South African Square Kilometre Array Project Postgraduate Bursary Programme

MEng Research Project Proposal to be considered for Bursary Funding to Commence in 2020

1. Title of Research Project: RFI Warning System Development

2. Academic Level: M Eng

3. Supervisor's Title and Full Name: Dr Pieter Gideon Wiid

4. Co-supervisor's title and full name: Mr Arno Barnard

5. Supervisor's University: Stellenbosch University

6. Overview and Aims of the Research Project:
The Square Kilometre Array (SKA) Project is extremely sensitive and highly susceptible to radiated emissions from common communication sources like mobile phone GSM, LTE, Bluetooth and Wi-Fi signals. This project topic deals with the development of a system that can do detection of RFI and provide a warning notification through sounding an alarm or visual indication of RFI detection, especially for visitors to the site. The system development will include the RF front-end development, hardware and software integration of the detection component, the warning notification, as well as its own shielding and filtering to operate close to the core of the SKA and comply with SARAO RFI policies.

7. Relevance of the research proposed to the priority areas of MeerKAT / SKA:
The monitoring of interference in the radio quiet zone in the Karoo is becoming more relevant with the MeerKAT telescope actively doing scientific observations.
This falls in priority area 4.2.3 Hardware and data analysis systems for detecting, monitoring and identifying Radio Frequency Interference (RFI), including the use of telescope data (e.g. using MeerKAT visibilities to locate RFI sources).

8. Research work breakdown:

a. Year 1: The student will conduct an in-depth literature study in the first semester of current telecom signal detection systems, current designs and implementations as well as available hardware for front-ends of such systems, processing and control methods and applications, and electromagnetic compatibility principles of shielding and filtering. The second semester will include proposed designs of such systems in simulation, with proposed implementation in available hardware, and evaluating their benefits and drawbacks.

b. Year 2: The first semester of year 2 will include construction and testing of the selected proposed system designs, further optimisation and proper shielding and filtering for testing in a controlled environment, with possible testing at the SKA site. The dissertation writing will be done during this time as well, where the second semester will be used for the final analysis and completing the dissertation.

9. Availability of required data / access to required equipment /availability of research facilities and other resources required:

The Stellenbosch University has a shielded reverberation chamber, an anechoic chamber, a Rohde and Schwarz 8 GHz network analyser, as well as a Rohde and Schwarz 40 GHz Spectrum Analyser and soon a Tektronix 2.5 GHz oscilloscope for testing purposes. A 3D-printer as well as numerous fine-mechanic machinery and materials are available at the E&E Department workshops, for prototype container parts. A PCB milling facility is also available in the department. Electronic components for filters and other system hardware components can be sourced through the university as well.