South African Square Kilometre Array Project Postgraduate Bursary Programme

MEng Research Project Proposal to be considered for Bursary Funding to Commence in 2019

1. Title of Research Project: SDR-Based Measurement Systems
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:
This topic deals with the development of low-cost spectrum analysers and real-time spectrum analysers using software-defined radio (SDR) boards together with mini-computer boards like the Raspberry Pi or Beaglebone Black and/or FPGA-based processing boards like the Parallela. System architecture and integration are important in this topic. Different low-cost architectures will be evaluated to propose the most viable low-cost measurement systems for use on UAV's and farms for the SKA.
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 as the AGA act will be in effect from 2019. Monitoring on farms and measurements of ICASA licensed emitters using UAV's are required to assist in this task, requiring multiple low-cost and low-form-factor measurement systems. This falls in priority area 5 - Instrumentation and data analysis for Radio Frequency Interference (RFI) detection, analysis and archival.
8. Research work breakdown:
a. Year 1: The student will conduct an in-depth literature study in the first semester of current spectrum analyser, real-time spectrum analyser and oscilloscope technologies, as well as alternative technologies currently using SDR's and processing boards. The second semester will include the evaluation and benchmarking of different hardware solutions to investigate different system architectures. This semester would also involve the design of prototype measurement systems and evaluating their benefits and drawbacks.
b. Year 2: The first semester of the year 2 will include construction and testing of proposed system designs, where the best option will be selected and further optimised for possible use on a Karoo farm (off the SKA main site) or on a UAV-based sytem . 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 and Rohde and Schwarz network analyser, as well as a Rohde and Schwarz Spectrum Anlyser for

benchmark testing. A transient analyser system like the SKA RTA3 and a real-time spectrum analyser available at SARAO Cape Town offices will be required for testing as well. A 3D-printer is available at the E&E Department, if prototype parts are required. A PCB milling facility is also available in the department. Electronic components can also be sourced through the university as well.

10. Signature and Date

2018/08/28

Dr Pieter Gideon Wiid

Date