GWB and GSB Data Analyses: Standard Operating Procedure

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Abstract

In this report, we present a methodology to run scripts in order to generate a series of plots from GMRT wideband backend (GWB) and GMRT software backend (GSB). The scripts provides following series of plots:
- amplitude (self-power) as a function of time for the reference scan,
- amplitude (self-power) as a function of time,
- amplitude (self-power) as a channel for the reference scan,
- amplitude (cross-power) as a function of time for the reference scan,
- amplitude (cross-power) as a function of time,
- amplitude (cross-bandshape) as a function of channel for the reference scan,
- phase (cross-power) as a function of time for the reference scan,
- phase (cross-power) as a function of time, and
- phase (cross-bandshape) as a function of channel for the reference scan.

Each of these two plots consists of two panels, the left panel and the right panel corresponds to the GWB and GSB, respectively. These plots could be then used routinely for testing the stability the new GWB and debugging the same with GSB as the benchmark.

1 Introduction

The on-going upgrade of the GMRT have led to the development of the new GMRT wideband backend (GWB). A lot of data along with simultaneous observations using the GMRT software backend (GSB) have been acquired in order to test and debug this new GWB. Here, in this SOP, we present a methodology to make several comparison plots from these two backends. Therefore, we present how to run these scripts and what are the output products from these scripts.

2 Running the "scripts"

2.1 Analysing GWB Data

```
astro6:/home/sachin/gwb-gsb/gpu_analysis.pl gwb_20nov13.lta 7 500 C06 "3C"
```

where `gwb_20nov13.lta` is the `lta` file, and
`7` is `scan #`,
`500` is `channel #`,
`C06` is `reference antenna` and
`"3C"` chooses all `"3C"` sources present in the `lta` file.

For example, the output files generated are

Self power: Amplitude vs. time (for channel 500) for the reference scan (# 7),
output file name `GWB_self_amp_vs_time_scan-7_chan-500_plot.png`

Self power: Amplitude vs. time (for channel 500) for all scans,
output file name `GWB_self_amp_vs_time_plot_allscan_chan-500.png`

Self power: Amplitude vs. channel for the reference scan (# 7),
output file name `GWB_self_amp_vs_chan_scan-7_plot.png`

Cross power: Amplitude vs. time (for channel 500) for the reference scan (# 7),
output file name `GWB_cross_amp_vs_time_scan-7_chan-500_plot.png`

Cross power: Amplitude vs. time (for channel 500) for all scans,
output file name `GWB_cross_amp_vs_time_plot_allscan_chan-500.png`

Cross power: Amplitude vs. channel for the reference scan (# 7),
output file name `GWB_cross_amp_vs_chan_scan-7_plot.png`

Cross power: Phase vs. time (for channel 500) for the reference scan (# 7),
output file name `GWB_cross_phs_vs_time_scan-7_chan-500_plot.png`

Cross power: Phase vs. time (for channel 500) for all scans (# 7), and
output file name `GWB_cross_phs_vs_time_plot_allscan_chan-500.png`

Cross power: Phase vs. channel for the reference scan (# 7).
output file name `GWB_cross_phs_vs_chan_scan-7_plot.png`

