack thereof...). While electromagnetic simulations have been recently used for this task more frequently, any type of measured data can be valuable in improving the accuracy of the estimation. This is normally easier said than done, because measurements are hard to obtain, be incomplete, and are typically noisy. This project will develop formal methods of incorporating incomplete and noisy measurements (which might have systematic errors) into a simulation-based antenna model which can be used to characterize the system or in an inverse problem for geometric parameter estimation. It will be applied to several real-world problems, including the REACH radiometer project, the HIRAX telescope, the ngVLA dish prototype, and possibly SKA prototype antennas.

Details of Research Project

1. *Engineering merit:*

This project falls in the first focus area for engineering postgraduate research for 2027, since it directly addresses skills needed to characterize antennas for radio telescopes.

Although this project is more theoretical and mathematically oriented than many engineering projects, it addresses a very important question that comes up repeatedly in radio astronomy – what does the beam look like, and why does it look that way? One example was raised by the group of Mario Santos and the MeerKLASS experiment about far-out sidelobes of the MeerKAT antennas and their effect when scanning over terrestrial RFI sources. Simulation can only go so far, and measurements can, in principle, be used to augment simulation models to provide more accurate results. There are several recent research efforts working on associated problems, including the development of compact models for antenna beams (also as a function of frequency) using exponential analysis, by Michele Pugno at Antwerp University (no reference yet – personal communication), the extensive efforts by Matthieu de Villiers and other at SARAO in modelling MeerKAT beams, the efforts to characterize the HIRAX telescope through drone measurements (this is also an important topic in the SKA-low community), as well as the recent result in the PhD by Carla Pieterse that the beam pattern of a single element 21cm cosmic dawn radiometer experiment, like REACH, needs to be known to -35 dB accuracy to have the best chance of an undisputed detection.

Research Objectives

1. **Develop a Simulation-Based Antenna Characterization Framework**
 - Construct high-fidelity electromagnetic models for relevant radio astronomy antennas to predict beam patterns and structural effects on system performance.
 - Decompose the models into basis function expansions to reduce the dimensionality as far as possible.
2. **Integrate Noisy and Incomplete Measurements into the Characterization Process**
 - Develop formal methods for handling real-world measurement data, including systematic errors, missing information, and varying noise levels.
 - Investigate data fusion techniques that combine electromagnetic simulations with measured (or initially noisy simulated) data to improve accuracy.
3. **Formulate and Solve Inverse Problems for Geometric Parameter Estimation**
 - Develop mathematical and computational methods to infer structural deformations or misalignments from observed beam distortions.
 - Apply Bayesian inference, machine learning, and statistical optimization techniques to extract meaningful geometric insights from beam pattern deviations.
4. **Validate the Framework with Real-World Antenna Systems**
 - Test the developed methods on practical cases, including the REACH radiometer, HIRAX telescope, ngVLA dish prototype, and SKA prototype antennas.
 - Compare simulation-based predictions with real measurements to refine the accuracy of the model.
5. **Generalize the Approach for Broader Applications in Radio Astronomy and Beyond**
 - Assess the applicability of the developed techniques to different types of radio telescopes and large-scale antenna arrays.
 - Investigate potential use cases in satellite communication, radar, and other fields where precise antenna characterization is critical.

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

This project will integrate electromagnetic simulations with real-world measurement data to enhance antenna characterization accuracy. The first step involves building high-fidelity simulation models using full-wave and physical optics methods, and projecting them onto lower dimensional basis function expansions. These models will be refined by incorporating noisy and incomplete measurement data, using statistical filtering techniques such as Gaussian Process Regression, and Bayesian inference. To solve the inverse problem of estimating geometric deformations from beam distortions, machine learning techniques, including neural networks and inverse modeling approaches, will be explored. Finally, real-world validation will be conducted using data from existing radio telescopes, ensuring that the developed framework is both practical and adaptable for future applications in astronomy and beyond.

3. *Skills development*

The candidate will develop skills in antenna design and simulation, as well as in mathematical modelling and inference.

4. *Details of the availability of required infrastructure/equipment*

Most of the work will be simulation driven, so physical infrastructure required is mainly computers and simulation software – all of which are available in the research group. Specifically access to CST, GRASP and MATLAB will be needed.

5. *Milestones*

Y1S1: Literature study, and initial implementation of simulation-based models. Start investigating how to handle incomplete and noisy data (measured data).

