

Section A: Overview of the Research Project

1. *Title of the research project*
Design of a feed antenna for the HIRAX telescope
2. *Broad area of research (Engineering or Science):* Engineering
3. *Academic level of research project (Masters or Doctoral):* Masters
4. *Abstract of research project*
The HIRAX telescope is currently in its prototyping phase, with dishes, feeds and receivers designed and the first prototypes delivered. There are, however, some problems with beam symmetry in the primary and secondary antenna beams. This project will perform the design and fabrication of a completely new feed antenna for the HIRAX dishes, starting from a blank slate. One can then compare the performance (electromagnetic and cost) of the new antenna to the current system, and possibly consider the new antenna for future system upgrades.
5. *Primary supervisor's details:*
 - a. *Full name of primary supervisor:* Dirk Izak Leon de Villiers
 - b. *Primary supervisor's email address (please note that if this project is approved, this email address will be made available to students to contact the primary supervisor)*
ddv@sun.ac.za
 - c. *University where primary supervisor is employed:* Stellenbosch University

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.*
The HIRAX telescope will operate over an octave bandwidth between 400 MHz and 800 MHz and employs 6 m parabolic reflectors with a deep focal ratio of 0.23. This presents some severe challenges for the feed design, since it is difficult to get an antenna that will operate over the required bandwidth, while illuminating the dish properly without causing too much coupling back into the feed from the dish apex. The current solution is a clover-leaf style crossed dipole antenna, which is very light and cheap, but has some performance problems, especially beam symmetry and cross polarization isolation.
This project will design a completely new feed for the HIRAX dishes, starting with the now maturing quad-ridge flared horn technology. Although it is not immediately clear how well such a feed will perform in the HIRAX dish, similar feeds have been made for deep parabolic reflectors such as the Effelsburg radio telescope. To keep the size of the feed down, a dielectric insert will be used in the horn. By performing this full design process, a feed can be delivered which can be compared against the performance of the current versions, to allow the system engineers on the project a choice of antenna for possible future upgrades to the system.
2. *Feasibility: outline the methods that will be used to achieve the objectives. Provide details on the availability of required data / access to required equipment / availability of research facilities and other resources required. Include any relevant expected intermediate milestones and associated timeframes towards attaining the overall objectives of the project.*
For the design work, all the software packages required are available in the group. We also have access to an antenna measurement chamber, which should be able to measure the performance of the antenna at the high end of the frequency band for comparison with simulated results. The low frequency performance can be tested through scale model prototypes, or by measuring at an outdoor range.
We have close collaboration with the HIRAX team, and Stellenbosch University is in the process of formally joining the collaboration.
3. *Link the proposed project to one or more of the SRAO research priority areas for 2024 (refer to Section 5 of the Application Guide), and explain in some detail how the proposed research will contribute to the priority area(s).*
(1) Radio astronomy antennas and receiver systems (including digitisation) associated with supported and hosted instruments.
4. This project is most suited to a student with interest in both mathematical modelling as well as antenna design. Experience in radio astronomy related projects would be helpful.

CURRICULUM VITAE

DIRK IZAK LEON DE VILLIERS

BIOGRAPHY

Dirk de Villiers started his research as a PhD student at Stellenbosch University working on wideband conical transmission line combiners in the microwave frequency range. After completion of the PhD he was appointed as a Post Doctoral fellow at Stellenbosch University by the South African Square Kilometer Array (SKA) project. He worked on several types of passive microwave devices and antennas, including the development of an improved type of orthomode transducer, the design and performance analysis of focal plane array feeds for reflector antennas, and the development of very wide band reflector antenna feeds. On completion of the fellowship he was subsequently employed full-time as a lecturer at Stellenbosch University. Here he continued research work on reflector antennas through design of offset Gregorian reflectors for the MeerKAT radio telescope as well as the shaped dishes for the SKA and ngVLA radio telescopes (in collaboration with and on contract for EMSS Antennas (Pty) Ltd in Stellenbosch, South Africa), and was promoted to Senior Lecturer in 2012 and Associate Professor in 2015. In 2018 he was promoted to Professor and appointed as the SARChI research chair in Antenna Systems for the SKA at Stellenbosch University.

During 2014 he spent six months on sabbatical as visiting researcher at Chalmers University of Technology in Gothenburg, Sweden where he started applying some formal model driven design and optimization techniques on the design of reflector antenna systems (in collaboration also with Reykjavik University in Reykjavik, Iceland). His current research interest is mainly in antenna design through model driven optimization (with applications in reflector antennas and feeds as well as arrays), but he still remains actively involved in research on other passive microwave devices such as filters and combiners through graduate student supervision.

