The GMRT Pulsar Tool (gptool)

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Description

The GMRT Pulsar Tool (gptool) is a real-time RFI mitigation tool for beamformer data used at the Giant Metrewave Radio Telescope. The tool processes beamformer data from the telescope in default chunks of 5 seconds (can be changed at runtime), which contains typically tens of thousands of time samples and 2k channels. On each chunk it can perform the following excision:

1. Frequency domain filtering
    - Compute the mean bandshape and the rms bandshape over the 5 second chunk. Divide these to get the mean-by-rms bandshape.
    - Normalize the bandshape using a cumulative smooth bandshape generated using a running median window.
    - Perform n-σ excision on both of the above bandshapes using the MAD alogirthm.
    - Flag certain user-defined channels by default.
2. Time domain filtering
    - Correct for the bandpass, exclude bad channels and collapse along spectral domain to get a *zero-DM* time series.
    - Use a histogram based approach to compute the central tendency and standard deviation of the underlying noise distribution.
    - Perform n-σ excision using the above statistics.
3. Dedisperse/Write to disk : At this stage gptool offers two options : (a) Keep track of the flags to dedisperse the time series at a fixed DM value followed by folding for a particular known pulsar. Both the dedispersed series and the folded profile are dumped to the disk. (b) Replace all flagged time series and channels by the central tendency of the *zero-DM* series and dump this 2D time-frequency data to disk. This can then be fed to other pipelines for further processing.

Code

The code is in C++ and is parallized using OPENMP. The parallization by default uses 5 threads and this can be increased by a factor of n at *runtime* depending on the user's need.

Potential Utility

gptool is a very flexible tool which combines multiple effective and computationally-efficient temporal and spectral domain RFI mitigation. The tool is regularly used at the GMRT observatory in the real-time mode to monitor pulsar observations. With 5 computing threads, gptool is able to do RFI excision, dedispersion followed by folding at a time resolution of $\approx 40\mu$s with 2048 spectral channels. Further, it can be set to use more threads at real-time without requiring the need to compile. In addition, gptool is well tested at this point of time as it has been the default RFI mitigation tool for a couple of pulsar/FRB surveys at the GMRT for over a year now.