Y1S2: Start integrating noisy data into simulation models.

Y2S1: Complete integration of noisy and simulation data. Write a conference paper on the results.

Y2S2: Build inverse problem framework and start applying it to real-world examples.

Y3S1: Complete real-world examples and investigate expansion to other fields. Evaluate the efficacy of the method and write journal paper.

Y3S2: Write dissertation.

6. This project is most suited to a student with an interest in both mathematical modelling as well as antenna design. Experience in radio astronomy related projects would be helpful.

PUBLICATIONS

INTERNATIONAL JOURNAL PAPERS

1. (2026) D.I.L. de Villiers, Z. du Toit and R. Lehmensiek, 'Tri-Ridge Flared Horn Antennas as a Trapped Mode Free Alternative to Quad-Ridged Flared Horns in Wideband Reflector Feed Applications', *IEEE Transactions on Antennas and Propagation*, submitted.
2. (2026) G.V.C. Allen, S. Pegwal, D.I.L. de Villiers, and the REACH collaboration, 'Circuit Modeling for In Situ 21 cm Radiometer Calibration', *Journal of Astronomical Instrumentation*, submitted.
3. (2025) S.A.K. Leeney and the REACH collaboration, "Radiometer Calibration using Machine Learning", *Scientific Reports*, vol. 15, no. 34335, pp. 1 – 15, Oct. 2025.
4. (2025) M. Venter and D.I.L. de Villiers, 'Efficient Beam Pattern Modeling for Reflector Antennas Within Multidimensional Feed Parameter Spaces Using a Reference Design', *IEEE Transactions on Antennas and Propagation*, vol. 73, no. 9, pp. 6943 - 6948, Sep. 2025.
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6. (2024) W.J. Cerfonteyn, F.T.T. Mokhupuki and D.I.L. de Villiers, 'Receiving Sensitivity Ripple in Electrically Small Offset Gregorian Reflector Antennas', *IEEE Antennas and Wireless Propagation Letters*, vol. 23, no. 10, pp. 2925-2928, Oct. 2024.
7. (2024) J. Cumner, C.M. Pieterse, D.I.L. de Villiers, and E. de Lera Acedo, "The effects of the antenna power pattern uncertainty within a global 21 cm experiment", *Monthly Notices of the Royal Astronomical Society*, vol. 531, no. 4, pp. 4734–4745, Jul. 2024.
8. (2024) R.-M. Weideman, A. Cuyt and D.I.L. de Villiers, "Characterizing the Electric Field Ripple in Reflector Antennas Using Sub-Sampled Exponential Analysis", *IEEE Transactions on Antennas and Propagation*, vol. 72, no. 7, pp. 5511 – 5519, Jul. 2024.
9. (2022) J. Cumner, E. de Lera Acedo, D.I.L. de Villiers and the REACH Collaboration, "Radio antenna design for sky-averaged 21 cm cosmology experiments: the REACH case", *Journal of Astronomical Instrumentation*, vol. 11, no. 1, 2022.
10. (2022) E. De Lera Acedo, D.I.L. de Villiers and the REACH Collaboration, "The REACH radiometer for detecting the 21-cm hydrogen signal from redshift $z \approx 7.5-28$ ", *Nature Astronomy*, vol. 6, pp. 984 – 998, 2022.
11. (2022) D.I.L. de Villiers and R. Lehmensiek, "Multi-level Approximations for Fast and Accurate Antenna Noise Temperature Calculation of Dual-Reflector Antennas", *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 6, pp. 4784-4793, Jun. 2022.
12. (2022) I. Heywood, I. Rammala, F. Camilo, W. D. Cotton, F. Yusef-Zadeh, T. D. Abbott, R. M. Adam, G. Adams, M. A. Aldera, K. M. B. Asad, E. F. Bauermeister, T. G. H. Bennett, H. L. Bester, W. A. Bode, D. H. Botha, A. G. Botha, L. R. S. Brederode, S. Buchner, J. P. Burger, T. Cheetham, D. I. L. de Villiers, et al., "The 1.28 GHz MeerKAT Galactic Center Mosaic", *The Astrophysical Journal*, vol. 925, no. 2, pp. 1 – 20, Feb. 2022.
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 16. (2022) D.I.L. de Villiers and R. Lehmsiek, "Plate Scale in Shaped Offset Gregorian Reflectors", *Radio Science Letters*, vol. 3, pp. 1 – 3, 2021.
 17. (2021) R. Lehmsiek and D.I.L. de Villiers, "An optimal 18-meter shaped offset Gregorian reflector for the ngVLA radio telescope", *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 12, pp. 8282-8290, Dec. 2021.
 18. (2021) K.M.B. Asad, J.N. Girard, M. de Villiers, R. Lehmsiek, T. Ansah-Narh, K. Iheanetu, O. Smirnov, M.G. Santos, J. Jonas, D.I.L. de Villiers, K. Thorat, B. Hugo, S. Makhathini, F. Camilo, G.I.G. Jozsa, S.K. Sirothia, "Primary beam effects of radio astronomy antennas - II. Modelling the MeerKAT L-band beams", *Monthly Notices of the Royal Astronomical Society*, stab104, 2021, pp. 2970 – 2983.
 19. (2021) F. Mokhupuki and D.I.L. de Villiers, "Efficient optimisation of wideband reflector feed antennas for optimal receiving sensitivity", *Wiley International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, vol. 34, no. 3, 2021; pp. e2849.
 20. (2021) J.-G. Bij de Vaate, D.I.L. de Villiers, D.B. Davidson and W. van Cappellen, "Expanding the Field of View: Station Design for the AAMID SKA Radio Telescope", *Experimental Astronomy*, vol. 51, 2021, pp. 1 - 16.
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 22. (2021) S.G.H. Kriel and D.I.L. de Villiers, "Mutual Coupling Effects between Test and Reference Antennas in Near-field Measurements", *Radio Science Letters*, vol. 2, 2020, pp. 1 - 4.
 23. (2020) H.J. du Toit and D.I.L. de Villiers, "A Fully Isolated 16-way Radial Power Combiner", *IEEE Transactions on Microwave Theory and Techniques*, vol. 68, no. 7, pp. 2531-2538, July 2020.
 24. (2020) F. Knaepkens, A. Cuyt, W-s Lee and D.I.L. de Villiers, "Regular Sparse Array Direction of Arrival Estimation in One Dimension", *IEEE Transactions on Antennas and Propagation*, vol. 68, no. 5, pp. 3997-4006, May 2020.
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INTERNATIONAL CONFERENCE PROCEEDINGS