He has received several academic awards including the ECSA Medal of Merit for the top final year engineering student at Stellenbosch University in 2004, the ESKOM award for the top final year electrical and electronic engineering student in South Africa in 2005, and the Chancellors' Medal from Stellenbosch University in 2007. The Chancellors' medal is awarded annually to the top graduating student in the university across all disciplines. Furthermore, he has received the deans award for exceptional general performance every year between 2011 and 2016, as well as the Vice-Rectors' award for research and its outputs every year from 2015 to 2017.

He serves as a reviewer for, among others, the IEEE Transactions on Antennas and Propagation, Transactions on Microwave Theory and Techniques, Antennas and Propagation Magazine, Microwave and Wireless Components Letters, and Antennas and Wireless Propagation Letters, the IET Microwaves, Antennas and Propagation, and International Journal of RF and Microwave Computer-Aided Engineering, as well as the Wiley International Journal of Numerical Modelling: Electronic Networks, Devices and Fields, and Electronics Letters, along with several international conferences in the Antennas and Propagation fields. He regularly organizes special sessions on antenna modelling and optimization, as well as antennas for radio astronomy, at international conferences, and served on the organizing committee of the 2011, 2016, and 2018 editions of the South African IEEE AP/MTT/EMC conference as well as the 2022 ICEAA conference. He is a senior member of URSI and the IEEE, and serves as rotating chair and vice-chair of the South

African IEEE joint chapter for AP/MTT/EMC since 2016. He is the main organizer of the European School of Antennas (ESoA) course on Antennas for Radio Telescopes, held in Stellenbosch, South Africa, in November 2016 and 2019, and is a regular lecturer in the ESoA Reflector and Lens Antennas course at Chalmers University in Gothenburg, Sweden (2011, 2014, 2017, and 2022 editions).

He has authored or co-authored more than 125 publications in international peer reviewed journals and conference proceedings, which has garnered more than 700 citations according to the Scopus database (excluding self-citations). His current h-index, according to the same database, is 12 (excluding self-citations).

The combiner he developed for his PhD work has been included in a textbook on high power solid state amplifiers as a standard combination network used in such systems (Solid-State Microwave High-Power Amplifiers by Franco Sechi and Marina Bujatti: Artech House).

PERSONAL INFORMATION

Birth Date	1982-10-13
Address	13 Bergpiek street Capolavoro Estate Kylemore Stellenbosch 7600 South Africa
Cell	+27 (0)83 562 8721
ID no	821013 5061 08 0
Nationality	South African
Languages	Afrikaans and English

EDUCATION

2007	PhD (Electronic Engineering) , Stellenbosch University
2004	BEng (Electric and Electronic) – Cum Laude , Stellenbosch University
2000	Senior Certificate , Paul Roos Gymnasium, Stellenbosch

AWARDS AND ACHIEVEMENTS

2022	• IEEE APS Harold A. Wheeler Applications Prize Paper Award
2019	• Vice Rectors' Award for Research Outputs , Stellenbosch University
2017	• Vice Rectors' Award for Research Outputs , Stellenbosch University
2016	• Vice Rectors' Award for Research Outputs , Stellenbosch University
2015	• Rectors' Award for General Performance , Stellenbosch University
	• Vice Rectors' Award for Research Outputs , Stellenbosch University
2014	• Rectors' Award for General Performance , Stellenbosch University
2013	• Rectors' Award for General Performance , Stellenbosch University
2012	• Best Upcoming Researcher , Engineering Faculty, Stellenbosch University
	• Rectors' Award for General Performance , Stellenbosch University
2007	• Chancellors' Medal , Stellenbosch University (Awarded annually to the top student in the university, based on excellent academic achievement as well as extra-curricular activities)
	• Best Student Paper Using CST Microwave Studio , Computer Simulation

- Technology (CST), Darmstadt, Germany
- 2005 • **Merit Award for Academic Excellence for the Top Electrical & Electronic Engineering Final Year Student in South Africa, ESKOM**
- 2004 • **ECSA Medal of Merit for the Top Final Year Engineering Student, Stellenbosch University**
- **Academic Colours, Stellenbosch University**
- **Jac van der Merwe Prize for Innovation for the Most Innovative Final Year Engineering Project, Engineering Faculty of Stellenbosch University**

