

## **Section A: Overview of the Research Project**

1. *Title of the research project*  
Design of a low noise amplifier 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. This project will perform the design, fabrication, and measurement of a new low noise amplifier (LNA) for the HIRAX telescope using the latest transistor technology. Both a differential and a single ended version will be made to be compatible with any type of future feed upgrade.
5. *Primary supervisor's details:*
  - a. *Full name of primary supervisor:* Werner Steyn
  - 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)*  
wernersteyn@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 currently uses a so-called clover leaf crossed dipole antenna with a differential LNA first stage amplifier instead of a passive balun. This reduces the loss in the antenna structure, but at the apparent cost of beam symmetry in the system due to the difficulty in physically feeding the crossed dipoles symmetrically with a differential line. The current system also displays higher measured loss than anticipated. Efforts are underway to properly characterize the LNA and feed assembly in terms of beam pattern and noise temperature.  
This project will start anew with the design of an LNA for the HIRAX band, using the latest available commercial transistors, and deliver both a single-ended and differential version of the LNA. The amplifier will be carefully characterized in terms of gain, noise performance and stability, to simplify later integration with the current antenna or new versions if needed.
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 have in-house PCB fabrication capability, and access to industrial manufacturers for precision work. The group hosts and runs a well-equipped RF and microwave laboratory to measure the performance of the amplifiers for comparison with simulated results.  
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.



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Abbreviated *Curriculum vitae*

Werner Steyn

June 2023

## BIOGRAPHICAL SKETCH

### PERSONAL INFORMATION

<b>Surname</b>	Steyn	<b>Name</b>	Werner
<b>Title</b>	Dr	<b>Nationality</b>	RSA
<b>CURRENT EMPLOYMENT INFORMATION</b>			
<b>Organisation</b>	Stellenbosch University	<b>Department/Division</b>	Electric & Electronic Engineering
<b>Position</b>	Senior Lecturer	<b>Email address</b>	<a href="mailto:wernersteyn@sun.ac.za">wernersteyn@sun.ac.za</a>
<b>Tel.</b>	Cell: 0836399930	<b>Web address</b>	N/A

## RECENT EMPLOYMENT HISTORY

<b>Employer</b>	<b>Position</b>	<b>Period</b>
Stellenbosch University	Senior Lecturer	March 2021 -
Reutech Radar Systems	Technology Executive	2013 – Feb 2021
Reutech Radar Systems	Design Engineer	2002 - 2013

## HIGHEST ACADEMIC QUALIFICATION(S)

<b>Degree</b>	<b>Field of study</b>	<b>Higher education institution</b>	<b>Year</b>
PhD	Electric and Electronic Engineering	Stellenbosch University	Dec 2001

## POST GRADUATE SUPERVISION

<b>Degree</b>	<b>Current number of students</b>	<b>Completed number of students</b>
PhD	2	1
MSc	3	2

## RESEARCH/SCIENTIFIC/TECHNICAL OUTPUTS

Type	Number	Number as First or communicating author
Articles in peer-reviewed or refereed journals	2	1
Published conference papers	12	2
Patents	1	0

## RESEARCH PUBLICATION OUTPUTS

### FULL REFERENCES OF PEER-REVIEWED ARTICLES IN THE LAST FIVE YEARS

#### Papers in refereed journals:

1. D. Klink, P. Meyer and W. Steyn, "Efficient Yield Estimation of Multiband Patch Antennas Using NLPLS-Based PCE," in *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 8, pp. 7037-7045, Aug. 2022, doi: 10.1109/TAP.2021.3138496.

#### Refereed full length papers in the proceedings of international symposia:

1. D. Klink, P. Meyer and W. Steyn, "Comparison of Coefficient Calculation Techniques for NLPLS PCE Models of Antennas," *2022 16th European Conference on Antennas and Propagation (EuCAP)*, 2022, pp. 1-5, doi: 10.23919/EuCAP53622.2022.9769179.
2. K. Kotzé, P. Meyer and W. Steyn, "Design and Measurement of a Bandwidth Enhanced Quad-Ridged OMT," *2022 16th European Conference on Antennas and Propagation (EuCAP)*, 2022, pp. 1-4, doi: 10.23919/EuCAP53622.2022.9769398.
3. P.W. van der Walt and W. Steyn, "Where RF meets DC," *2022 International Conference on Electromagnetics in Advanced Applications (ICEAA)*, September 2022
4. D. Klink, P. Meyer and W. Steyn, "Efficient sensitivity analysis of EM structures using NLPLS-based PCE," *2022 International Conference on Electromagnetics in Advanced Applications (ICEAA)*, September 2022
5. J Fourie, P. Meyer and W. Steyn, "Helical Resonator Notch Filter for Protection Against Jamming," *2022 International Conference on Electromagnetics in Advanced Applications (ICEAA)*, September 2022
6. B. Wessels, K. Kotzé, L Johnson, W. Steyn and P. Meyer, "Optimization-Based Multimodal Characterization of Waveguide Transitions," *2022 International Conference on Electromagnetics in Advanced Applications (ICEAA)*, September 2022
7. W. Steyn, "Ultra-Wideband Modified Bow-Tie Antenna for FMCW GPR Applications," *2023 17th European Conference on Antennas and Propagation (EuCAP)*, Florence, Italy, 2023