1. (2026) M. Pugno, A. Cuyt and D.I.L de Villiers, "Compact Antenna Beam Models Using Spherical Wave Expansion and Sparse Frequency Interpolation", *European Conference on Antennas and Propagation (EuCAP)*, Dublin, Ireland, March 2026, *accepted*.
2. (2025) G.V.C. Allen, D.I.L. de Villiers and S. Pegwal, "Balun Circuit Modelling for Global 21-cm Experiments", *International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Palermo, Italy, September, 2025, pp. 437-442.
3. (2025) A. Lötter and D.I.L. de Villiers, 'Analytical Estimates of the Fundamental-Mode Fields in Regular Polygonal Waveguides with Application to Tri-Ridged Orthomode Transducers', *URSI Asia Pacific Radio Science Conference*, Sydney, Australia, August 2025, pp. 1 - 4.
4. (2025) R. Lehmensiek, D.I.L. de Villiers and M.M. Botha, "Performance of Computational Tools for Wideband Quadruple-Ridged Flared Horn Analysis", *European Conference on Antennas and Propagation (EuCAP)*, Stockholm, Sweden, March, 2025, pp. 1 -5.
5. (2025) M. Venter and D.I.L de Villiers, "Fast Multi-Dimensional Feed Optimization on Reflector Antennas Using a Reference Design", *European Conference on Antennas and Propagation (EuCAP)*, Stockholm, Sweden, March, 2025, pp. 1- 5.
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10. (2024) R. Lehmensiek and D.I.L. de Villiers, "A Performance Comparison of Sub-Octave Band Corrugated Horns to a Quadruple-Ridged Flared Horn for the ngVLA Radio Telescope", *European Conference on Antennas and Propagation (EuCAP)*, Glasgow, Scotland, March, 2024, pp. 1 - 3.
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13. (2023) M. Venter and D.I.L. de Villiers, "Beam modeling of reflector antennas across elevation", *URSI General Assembly*, Sapporo, Japan, August 2023, pp. 1 - 4.
14. (2023) T. Stek, D.I.L. de Villiers, E. Meyer and D.S. Prinsloo, "Towards Accelerating the Feed Design of a Series of Different Reflector Antennas", *IEEE AP-S International Symposium on Antennas and Propagation*, Portland, OR, USA, July 2023, pp. 759 - 760.
15. (2023) D.I.L. de Villiers and R. Lehmensiek, "Performance estimates of the 18-meter ngVLA reflector system with main reflector rim extension", *IEEE AP-S International Symposium on Antennas and Propagation*, Portland, OR, USA, July 2023, pp. 763 - 764.
16. (2023) R. Lehmensiek and D.I.L. de Villiers, "A Method to Design Trapped-Mode Free Quadruple-Ridged Flared Horn Antennas", *European Conference on Antennas and Propagation (EuCAP)*, Florence, Italy, March 2023, pp.
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21. (2022) R.-M. Weideman, R. Louw, F. Knaepkens, D.I.L. de Villiers, A. Cuyt and W.-s. Lee "Simulated performance of antenna position estimation through sub-sampled exponential analysis", *International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Cape Town, South Africa, September 2022, pp. 128 - 132.
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12. (2021) D.I.L. de Villiers, E. De Lera Acedo, J.M. Cumner, Q.D. Gueuning on behalf of the REACH collaboration, "Antenna Design for the REACH Global 21cm Experiment", *URSI General Assembly*, Rome, Italy, August 2021.
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14. (2021) R. Lehmensiek and D.I.L. de Villiers, "On the design of the 18 m offset Gregorian dual reflector antenna for the ngVLA" *URSI General Assembly*, Rome, Italy, August 2021.
15. (2019) D.I.L. de Villiers, R. Louw, R. Weideman, A. Cuyt, et al., "Practical Performance of Regular Sparse Array Direction of Arrival Estimation in 1-D", *International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Grenada, Spain, September 2019.
16. (2019) B. Klopper, D.I.L. de Villiers and E. de Lera Acedo, "Antenna Design and Optimisation of the Radio Experiment for the Analysis of Cosmic Hydrogen", *International Conference on Electromagnetics in Advanced Applications (ICEAA)*, Grenada, Spain, September 2019.
17. (2017) R. Lehmensiek and D.I.L. de Villiers, "On the performance limits of the SKA1-mid reflector system", 32nd URSI General Assembly, Montreal, Canada, August, 2017.
18. (2013) M. H. Volkmann, C. J. Fourie, D.I.L. de Villiers, D.B. Davidson, W.J. Perold, and T. Ortlepp, "Improving the Square-Kilometre Array with Superconductor Electronics", *European Conference on Applied Superconductivity (EuCAS)*, Genova, Italy, September, 2013.
19. (2011) M.H. Volkmann, C.J. Fourie, W.J. Perold, D.B. Davidson, H.C. Reader and D.I.L. de Villiers, "Superconducting circuits in the Square Kilometre Array radio telescope", *European Conference on Applied Superconductivity (EuCAS)*, The Hague, The Netherlands, September, 2011.