PROFESSIONAL EXPERIENCE

- Jan 2018 – Present **NRF SARChI Research Chair in Antenna Systems for SKA, Stellenbosch University**
- Jan 2018 – Present **Full Professor, Stellenbosch University**
- Teach graduate Electromagnetics and Antennas courses
 - Supervisor for Masters and PhD projects in the Electronics and Electromagnetics group
 - Line Manager of Junior Lecturer, Lecturer and Senior Lecturer positions
- Jan 2016 – Dec 2017 **Associate Professor, Stellenbosch University**
- Teach graduate Electromagnetics and Antennas courses
 - Teach 2nd year Electronics courses
 - Development of a new Electronics course (344) for third year Mechanical and Industrial Engineering students, in addition to streamlining the Electronics chain of courses for E&E Engineering students
 - Supervisor for Masters and PhD projects in the Electronics and Electromagnetics group
 - Line Manager of Junior Lecturer and Lecturer positions
- Jan 2012 – Dec 2015 **Senior Lecturer, Stellenbosch University**
- Teach graduate Electromagnetics and Antennas courses
 - Teach 2nd year Electronics courses
 - Supervisor for Masters and PhD projects in the Electronics and Electromagnetics group
- Feb 2010 – Present **Contract Research, EMSS Antennas (Pty) Ltd., Stellenbosch**
- Investigation of wideband feed performance for possible use in the MeerKAT radio telescope
 - Design of the offset dual reflector system for the MeerKAT, SKA and ngVLA radio telescopes
 - Design of wideband feeds for the ngVLA radio telescope
- Feb 2010 – Dec 2011 **Lecturer, Stellenbosch University**
- Teach 2nd year Electronics courses
 - Supervisor for Masters projects in the Electronics and Electromagnetics group
- Jan 2008 – Dec 2009 **Post-Doctoral Fellow, Stellenbosch University**
- Wideband Orthomode Transducer (OMT) design for radio astronomy applications
 - Radio telescope Focal Plane Array (FPA) research
 - UWB reflector feed design
- Feb 2008 – Jun 2009 **Part Time Lecturer, Cape Peninsula University of Technology**
- Teach the final year BTech and MTech Electric and Magnetic Field Theory Course
- Jun 2001 – Jul 2004 **Student Vacation Work, Advanced Technologies and Engineering (Pty) Ltd.**
- MATLAB implementation of UAV flight model (2002 - 2004)
 - System Integration Assistant (2001 - 2002)

RESEARCH FOCUS AREAS

- Antenna design through surrogate modelling
- Reflector antennas
- Antennas for radio telescope applications
- Axially symmetric microwave power combiners

RESEARCH OUTPUTS

CITATION METRICS

Database	Citation Count		h-index	
	All	Excl. Self-Cite	All	Excl. Self-Cite
Scopus	735	~	15	12
Web of Science	550	393	~	12
Google Scholar	1081	~	18	~

Date compiled: 2022/01/18

INTERNATIONAL JOURNAL PAPERS

Most important journals in the fields of Antennas and Microwave Engineering:

IEEE Transactions on Antennas and Propagation (Impact Factor: 2.975)

IEEE Transactions on Microwave Theory and Techniques (Impact Factor: 2.897)

IEEE Antennas and Wireless Propagation Letters (Impact Factor: 2.533)

IEEE Microwave and Wireless Components Letters (Impact Factor: 1.887)

IET Microwaves, Antennas & Propagation (Impact Factor: 1.187)

Wiley Electronics Letters (Impact Factor: 1.155)

Wiley Microwave and Optical Technology Letters (Impact Factor: 0.731)

1. (2023) D.I.L. de Villiers and Z. du Toit, "Generalised feed efficiency factorization of reflector antennas", *IEEE Transactions on Antennas and Propagation*, in preparation.
2. (2023) S.G.H. Kriel and D.I.L. de Villiers, "A Figure of Merit for the X-Band All-Sky Survey", *Radio Science*, in preparation.
3. (2022) D. Crichton, M. Aich, A. Amara, K. Bandura, B. Bassett, C. Bengaly, P. Berner, S. Bhatporia, M. Bucher, T.-C. Chang, H.C. Chiang, J.-F. Cliche, C. Crichton, R. Dave, D.I.L. de Villiers, et al., "The Hydrogen Intensity and Real-time Analysis eXperiment: 256-Element Array Status and Overview", *Journal of Astronomical Telescopes, Instruments, and Systems*, vol. 8, no. 1, Jan. 2022.
4. (2022) R. Louw, F. Knaepkens, A. Cuyt, W.-s. Lee, S.J. Wijnholds, D.I.L. de Villiers and R.-M. Weideman, "Antenna Position Estimation through Sub-Sampled Exponential Analysis of Signals in the Near-Field", *Radio Science Letters*, vol. 3, 2021, pp. 1 - 5.
5. (2022) D.I.L. de Villiers and R. Lehmensiek, "Plate Scale in Shaped Offset Gregorian Reflectors", *Radio Science Letters*, vol. 3, 2021, pp. 1 - 3.
6. (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.
7. (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.

