Section A: Overview of the Research Project Proposal

1) **Title of research project:** Monitoring Radio Frequency Interference for Radio Astronomy Observatory

2) **Broad area of research:** Engineering

3) **Academic Level of research project:** MEng

4) **Research project abstract/summary (max 250 words):**

A well-known problem at the SKA Karoo site is the interference from other radio signals, such as air traffic communication, that results in a reduced signal-to-interference ratio and problems with amplifier linearity for specific frequencies. In order to minimise potential data loss or damage to sensitive equipment, prompt identification of RFI sources is necessary. A real-time RFI monitoring system can improve the overall system reaction time for adaptive RFI mitigation. Therefore, this masters project aims to realise a working real-time RFI monitoring system using SDR and other COTS components with the aim of providing information to an adaptive front-end radio astronomy receiver.

5) **Primary supervisor's details:**

a. **Full name:** Dr Jacki Gilmore

b. **Email address:** jackivdm@sun.ac.za

c. **University:** Stellenbosch University

5) **Co-supervisor's details:**

a. **Full name:** Dr Elmine Meyer

b. **Email address:** e.meyer@tue.nl

c. **University:** Eindhoven University of Technology

Section B: Details of the Research Project Proposal

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.**

A well-known problem at the SKA Karoo site is the interference from other radio signals, such as air traffic communication, that results in a reduced signal-to-interference ratio for specific frequencies. The main goal of this masters project is to realise a working real-time RFI monitoring system using SDR and other COTS components with the aim of providing information to an adaptive front-end radio astronomy receiver.

Envisioned minor objectives:

- A review of variable receiver topologies in view of figures-of-merit such as operational bandwidth, frequency range and system noise temperature.
- A review of digital signal processing techniques relevant to the chosen application.

Envisioned major objectives:

- Development of a real-time RFI monitoring system using SDR and other COTS components for information input to radio astronomy receivers.
- Development of real-time information prompt signal format and methodology to enable an adaptive front-end to mitigate RFI.

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.**

The antenna will be designed with the aid of commercial electromagnetic simulation software, and manufactured and measured at in-house facilities.

A well-equipped antenna test range and all the required software tools, and an established workshop with qualified technical staff are available in-house at Stellenbosch University.

Timeframe and intermediate milestones:

Semester 1: The student will complete coursework and literature review relevant to the topic.

Semester 2: Preliminary RFI measurements and system design and advanced simulation will take part in this semester.

Semester 3: Design refinement, prototype manufacturing and assembly. Final system construction and preliminary measurements.

Semester 4: Final measurements, data analysis, and writing of thesis.

3) **Link the proposed project to one or more of the SARAO research priority areas for 2021 (refer to Section 5 of the Application Guide), and explain in some detail how the proposed research will contribute to the priority area(s).**

Research priority area: 5.2.1 Radio astronomy antennas and receiver systems (including digitisation) associated with supported and hosted instruments and 5.2.3 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).

The aim of this masters project is to realise a working real-time RFI monitoring system using SDR and other COTS components with the aim of providing information to an adaptive front-end radio astronomy receiver. The research therefore contributes to radio astronomy antennas and receiver systems given the design, manufacturing and measurement of an RFI monitoring station. It is necessary to do preliminary RFI measurements and identify RFI sources in order to create initial design specifications. Therefore, the research directly contributes to RFI identification and hardware for RFI mitigation. The results of this project will enable improved receiver response to troublesome RFI.

4) **If relevant, describe any particular qualifications, academic abilities, skills and/or experience that a student should have in order to successfully deliver on the objectives of the research proposed.**

Not relevant