NATIONAL CONFERENCE PRESENTATIONS

1. (2018) D.I.L. de Villiers, 'The SARChI Chair in Antenna Systems for the SKA at Stellenbosch University' *South African IEEE AP/MTT/EMC Conference*, Stellenbosch, South Africa, August, 2018.
2. (2016) N. Mutoenkole, D.I.L. de Villiers, 'Parametric Modelling of Antenna Responses' *South African IEEE AP/MTT/EMC Conference*, Stellenbosch, South Africa, July, 2016.
3. (2014) D.I.L. de Villiers, R.D. Beyers, 'Recent Advances in Conical Transmission Line Power Combiner Design' *South African IEEE AP/MTT/EMC Conference*, Pretoria, South Africa, May, 2014.
4. (2011) D.I.L. de Villiers, R. Lehmensiek, E. Knox-Davies and I.P. Theron, 'Preliminary Reflector Design of the MeerKAT Radio Telescope' *South African IEEE AP/MTT/EMC Conference*, Stellenbosch, South Africa, April, 2011.
5. (2009) D.I.L. de Villiers, 'Ultra Wideband Reflector Antenna Feeds' *South African SKA Postgraduate Bursary Conference*, Stellenbosch, South Africa, December, 2009.
6. (2009) D.I.L. de Villiers, 'Development of a Wideband Ortho-Mode Transducer' *South African IEEE AP/MTT Conference*, Stellenbosch, South Africa, March, 2009.
7. (2008) D.I.L. de Villiers, 'Development of a Wideband Ortho-Mode Transducer' *South African SKA Postgraduate Bursary Conference*, Stellenbosch, South Africa, December, 2008.
8. (2007) D.I.L. de Villiers, P. Meyer and P.W. van der Walt, 'Design of a Ten-Way Conical Transmission Line Power Combiner' *South African IEEE AP/MTT Conference*, Stellenbosch, South Africa, March, 2007.