8. (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.
9. (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.
10. (2022) K. Knowles, W. D. Cotton, L. Rudnick, F. Camilo, S. Goedhart, R. Deane, M. Ramatsoku, M. F. Bietenholz, M. Brüggén, C. Button, H. Chen, J. O. Chibueze, T. E. Clarke, F. de Gasperin, R. Ianjamasimanana, G. I. G. Józsa, M. Hilton, K. C. Ksebonye, K. Kolokythas, R. C. Kraan-Korteweg, G. Lawrie, M. Lochner, S. I. Loubser, P. Marchegiani, N. Mhlahlo, K. Moodley, E. Murphy, B. Namumba, N. Oozeer, V. Parekh, D. S. Pillay, S. S. Passmoor, A. J. T. Ramaila, S. Ranchod, E. Retana-Montenegro, L. Sebokolodi, S. P. Sikhosana, O. Smirnov, K. Thorat, T. Venturi, T. D. Abbott, R. M. Adam, G. Adams, M. A. Aldera, E. F. Bauermeister, T. G. H. Bennett, 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 MeerKAT Galaxy Cluster Legacy Survey I. Survey Overview and Highlights", *Astronomy and Astrophysics*, vol. 657, no. A56, pp. 1 – 41, Jan. 2022.
11. (2021) R. Lehmensiek 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.
12. (2021) K.M.B. Asad, J.N. Girard, M. de Villiers, R. Lehmensiek, T. Ansh-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.
13. (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.
14. (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.
15. (2021) T. Marinovic, D.I.L. de Villiers, D.J. Bekers, M.N. Johansson, A. Stjernman, R. Maaskant, and G.A.E. Vandenbosch, "Fast Characterization of Mutually-Coupled Array Antennas Using Isolated Antenna Far-field Data", *IEEE Transactions on Antennas and Propagation*, vol. 69, no. 1, pp. 206-218, Jan. 2021, doi: 10.1109/TAP.2020.3016395.
16. (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.
17. (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.
18. (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.
19. (2019) I. Heywood, et al., "A major outburst event inflating 430 pc bipolar radio bubbles in the Galactic Centre", *Nature*, vol. 573, no. 7773, pp. 235 – 237, September, 2019.
20. (2019) B. Klopper and D.I.L. de Villiers, "Efficient Impedance Response Modeling of Broadband Antenna Elements in Large Sparse-Regular Phased Arrays", *IEEE Transactions on Antennas and Propagation*, vol. 67, no. 4, pp. 2809 – 2812, 2019.
21. (2019) A. Cuyt, R. Louw, C. Segers and D.I.L. de Villiers, "Rapid design of wideband unidirectional sinuous antennas through blended rational interpolation", *Wiley*

