Characterization of the RFI Environment at DRAO : The Classical Approach

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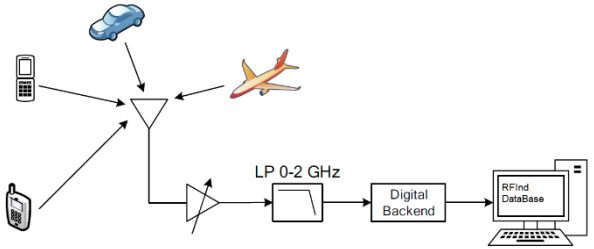
RFInd

The Dominion Radio Astrophysical Observatory (DRAO) is located in interior BC, Canada and due to the natural RFI protection provided by the surrounding mountain ranges it has been selected to host multiple radio telescopes including the Canadian Hydrogen Intensity Mapping Experiment (CHIME), the DRAO Synthesis Telescope and the John A. Galt 26m Telescope.

The recently started RFI novelty detection (RFInd) project expect to characterize the RFI environment at DRAO using machine learning techniques. The monitoring has just started in August 2021 and the initial configuration covers the frequency range from 350 – 1800 MHz for a single polarization with time resolution of 750 ms and frequency resolution of 3.33 kHz.

Another ongoing project at DRAO is the Advanced Radio Telescope Test Array (ARTTA-4) with the aim of testing the novel telescope timing distribution concept proposed in *"Incoherent clocking for radio telescopes"*, B. Carlson, Astronomical Telescopes + Instrumentation, 2020, on-the-sky by upgrading the entire signal chains for 4 of the antennas of the existing Synthesis Telescope with the state of the art receiver, data transmission and digitizer technologies. Subsequently, this array is to be used as a test bed for the current and future technologies developed at DRAO and its collaborators.

A study has been initiated to estimate the achievable sensitivities with the ARTTA-4 and the RFI environment is a key factor in this estimation. In this study we expect to follow the classical approach outlined in *"Spectrum Quietness Metrics for Radio Astronomy"*, A. Chippendale and K. Wormnes, APEMC-2013 for characterizing the RFI environment at DRAO and we are particularly interested in the time variation of the ***Total RFI Power*** in the diurnal cycles.

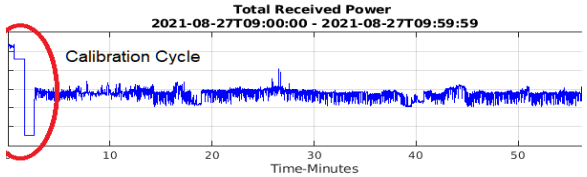


RFInd receiver systems consisted of an Omni-directional antenna to capture the RFI at DRAO, then these signals are amplified and low-pass filtered to supress signals > 2 GHz and digitized at the rate of 4 Gsps. A FPGA-GPU hybrid Channelizer segments the digitized sequence into 600,000 channels and the power in each channel is accumulated for 750 ms before being saved into the 'RFInd Database'.

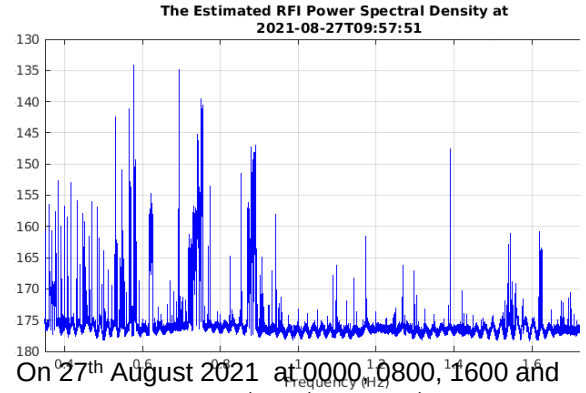
A calibration cycle runs in the beginning of every hour with the following order

- 1 minute noise diode + antenna
- 1 minute noise diode + matched load
- 1 minute matched load only
- 57 minutes antenna only

The *effective* Excess Noise Ratio (ENR) of the Noise diode is ~10 dB.



The system gain estimates made with 50 Ω load is used to ccalibrate RFI measurements every hour. The estimated power spectral density (in dBm/Hz) of the spectrum at 09.57.51 on 2021-08-27 is shown below.



On 27th August 2021 at 0000, 0800, 1600 and 2400 hrs the 1st, 10th, 90th, and 99th percentiles for the observed Total- Power distribution for ARTTA-4 Band-1 (0.4-0.8 GHz) is shown below.