GRADUATE SUPERVISION

COMPLETED PHD DEGREES

1. (2020-2025) Zain du Toit (Co-supervisor with Prof. Robert Lehmensiek): 'A tri-ridge horn antenna for radio astronomy applications'
1. (2024-2025) Sindhu Gaddam (Co-supervisor with Prof Kavilan Moodley, student at UKZN), 'Design, Optimization, and Characterization of a Wideband Dual Polarized Feed Antenna for the HIRAX Radio Telescope'
2. (2022-2025) Steven Ndungu (Co-supervisor with Prof Stefan Wijnholds, Prof George Azzopardi and Dr Trienko Grobler): 'CARAD: Computer-aided Analysis of Radio Astronomy Data'
3. (2021-2024) Carla Pieterse: 'Antenna Beam Pattern Modelling for Sky-Averaged 21 cm Cosmology Experiments'
4. (2020-2024) Mariet Venter (Part-time student): 'Parametric Beam Modelling for Reflector Antennas'
5. (2021-2023) Rina-Mari Weideman (Co-supervisor with Prof Annie Cuyt): 'Sub-sampled Exponential Analysis in Antenna Applications'
6. (2019-2023) William Cerfonteyn: 'Impact and Cause of Sensitivity Ripple in Radio Astronomy Reflector Antennas'
7. (2021-2022) Prof Coenrad Fourie (DEng): 'Inductance in Superconductor Integrated Circuits'
8. (2019-2022) Ridalise Raal (Co-supervisor with Prof Annie Cuyt): 'Sub-Sampled Exponential Analysis Applied to Sparse Planar Antenna Array Configurations'
9. (2020-2022) Scott Kriel: 'A Figure of Merit for the X-Band All-Sky Survey'
10. (2017-2020) Fahmi Mokhupuki: 'Efficient Optimisation of Wideband Reflector Feed Antennas'
11. (2016-2019) Jako du Toit (Upgraded from Masters in 2018): 'Partially Filled Radial Power Combiner with Port Isolation'
12. (2018-2019) Jan-Gerald Bij de Vaate: 'Expanding the Field of View: Station Design for the AAMID SKA Radio Telescope'
13. (2016-2018) Brandt Kloppe: 'Antenna Elements for Sparse-Regular Aperture Arrays'
14. (2014-2016) Ngoy Mutonkule, 'Modelling of Antenna Responses'
15. (2013-2015) Ryno D. Beyers: 'Circuit Model Design of Conical Transmission Line Power Combiners and Isolation of Reactive Combiners'

COMPLETED MASTER'S DEGREES

1. (2024-2025) Madison Crews: 'Design of a feed antenna for the HIRAX telescope'
2. (2022-2023) Raynard Swanepoel (Co-supervisor with Dr. Danie Ludick): 'Automated Synthesis of Array Antennas for Improved Accuracy in RF Safety Simulations using Spherical Wave Elements'
3. (2022-2023) Henry Johnston: 'Radio Frequency Direction Finding and the Watson-Watt Method'
4. (2020-2022) Yusuf Dhoda (Co-supervisor with Dr Werner Steyn): 'Wide-Band Radio Receiver for Radio Astronomy Applications'
5. (2020-2021) Insight Agbetsiafa (Co-supervisor with Dr Trienko Grobler): 'An RFI Simulation Pipeline to Help Teach Interferometry and Machine Learning'
6. (2020-2021) Stella Schleich: 'Design and implementation of a two-element interferometer'
7. (2020-2021) Jacques Wolmarans: 'Beam ripple modelling in wideband dual-reflector antenna systems'
8. (2017-2020) Hein Swart (Part time student): 'Wideband Axially Symmetric Power Combiners Based on Short Step Filters'