- International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*, vol. 32, no. 1, Jan/Feb 2019.
22. (2018) F. Camilo, et al., "Revival of the Magnetar PSR J1622-4950: Observations with MeerKAT, Parkes, XMM-Newton, Swift, Chandra, and NuSTAR", *The Astrophysical Journal*, vol. 856:180, no. 2, pp. 1 – 11, April, 2018.
 23. (2018) R. Lehmensiek and D.I.L. de Villiers, "Noise Temperature Approximations for Offset Gregorian Reflector Systems", *IEICE Transactions on Communication*, vol. E101-B, no. 2, pp. 332 – 339, 2018.
 24. (2018) D.I.L. de Villiers, R. Lehmensiek and M.V. Ivashina, "Effects of Diffraction and Feed Pattern Variation in Shaped Offset Gregorian Reflectors", *IEICE Transactions on Communication*, vol. E101-B, no. 2, pp. 316 – 323, 2018.
 25. (2018) D.I.L. de Villiers and S.M. Koziel, "Fast Multi-Objective Optimisation of Pencil Beam Reflector Antenna Radiation Patterns Responses Using Kriging", *IET Microwaves Antennas and Propagation*, vol. 12, no. 1, pp. 120 – 126, 2018.
 26. (2017) N. Mutonkole and D.I.L. de Villiers, "Multivariate Adaptive Sampling of Parameterized Antenna Responses", *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 3, pp. 1073 - 1080, 2017.
 27. (2016) R.D. Beyers and D.I.L. de Villiers, 'A General Impedance Tapered Transition for N-way Conical and Coaxial Combiners', *IEEE Transactions on Microwave Theory and Techniques*, vol. 64, no. 12, 2016, pp. 4482 - 4490.
 28. (2016) D.I.L. de Villiers, "Fast Parametric Modeling of Radio Astronomy Reflector Antenna Noise Temperature", *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 6, 2016, pp. 2522 - 2526.
 29. (2016) N. Mutonkole, E.R. Samuel, D.I.L. de Villiers and T. Dhaene, "Parametric Modeling of Radiation Patterns and Scattering Parameters of Antennas", *IEEE Transactions on Antennas and Propagation*, vol. 64, no. 3, 2016, pp. 1023 - 1031.
 30. (2015) R. Lehmensiek, I.P. Theron and D.I.L. de Villiers, "Deriving an optimum mapping function for the SKA shaped offset Gregorian reflectors", *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 11, 2015, pp. 4658 - 4666.
 31. (2015) R. Lehmensiek and D.I.L. de Villiers, "Optimization of Log-Periodic Dipole Array Antennas for Wideband Omni-Directional Radiation", *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 8, 2015, pp. 3714 - 3718.
 32. (2015) R.D. Beyers and D.I.L. de Villiers, "Corrections to "Compact Conical Line Combiner Design Using Circuit Models"", *IEEE Transactions on Microwave Theory and Techniques*, vol. 63, no. 7, 2015, p. 2391-2391.
 33. (2015) D.I.L. de Villiers and R. Lehmensiek, 'Rapid Calculation of Antenna Noise Temperature in Offset Gregorian Reflector Systems', *IEEE Transactions on Antennas and Propagation*, vol. 63, no. 4, April, 2015, pp. 1564 - 1571.
 34. (2014) R.D. Beyers and D.I.L. de Villiers, 'Compact Conical Line Power Combiner Design Using Circuit Models', *IEEE Transactions on Microwave Theory and Techniques*, vol. 62, no. 11, November, 2014, pp. 2650 – 2658.
 35. (2014) R. Lehmensiek and D.I.L. de Villiers, 'On reflector feeds with unidirectional axially symmetric radiation patterns, their cross-polarization performance and efficiencies'. *IEEE Antennas and Propagation Magazine*, vol. 56, February, 2014, pp. 39 - 61.
 36. (2014) R. Lehmensiek and D.I.L. de Villiers, 'Constant Radiation Characteristics for Log-Periodic Dipole Array Antennas', *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 5, May, 2014, pp. 2866 – 2869.
 37. (2014) D.J. Ludick, R. Maaskant, D.B. Davidson, U. Jakobus, R. Mittra and D.I.L. de Villiers, "Efficient Analysis of Large Aperiodic Antenna Arrays Using the Domain Green's Function Method", *IEEE Transactions on Antennas and Propagation*, vol. 62, no. 4, April, 2014, pp. 1579 – 1588.

38. (2013) A. Ibbotson, D.I.L. de Villiers and K.D. Palmer, 'A Defocused Rotman Lens with Reduced Conjugate Port Coupling', *IEEE Microwave and Wireless Components Letters*, vol. 23, no. 8, August 2013, pp. 394 – 396.
39. (2013) D.I.L. de Villiers and R. Lehmensiek, 'Modeling of the Radiation Pattern of a Pair of Thin Circular-Arc Dipoles Over an Infinite Ground Plane', *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 8, August 2013, pp. 4375 - 4378.
40. (2013) A. Young, R. Maaskant, M.V. Ivashina, D.I.L. de Villiers and D.B. Davidson, 'Accurate Beam Prediction Through Characteristic Basis Function Patterns for the MeerKAT/SKA Radio Telescope Antenna', *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 5, May, 2013, pp. 2466 – 2473.
41. (2013) D.I.L. de Villiers, 'Prediction of Aperture Efficiency Ripple in Clear Aperture Offset Gregorian Antennas', *IEEE Transactions on Antennas and Propagation*, vol. 61, no. 5, May, 2013, pp. 2457 – 2465.
42. (2011) D.I.L. de Villiers, 'Offset Dual Reflector Antenna System Efficiency Predictions Including Sub-Reflector Diffraction', *IEEE Antennas and Wireless Propagation Letters*, vol. 10, 2011, pp. 947 - 950.
43. (2011) D.I.L. de Villiers, 'Aperture Efficiency Predictions in Symmetrical Paraboloidal Reflector Antennas with Non Planar Log-Periodic Type Feeds', *IEEE Antennas and Wireless Propagation Letters*, vol. 10, 2011, p 476 - 479.
44. (2009) D.I.L. de Villiers, P. Meyer and K.D. Palmer, 'Broadband Offset Quad-Ridged Waveguide Orthomode Transducer', *Electronics Letters*, vol. 45, no. 1, January, 2009, pp 60 – 62.
45. (2009) D.I.L. de Villiers and P. Meyer, 'The Numerical Calculation of Analytic Solutions for Higher-Order Modes in Conical Lines', *International Journal of RF and Microwave Computer-Aided Engineering*, vol. 19, no. 1, January, 2009, pp. 99-109.
46. (2008) D.I.L. de Villiers, P.W. van der Walt and P. Meyer, 'Design of Conical Transmission Line Power Combiners Using Tapered Line Matching Sections', *IEEE Transactions on Microwave Theory and Techniques*, vol. 56, no. 6, June, 2008, pp. 1478-1484.
47. (2007) D.I.L. de Villiers, P.W. van der Walt and P. Meyer, 'Design of a 10-Way Conical Transmission Line Power Combiner', *IEEE Transactions on Microwave Theory and Techniques*, vol. 55, no. 2, February, 2007, pp. 302-308.