2.2 Analysing GSB Data

```
astro6:/home/sachin/gwb-gsb/gsb_analysis.pl gsb_20nov13.lta 7 100 C06 "3C"
```

where `gsb_20nov13.lta` is the `lta` file, and
`7` is `scan #`,
`100` is `channel #`,
`C06` is `reference antenna` and
`"3C"` chooses all `"3C"` sources from the `lta` file.
    For example, the output files generated are
        Self power: Amplitude vs. time (for channel 100) for the reference scan (# 7),
            output file name `GSB_self_amp_vs_time_scan-7_chan-100_plot.png`
        Self power: Amplitude vs. time (for channel 100) for all scans,
            output file name `GSB_self_amp_vs_time_plot_allscan_chan-100.png`
        Self power: Amplitude vs. channel for the reference scan (# 7),
            output file name `GSB_self_amp_vs_chan_scan-7_plot.png`
        Cross power: Amplitude vs. time (for channel 100) for the reference scan (# 7),
            output file name `GSB_cross_amp_vs_time_scan-7_chan-100_plot.png`
        Cross power: Amplitude vs. time (for channel 100) for all scans,
            output file name `GSB_cross_amp_vs_time_plot_allscan_chan-100.png`
        Cross power: Amplitude vs. channel for the reference scan (# 7),
            output file name `GSB_cross_amp_vs_chan_scan-7_plot.png`
        Cross power: Phase vs. time (for channel 100) for the reference scan (# 7),
            output file name `GSB_cross_phs_vs_time_scan-7_chan-100_plot.png`
        Cross power: Phase vs. time (for channel 100) for all scans (# 7), and
            output file name `GSB_cross_phs_vs_time_plot_allscan_chan-100.png`
        Cross power: Phase vs. channel for the reference scan (# 7).
            output file name `GSB_cross_phs_vs_chan_scan-7_plot.png`

2.3 Combined GWB and GSB Plots

```
astro6:/home/sachin/gwb-gsb/combine_gwb_gsb.pl
```

    Here, the comparison output plot files being
        Self power: Amplitude vs. time (for a reference channel) for the reference scan (# 7),
            output file name `GWB_GSB-GWB_self_amp_vs_time_scan-7_chan-500_plot.png`
        Self power: Amplitude vs. time (for a reference channel) for all scans,
            output file name `GWB_GSB-GWB_self_amp_vs_time_plot_allscan_chan-500.png`
        Self power: Amplitude vs. channel for the reference scan (# 7),
            output file name `GWB_GSB-GWB_self_amp_vs_chan_scan-7_plot.png`
        Cross power: Amplitude vs. time (for a reference channel) for the reference scan (# 7),
            output file name `GWB_GSB-GWB_cross_amp_vs_time_scan-7_chan-500_plot.png`
        Cross power: Amplitude vs. time (for a reference channel) for all scans,
            output file name `GWB_GSB-GWB_cross_amp_vs_time_plot_allscan_chan-500.png`
        Cross power: Amplitude vs. channel for the reference scan (# 7),
            output file name `GWB_GSB-GWB_cross_amp_vs_chan_scan-7_plot.png`
        Cross power: Phase vs. time (for a reference channel) for the reference scan (# 7),
            output file name `GWB_GSB-GWB_cross_phs_vs_time_scan-7_chan-500_plot.png`
        Cross power: Phase vs. time (for channel 100) for all scans (# 7), and
            output file name `GWB_GSB-GWB_cross_phs_vs_time_plot_allscan_chan-500.png`
        Cross power: Phase vs. channel for the reference scan (# 7).
            output file name `GWB_GSB-GWB_cross_phs_vs_chan_scan-7_plot.png`
    Note that occasionally the combined output file states `*500*.png`, this `500` is due to file (incomplete) nomenclature, though we use channel no. 500 and channel no. 100 for GPU and GSB, respectively.

Each of these two plots consists of two panels, the left panel and the right panel corresponds to the GWB and GSB, respectively. Additionally, the baseline or antenna sequence order is identical in both panels.

3 Presenting the Results

Many of the results from these scripts are available at
http://www.gmrt.ncra.tifr.res.in/∼sachin.
These series of tests over time scales of a few months gives us a long time baseline to test improvements, issues, if any, etc. in the new GWB.

4 Current Status and Future Plans

We have tested and debugged these scripts extensively. These scripts work perfectly for the data acquired until 20 January 2014 and some of the results presented from it are explained in Section 3.

Next, we would soon fix the choice of channels in the two backends such that they correspond to the same observing frequency (in MHz). We would also incorporate the product of bandwidth and integration time, *viz.* $\sqrt{\Delta\nu \times t_{\mathrm{int}}}$, so that each record plotted in the two comparison plots has identical signal-to-noise ratio. Finally, new changes made in the GWB hardware and hence the recording format, *i.e.*, in the data acquisition chain or the "lta" format, we would modify these scripts and make them compatible accordingly.