9. (2019-2020) Rina-Mari Weideman: 'Linear Sparse Regular Array Antenna Demonstrator'
10. (2019-2020) Carla Pieterse: 'Comparison of prime focus and offset Gregorian reflector antennas for 21 cm intensity mapping' (Co-supervisor with Prof. Kavilan Moodley; Student at UKZN)
11. (2018-2019) Scott Kriel: 'Viability of UAV-based Antenna Pattern Measurements'
12. (2018-2019) Zain du Toit (Co-supervisor with Dr. Carlo van Niekerk): 'Wideband, low loss feed integration with a Pyramidal Sinuous Antenna'
13. (2018-2019) Jackline Koech (Co-supervisor with Dr. Gideon Wiid): 'Modified horn-type antennas for SKA RFI Monitoring'
14. (2017-2018) Michael Johnston (Co-supervisor with Dr. Carlo van Niekerk): 'Wideband Balun Design for the Pyramidal Sinuous Antenna'
15. (2017-2018) Shane Moyce: 'Hardware limitations of interference suppressing beamforming'
16. (2017-2018) William J. Cerfonteyn: 'A 22.2 GHz Antenna for Water vapour Radiometry'
17. (2015-2018) David Wolsky (Part time student): 'Automated Space-Mapping Framework for Electromagnetic Device Optimisation'
18. (2016-2017) Clifford Sibanda: 'Design and Optimization of Gap Waveguide Components through Space Mapping'
19. (2016-2017) Ridalise Louw: 'Surrogate Modelling of Performance Metrics of a Wideband Feed for the SKA Reflector Antenna'
20. (2016-2017) Malan A.X. Ruppert: 'A Study on Phased Array Feeds for Paraboloidal Reflector Antennas' – Co-Supervisor with Dr. Ryno Beyers
21. (2015-2017) Nicol Steenkamp: 'Design of a Wideband Sinuous Antenna for Radio Telescope Applications'
22. (2014-2015) Alex A. Vermeulen: 'The design of a dual reflector feed using surrogate modeling techniques'
23. (2014-2015) Brandt Klopper: 'Fast Design and Optimisation of One-Dimensional Microstrip Patch Antenna Arrays'
24. (2013-2014) Lukas M. van Vuuren: 'Design of a Receiver System for Use in Radio Astronomy'
25. (2012-2013) Ngoy Mutionkole: 'Study of a Wideband Sinuous Feed for Reflector Antenna Applications'
26. (2011-2013) Dewald Schoeman: 'Full Scale Low-Cost Ultra Wide Band Antenna for SKA Low Frequency Array'
27. (2011-2012) Alex Ibbotson: 'The Design and Analysis of a Rotman Lens with Reduced Conjugate Port Coupling' – Co-Supervisor with Prof Keith Palmer
28. (2010-2012) Stephanie Alphonse: 'Fast Analysis of a Compound Large Reflector Antenna' – Co-Supervisor with Prof Keith Palmer
29. (2010-2011) Shamim O. Nassar: 'An Investigation of the Equivalence Between Comblin and Evanescent-Mode Waveguide Filters & of Aspects Related to Reduction of Manufacturing Costs for Comblin Filters' – Co-Supervisor with Prof. Petrie Meyer
30. (2010-2011) David VdM. Prinsloo: 'Characterisation of L-band Differential Low Noise Amplifiers' – Co-Supervisor with Prof. Petrie Meyer
31. (2010-2011) Phillip Terblance: 'Electronically Adjustable Bandpass Filter' – Co-Supervisor with Prof. Petrie Meyer
32. (2009-2010) Karla Schoeman: 'Waveguide Antenna Feed for the Square Kilometre Array' – Co-Supervisor with Prof. Petrie Meyer
33. (2009-2010) Sunelle Otto: 'A study of radio astronomy principles and SKA pathfinder system designs with pulsar science' – Co-Supervisor with Prof. Petrie Meyer

CURRENT PHD STUDENTS

1. (2024 - 2026) Gary Allen (Upgraded from MEng end 2025)
2. (2025 - 2026) Michele Pugno (Co-supervisor with Prof. Annie Cuyt and Dr. Jacki Gilmore)
3. (2023-2026) Aiden Lötter (Upgraded from MEng end 2024)
4. (2024 - 2026) Graeme Young (Part-time student; co-supervisor with Dr. Werner Steyn)

CURRENT MASTERS STUDENTS

1. (2025-2026) Gerben Visser



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INGENIEURSWESE

Electrical & Electronic Engineering
Elektriese & Elektroniese Ingenieurswese

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,

Dirk de Villiers