INTERNATIONAL CONFERENCE PROCEEDINGS

Most important conferences in the fields of Antennas and Microwave Engineering:

IEEE International Microwave Symposium (IMS)

IEEE AP-S International Symposium on Antennas and Propagation

European Conference on Antennas and Propagation (EuCAP)

European Microwave Conference

International Conference on Electromagnetics in Advanced Applications (ICEAA)

International Symposium on Antennas and Propagation

1. (2023) M. Venter and D.I.L. de Villiers, "Beam modeling of reflector antennas across elevation", *URSI General Assembly*, Sapporo, Japan, August 2023, *submitted*.
2. (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, *submitted*.
3. (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, *submitted*.
4. (2023) Z. du Toit, F.T.T. Mokhupuki and D.I.L. de Villiers, "Tri-ridged waveguide orthomode transducer", *International Microwave and Antennas Symposium*, Cairo, Egypt, February 2023, *accepted*.

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7. (2021) E. De Lera Acedo and D.I.L. de Villiers on behalf of the REACH collaboration, "Exploring the sky-averaged 21-cm line from the South African Karoo using REACH", *URSI General Assembly*, Rome, Italy, August 2021.
8. (2021) R. Lehmsiek 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.
9. (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.
10. (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.
11. (2017) R. Lehmsiek and D.I.L. de Villiers, "On the performance limits of the SKA1-mid reflector system", 32nd URSI General Assembly, Montreal, Canada, August, 2017.
12. (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.
13. (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. Mutonkole, 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.

REVIEWER FOR ACADEMIC LITERATURE

JOURNALS

IEEE

- Transactions on Microwave Theory and Techniques (TMTT)
- Transactions on Antennas and Propagation (TAP)
- Antennas and Propagation Magazine (APM)
- Antennas and Wireless Propagation Letters (AWPL)
- Microwave and Wireless Components Letters (MWCL)

IET

- Microwaves, Antennas and Propagation (IETMAP)
- Electronics Letters (EL)

Wiley

- International Journal of Numerical Modelling: Electronic Networks, Devices and Fields
- International Journal of RF and Microwave Computer-Aided Engineering

URSI

- Radio Science Letters

Taylor and Francis

- Journal of Electromagnetic Waves and Applications
- International Journal of Electronics

Emerald

- Engineering Computations

Hindawi

- International Journal of Antennas and Propagation

Bentham Science

- Recent Patents on Electrical Engineering

SAIEE

- Africa Research Journal

CONFERENCES

- **European Microwave Week (EMW):** 2020 - present
- **IEEE International Symposium on Antennas and Propagation (AP-S):** 2018 - present
- **European Conference on Antennas and Propagation (EuCAP):** 2014 - present
- **International Conference on Electromagnetics for Advanced Applications (ICEAA):** 2017 - present

GRADUATE SUPERVISION

COMPLETED PHD DEGREES

1. (2021-2022) Prof Coenrad Fourie (DEng): 'Inductance in Superconductor Integrated Circuits'
2. (2019-2022) Ridalise Louw (Co-supervisor with Prof Annie Cuyt): 'Sub-Sampled Exponential Analysis Applied to Sparse Planar Antenna Array Configurations'
3. (2017-2020) Fahmi Mokhupuki: 'Efficient Optimisation of Wideband Reflector Feed Antennas'
4. (2016-2019) Jako du Toit (Upgraded from Masters in 2018): 'Partially Filled Radial Power Combiner with Port Isolation'
5. (2018-2019) Jan-Gerald Bij de Vaate: 'Expanding the Field of View: Station Design for the AAMID SKA Radio Telescope'
6. (2016-2018) Brandt Klopper: 'Antenna Elements for Sparse-Regular Aperture Arrays'
7. (2014-2016) Ngoy Mutonkule, 'Modelling of Antenna Responses'
8. (2013-2015) Ryno D. Beyers: 'Circuit Model Design of Conical Transmission Line Power Combiners and Isolation of Reactive Combiners'

