Hartebeesthoek Radio Astronomy Observatory (HartRAO)

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Abstract

HartRAO is the only fiducial geodetic site in Africa and participates in VLBI, GPS and SLR global networks. This report provides an overview of our geodetic VLBI activities during 2001. The status of the 26m radio telescope surface upgrade is reported. Future plans include the MKV upgrade and the procurement or construction of an additional radio telescope.

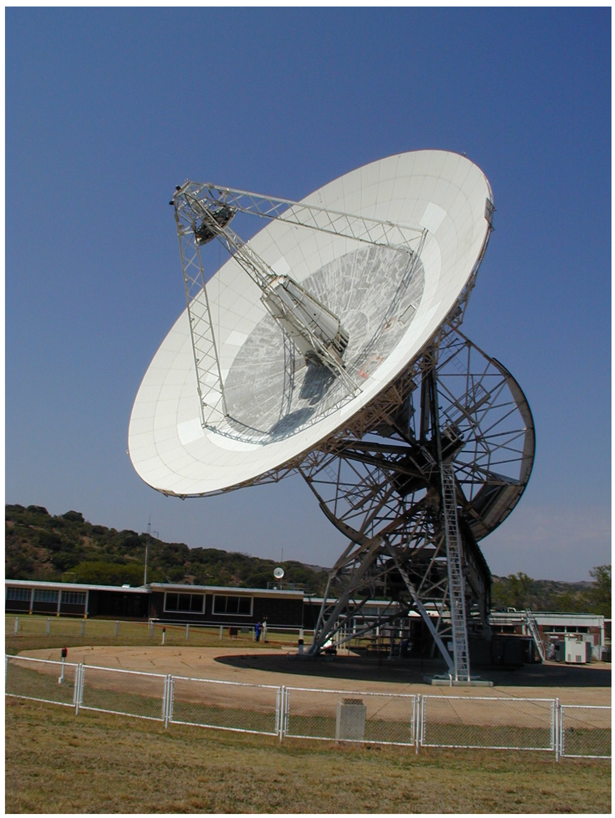

Figure 1. The 26 metre radio telescope. Four of the outer rings of the surface have been upgraded from perforated to solid panels. It is expected that the surface upgrade will be completed during 2002.

1. Geodetic VLBI at HartRAO

HartRAO is located north of Krugersdorp (close to Johannesburg), South Africa, in a valley of the foothills of the Witwaters mountain range. HartRAO uses a 26 metre equatorially mounted Cassegrain radio telescope built by Blaw Knox in 1961. The telescope was part of the NASA deep space tracking network (Deep Space Instrumentation Facility (DSIF) 51) until 1975 when the facility was converted to an astronomical observatory. The telescope is colocated with an SLR station (MOBLAS-6) and an IGS GPS station (HRAO). HartRAO joined the EVN as an associate member during 2001. Astronomical and geodetic VLBI has been allocated an equal share (15% each) of telescope time.

2. Technical Parameters of the VLBI Telescope of HartRAO

The feed horns used for 13 cm and 3.5 cm are single polarised conical feeds. Both S and X bands have right hand circular polarisation. The RF amplifiers are cryogenically cooled HEMTS. Table 1 contains the technical parameters of the HartRAO radio telescope [1]. Upgrade to a MKV recording unit is essential and is part of our future plans.

Table 1. Technical parameters of the radio telescope of HartRAO for geodetic VLBI, [1].

Parameter	HartRAO-VLBI
owner and operating agency	HartRAO
year of construction	1961
radio telescope mount	offset equatorial
receiving feed	Cassegrain
diameter of main reflector d	$25.914m$
focal length f	$10.886m$
f/d	0.424
surface contour of reflector	$\pm 2.0mm$
wavelength limit	2.5 cm
pointing resolution	$0.001°$
pointing repeatability	$0.004°$
X-band (standard $\nu = 8.580GHz, \lambda = 0.0349m$)	$8.180 - 8.980\,GHz$
T_{sys}	$65\,K$
S_{SEFD}	$1500\,Jy$
Point source	$17.1\,Jy/K$
3 dB beamwidth	$0.092°$
S-band (standard $\nu = 2.280GHz, \lambda = 0.1316$)	$2.210 - 2.344GHz$
T_{sys}	$40\,K$
S_{SEFD}	$1500\,Jy$
Point source	$9.7\,Jy/K$
3 dB beamwidth	$0.332°$
VLBI terminal type	MKIV
recording media	thin-tape only
Field System version	9.4.18
attended VLBI observations	24h, mode C

3. Staff Members Involved in VLBI

Table 2 lists the HartRAO station staff who are involved in geodetic VLBI. Marisa Nickola has been responsible for downloading of schedules, preparing SNAP files and related documentation. Several of the SLR operators have participated in geodetic VLBI shifts. Jonathan Quick (VLBI friend) has continued to provide technical support for the Field System as well as for hardware problems.

Table 2. Staff supporting geodetic VLBI at HartRAO.

Name	Background	Dedication	Function	Programme
Ludwig Combrinck	Geodesy	20%	Programme Leader	Geodesy
Jonathan Quick	Astronomy	5%	Hardware/Software	Astronomy
Marisa Nickola	Technical	30%	Logistics/Operations	Geodesy
William Moralo	Technical	5%	Operator	Geodesy
Pieter Stronkhorst	Technical	5%	Operator	Geodesy
Solly Mohlabeng	Technical	5%	Operator	Geodesy

4. Current Status

During 2001 HartRAO participated in 57 experiments (Table 3), which utilised the telescope time allocated to geodetic VLBI to its fullest extent. The upgrade of the telescope (see Figure 1) surface is continuing and completion of the upgrade project is expected during 2002. The average rms error per panel is below 200 microns and all work is done on site (see Figure 2) by our own staff. It is planned to use holography to determine the overall shape of the dish after all the new panels have been installed. Based on the results of the holography, individual panels will be adjusted to obtain the best overall surface shape. Automation of the dichroic, which will include the construction of a new and more efficient dichroic, will commence once the surface upgrade has been completed.

Table 3. Geodetic VLBI experiments HartRAO participated in during 2001.

Experiment	**Number of Sessions**
CORE-OHIG1	3
CONT-M	3
CORE-1	12
CORE-3	10
CORE-C2	2
CRF-MS	2
IRIS-S	12
RDV	6
SYOWA	5
S2IMAGE	2

Figure 2. All upgrade work to the telescope surface is done on site by our own staff. Here Amos Kekae is soda-brading the structure to clean off any old paint.

5. Future Plans

The radio telescope has been modernised by equipping it with an electric drive and its surface tolerance is being improved to about 200 micron rms accuracy. Even so, it is an old telescope (41 years) and cannot be expected to meet our requirements forever. There is a requirement for astronomy purposes to be capable of operating in the millimeter region, which would necessitate a new telescope. Furthermore, to participate in the objectives of the IVS and to meet our regional responsibility, we require more telescope time allocated to geodetic VLBI. A new, additional telescope, would enable us to meet these objectives. Therefore, we are investigating avenues of either building locally or sourcing a telescope abroad.

The Geodesy Programme is an integrated programme, supporting VLBI, SLR and GPS and is active in several colloborative projects with GSFC, JPL, GFZ (Potsdam) and local institutes.

References

[1] Combrinck, L., Hartebeesthoek Radio Astronomy Observatory (HartRAO), In: International VLBI Service for Geodesy and Astrometry 2000 Annual Report, NASA/TP–2001-209979, N. R. Vandenberg and K. D. Baver (eds.), 84-87, 2001.