

Research Project Proposal for Masters Research 2020

Section A: Overview of the Research Project Proposal

Academic level of research project: Masters

Broad field of research: Engineering

Title of the research project: Performance comparison trade-off investigation between Vivaldi and Sinuous Antenna.

Abstract/Summary:

The Sinuous Antenna has been proposed and investigated for use as a single-pixel feed antenna for SKA applications. It has numerous advantages such as wideband and stable phase center. There are however challenges in the manufacturing and feeding of the Sinuous Antenna. To put the benefits in better context it could prove useful to compare it to another antenna which has similar attributes. The Vivaldi antenna is such an antenna.

In this project, we explore the merits of the Vivaldi as a candidate antenna for reflector feeding and directly compare the performance and implementation of the two solutions.

Section C: Full Research Project Proposal

1. Scientific Merit

The goal of this research project is to put the performance benefit of Sinuous Antenna as a feed antenna in context by comparing it to an antenna that offers similar bandwidth performance while reducing the implementation complexity. The Sinuous Antenna has been

investigated for a while and the performance is fairly well understood [1, 2]. The performance remains promising but the actual implementation remains a challenge. The Vivaldi as an option has not been given the same examination and could prove insightful to do a direct comparison.

Performance is an important metric but ease of implementation and the reliability of such a design are also crucial factors in determining the better solution. This project seeks the answer some of these questions.

- [1] R. Gawande and R. Bradley, "Towards an ultra-wideband low noise active sinuous feed for next generation radio telescopes," IEEE Transactions on Antennas and Propagation, vol. 59, no. 6, pp. 1945 - 1953, June 2011.
- [2] D. I. L. de Villiers, "Initial study of a pyramidal sinuous antenna as a feed for the SKA reflector system in band-1," in 2017 IEEE International Symposium on Antennas and Propagation USNC/URSI National Radio Science Meeting, July 2017, pp. 555-556.

2. Feasibility

Methods:

This work will feature lots of simulation work, both full-wave solvers like CST Microwave Studio and Microwave Circuit Solvers like AWR. UCT is fully capable of handling this requirement.

To verify models and simulation results there is need to do rigorous testing. Thus numerous design prototypes will be built and their performance will be validated in our RF Lab (as well as outside testing facilities) which houses all the test equipment we require.

This project is expected to take 2 years.

1st year objectives – develop a linear polarized Vivaldi antenna using theoretical design and explore fully in simulation. Fabricate & test and finally compare to the linear polarized Sinuous Antenna.

2nd year objectives – Extend the design to support circular polarization.

This research is linked to priority area 3: "Radio Astronomy antennas and receivers." The balun is an important device that allows for a balance current distribution on the feed antenna that will illuminate the dish. The benefits of this work is that performance of such structures/devices can be improved and also analysis methods/models can potentially be used elsewhere to benefit the project.

The ideal student should have an aptitude for problem solving and creative thinking. He/she should have an interest in Electromagnetics or Microwave Theory.



18 September 2019