COMPLETED MASTERS DEGREES

1. (2020-2022) Yusuf Dhoda (Co-supervisor with Dr Werner Steyn): 'Wide-Band Radio Receiver for Radio Astronomy Applications'
2. (2020-2021) Insight Agbetsiafa (Co-supervisor with Dr Trienko Grobler): 'An RFI Simulation Pipeline to Help Teach Interferometry and Machine Learning'
3. (2020-2021) Stella Schleich: 'Design and implementation of a two-element interferometer'
4. (2020-2021) Jacques Wolmarans: 'Beam ripple modelling in wideband dual-reflector antenna systems'
5. (2020 - 2021) Insight Agbetsiafa (Co-supervisor with Dr. Trienko Grobler): 'An RFI Simulation Pipeline to Help Teach Interferometry and Machine Learning'
6. (2017-2020) Hein Swart (Part time student): 'Wideband Axially Symmetric Power Combiners Based on Short Step Filters'
7. (2019-2020) Rina-Mari Weideman: 'Linear Sparse Regular Array Antenna Demonstrator'
8. (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)
9. (2018-2019) Scott Kriel: 'Viability of UAV-based Antenna Pattern Measurements'

10. (2018-2019) Zain du Toit (Co-supervisor with Dr. Carlo van Niekerk): 'Wideband, low loss feed integration with a Pyramidal Sinuous Antenna'
11. (2018-2019) Jackline Koech (Co-supervisor with Dr. Gideon Wiid): 'Modified horn-type antennas for SKA RFI Monitoring'
12. (2017-2018) Michael Johnston (Co-supervisor with Dr. Carlo van Niekerk): 'Wideband Balun Design for the Pyramidal Sinuous Antenna'
13. (2017-2018) Shane Moyce: 'Hardware limitations of interference suppressing beamforming'
14. (2017-2018) William J. Cerfonteyn: 'A 22.2 GHz Antenna for Water vapour Radiometry'
15. (2015-2018) David Wolsky (Part time student): 'Automated Space-Mapping Framework for Electromagnetic Device Optimisation'
16. (2016-2017) Clifford Sibanda: 'Design and Optimization of Gap Waveguide Components through Space Mapping'
17. (2016-2017) Ridalise Louw: 'Surrogate Modelling of Performance Metrics of a Wideband Feed for the SKA Reflector Antenna'
18. (2016-2017) Malan A.X. Ruppert: 'A Study on Phased Array Feeds for Paraboloidal Reflector Antennas' – Co-Supervisor with Dr. Ryno Beyers
19. (2015-2017) Nicol Steenkamp: 'Design of a Wideband Sinuous Antenna for Radio Telescope Applications'
20. (2014-2015) Alex A. Vermeulen: 'The design of a dual reflector feed using surrogate modeling techniques'
21. (2014-2015) Brandt Klopper: 'Fast Design and Optimisation of One-Dimensional Microstrip Patch Antenna Arrays'
22. (2013-2014) Lukas M. van Vuuren: 'Design of a Receiver System for Use in Radio Astronomy'
23. (2012-2013) Ngoy Mutonkole: 'Study of a Wideband Sinuous Feed for Reflector Antenna Applications'
24. (2011-2013) Dewald Schoeman: 'Full Scale Low-Cost Ultra Wide Band Antenna for SKA Low Frequency Array'
25. (2011-2012) Alex Ibbotson: 'The Design and Analysis of a Rotman Lens with Reduced Conjugate Port Coupling' – Co-Supervisor with Prof Keith Palmer
26. (2010-2012) Stephanie Alphonse: 'Fast Analysis of a Compound Large Reflector Antenna' – Co-Supervisor with Prof Keith Palmer
27. (2010-2011) Shamim O. Nassar: 'An Investigation of the Equivalence Between Compline and Evanescent-Mode Waveguide Filters & of Aspects Related to Reduction of Manufacturing Costs for Compline Filters' – Co-Supervisor with Prof. Petrie Meyer
28. (2010-2011) David VdM. Prinsloo: 'Characterisation of L-band Differential Low Noise Amplifiers' – Co-Supervisor with Prof. Petrie Meyer
29. (2010-2011) Phillip Terblance: 'Electronically Adjustable Bandpass Filter' – Co-Supervisor with Prof. Petrie Meyer
30. (2009-2010) Karla Schoeman: 'Waveguide Antenna Feed for the Square Kilometre Array' – Co-Supervisor with Prof. Petrie Meyer
31. (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. (2021-2023) Carla Pieterse
2. (2021-2023) Rina-Mari Weideman (Co-supervisor with Prof Annie Cuyt)
3. (2020-2023) Mariet Venter

