Search for Terrestrial and Extraterrestrial Technosignatures with the MWA

Research Field
Radio Astronomy/Engineering

Project Suitability
PhD
Honours

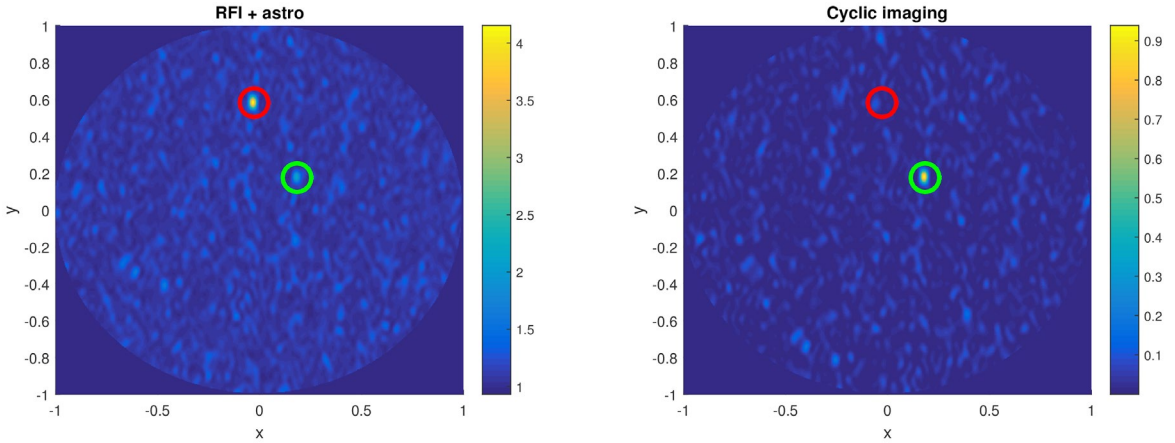
Project Supervisor
Dr Ian Morrison
ian.morrison@curtin.edu.au

Co-Supervisors
Dr Gregory Hellbourg
ghellbourg@astro.caltech.edu

The radio Search for Extraterrestrial Intelligence (SETI) is a worldwide effort aiming at detecting artificial radio transmissions from intelligent and communicative civilizations throughout the Universe, and demonstrate the non-uniqueness of life across the Universe. Many SETI programs have been conducted over the last decades, searching for narrowband features of non-human origin. Most of these ran on commensally collected data from world-class radio telescopes, with limited flexibility in sky, time, and frequency coverage.

The Murchison Widefield Array is (MWA), operated by the Curtin Institute of Radio Astronomy, is a low-frequency radio interferometer unparalleled in its wide field-of-view and the flexibility it offers to implement state-of-the-art signal processing methods to detect unknown artificial transmissions. The project offered here involves the development of an imaging pipeline - called *Cyclone* - enhancing active information-bearing radio transmissions through the exploitation of their non-stationary features, to distinguish them from natural astronomical transmissions. Figure 1 shows a comparison between the classic astronomical imaging pipeline and the Cyclone pipeline with a simulated data set featuring a natural astronomical source and an artificial transmission. The detected transmitters will then be classified into terrestrial or non-terrestrial sources after a thorough analysis of their locations and trajectory. This imaging system will be the first high-sensitivity wide-field SETI pipeline, releasing spatial constraints in the search parameter space. The detection of terrestrial transmitters will also support the creation of a Radio Frequency Interference database, providing an accurate assessment of the radio quietness and possible observational threats to the MWA telescope.

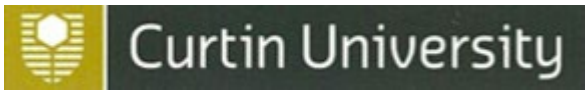
This project is suitable for students with Instrumental astronomy / Signal processing / Computer science backgrounds. Good programming skills required (C/CUDA/Python).



a. *Simulated result of classic all-sky energy-based imaging, featuring both an astronomical source (SNR = +5dB, highlighted in red) and an artificial transmitter (SNR = 0dB, highlighted in green)*

b. *Simulated result of the Cyclone imaging pipeline ran on the same dataset as shown in figure (a). The natural source is this time not detected, whereas the artificial transmission has been enhanced.*

Figure 1. Simulated comparison between the classic astronomical imaging pipeline and the Cyclone imaging pipeline


Curtin University