GMRT Usage / Observing program.

How the telescope is getting used. It can be divided in to following categories.

**1. Astronomical observations.**

1. Imaging .
2. Line .
3. Pulsar.
4. Solar (and planets) .
5. Event based (occultation , eclipse).
6. VLBI .
7. SETI .
8. EoR .
9. Ionosphere study (scintillation).
10. Radio sky surveys.

**2. Non astronomical observations.**

1. Satellite tracking.
2. Receiving artificial signals for testing purpose .

**3. System calibrations / routine tests / debugging the problems.**

1. Pointing.
2. Deflection.
3. Polarization leakage.
4. Antenna base coordinates measurement.
5. Tsys measurement.
6. Testing/checking the new systems .
7. RFI tests, etc .

**Observing program**

For any type of observation, user has to plan his/her observations as per the interest and the functionalites available at the telescope. It is like writing a computer program for doing some kind of task within a specific time period. New users has to learn the functionality of the telescope, while the experienced users can plan their observations more efficiently. Observatory helps the new users for preparing the observing program (observing help tools). Documents are available to know the functionality of the telescope. These programs are not always straightforward but complex also.

Observing a single source at one frequency with a phase calibrator for 8 hours is the example of straightforward program. Observing multiple sources at multiple frequencies becomes complex program. Normally straightforward programs are conducted through command file and complex programs conducted manually. User has a freedom to interrupt the running program and change it as per his/her wish. Some times the execution the program at some stage depends on the results from the previous stage (Initially user will observe two calibrators and then from data, he will choose the good calibrator and continue the observation with it).

Most of the time this decision making is done manually. Some times the program lags behind or runs faster, in such a cases user has to interrupt it and reschedule it. In case of system failures or natural interrupts like high winds observatory or user has to stop the program and wait till the things becomes normal. System failure is the time loss in observing session, appropriate rescheduling is required when the systems are up.

**Functionalities of the telescope systems (Main three).**

1. **Pointing/tracking the dishes ( servo system ) to desired positions/source.**
    1. Azimuth/Elevations rotations and pointing ( alt-azi mount )
    2. Pointing to astronomical source. ( RA, Dec )
    3. Tracking the astronomical source. ( RA, Dec )
    4. Tracking the planets ( RA&dRA/dt, Dec&dDec/dt)
    5. Tracking AZ, EL, RA, Dec.
    6. Brakes AZ/EL.
    7. Track change outer/inner.
    8. Scanning the source with specific speed in AZ, EL, RA and Dec.
    9. Offset tracking the source in AZ, EL, RA and Dec.
    10. Feed Focusing/rotation.

2. **Analog receiver tuning to get the desired frequency band (radio region).**
    1. RF band, RF attenuation.
    2. LO1 freq.
    3. IF band width, attenuation, gains, ALC.
    4. BB LO, BB band width, gains.

3. **Digital back end (digital receiver) tuning to get desired digital data.**
    1. Acquisitions band width, Time resolution, channel resolution.
    2. Total Intensity, Full stokes, Raw data
    3. Interferometry, Line, Pulsar ( IA/PA/VOLTAGE).
    4. Record data, disk storage, start record, stop record, power eq, phasing.

From the main three systems many combinations ( obs setup ) and from thirty dishes many groups ( sub arrays ) can be formed. One can write a Bach file/Command file ( API ) and conduct the various observations. During the one astronomical observing session user can change various sources and tune the analog receiver and digital back end one or many times. The time interval between the two successive source change or receiver tuning is not fixed and depends on the users requirements. The entire operation of tuning the receivers, tracking the various sources and collecting the digital data is called observing program.