4. (2020-2023) Scott Kriel
5. (2020-2023) Zain du Toit (Co-supervisor with Prof. Robert Lehmensiek)
6. (2019-2023) Malan A. X. Ruppert (Co-supervisor with Prof. Matthys Botha)
7. (2019-2023) William Cerfonteyn

CURRENT MASTERS STUDENTS

1. (2023) Aiden Lötter
2. (2022-2023) Henry Johnston
3. (2022-2023) Raynard Swanepoel (Co-supervisor with Dr. Danie Ludick)
4. (2018-2022) Ben van der Merwe (Part time student)

PROFESSIONAL SERVICE

EXTERNAL EXAMINER

PhD:

- Chalmers University of Technology, Gothenburg, Sweden
- Technical University of Eindhoven, Netherlands
- Antwerp University, Belgium
- Rhodes University, Grahamstown, South Africa

Masters:

- University of Pretoria, Pretoria, South Africa
- University of Cape Town, Cape Town, South Africa

INTERNATIONAL WORKSHOPS AND CONFERENCES

- Organizing committee co-chair of the International Conference on Electromagnetics in Advanced Applications (ICEAA), Cape Town, South Africa, September 2022.
- Technical Programme Committee of the IEEE MTT-S International Conference on Numerical Electromagnetic and Multiphysics Modeling and Optimization (NEMO), Reykjavik, Iceland, August, 2018
- Technical Programme Committee of the European Conference on Antennas and Propagation (EuCAP), 2017 – present
- Main organizer of the European School of Antennas course: Antennas for Radio Telescopes; Stellenbosch University, South Africa, (2016, 2019)
- Invited lecturer at the European School of Antennas course: Reflector and Lens Antennas; Chalmers University of Technology, Gothenburg, Sweden (2011, 2014, 2017, 2022)

LOCAL CONFERENCES

- Organising committee co-chair of the South African AP/MTT/EMC conference in Stellenbosch, South Africa, (2011, 2016, 2018)

PROFESSIONAL SOCIETIES

- Senior Member of URSI (2019 - Present)
- Rated researcher at the South African National Research Foundation: Level C1
- IEEE South African Section Joint AP/MTT/EMC Chapter: Chair (2017 – 2018)
- IEEE South African Section Joint AP/MTT/EMC Chapter: Vice chair for AP (2016,2019-2022)
- Senior member of the IEEE (2015 – Present, #80174571)
- Member of the IEEE (2010 - 2015)
- Member of the IEEE Antennas and Propagation Society (2009 - Present)
- Member of the IEEE Microwave Theory and Techniques Society (2008 - Present)
- Student Member of the IEEE (2005 - 2009)
- Golden Key International Honour Society (2003 - Present)

COLLABORATIONS

INTERNATIONAL

2011 – Present: **Chalmers University of Technology; Gothenburg, Sweden**

Prof. Per-Simon Kildal, Prof. Marianna Ivashina; Prof and Rob Maaskant

Outgoing research visits in 2014, 2016 and 2017

- Antenna design for the SKA
- Fast design of antenna arrays

2014 – 2018: **Ghent University; Ghent, Belgium**

Prof. Tom Dhaene and Dr. Ivo Couckuyt

Joint supervision of PhD student from Stellenbosch through student visit to Ghent in 2015; Collaborative research

- Parametric modelling of antenna impedance characteristics
- Surrogate based optimization of antenna responses using Kriging models

2014 – 2017: **Reykjavik University; Reykjavik, Iceland**

Prof. Slawomir Koziel

Collaborative research

- Surrogate based optimization of antennas

2016 – Present: **Antwerp University; Antwerp, Belgium**

Prof. Annie Cuyt

Joint supervision of Masters' student from Stellenbosch through student visit to Antwerp in 2016-2017

- Rational interpolation modelling of antennas

2012 – 2013: **Novi Sad University; Novi Sad, Serbia**

Prof. Vesna Crnojevic-Bengin

Outgoing research visits in 2012 and 2013

- Design of frequency selective surfaces

LOCAL

2015 – 2017: **University of Pretoria**

Dr. Pieter Jacobs

Collaborative research

- Gaussian process modelling of reflector antennas

2015 – Present: **University of Pretoria**

Prof. Tinus Stander

Joint supervision of Masters students from Stellenbosch and Pretoria Universities

- Radial power combiners and antenna arrays
- Development of a water vapour radiometer

REFERENCES

Prof. Petrie Meyer

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