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 2003. The status of the 26m radio telescope surface upgrade is reported. Future plans include automating the dichroic system which allows duel frequency operation. In order to meet future requirements of geodetic VLBI, we have initiated the first steps towards founding a new space geodetic station which will cater to new developments and challenges as addressed by VLBI2010 and future requirements of GPS and SLR/LLR.

Figure 1. The last panel of the 26 metre radio telescope surface upgrade being installed by Simon Morake and Andrew Masiteng.

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 have been allocated equal shares (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 Mark 5 recording unit has taken place during late 2003 and has been installed successfully.

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	$8.180 - 8.980\,GHz$
(standard $\nu = 8.580GHz, \lambda = 0.0349m$)	
T_{sys}	$65\,K$
S_{SEFD}	$1500\,Jy$
Point source	$17.1\,Jy/K$
3 dB beamwidth	0.092°
S-band	$2.210 - 2.344GHz$
(standard $\nu = 2.280GHz, \lambda = 0.1316$)	
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	10%	Programme Leader	Geodesy
Jonathan Quick	Astronomy	5%	Hardware/Software	Astronomy
Marisa Nickola	Technical	50%	Logistics/Operations	Geodesy
William Moralo	Technical	5%	Operator	Geodesy
Pieter Stronkhorst	Technical	5%	Operator	Geodesy
Attie Combrink	Geodesy	5%	Operator	Geodesy

4. Current Status

During 2003 HartRAO participated in 58 (63 the previous year) experiments (Table 3), which utilised the telescope time allocated to geodetic VLBI to its fullest extent. The antenna surface upgrade is continuing and the last panel was installed at the end of 2003 (see Figure 1) and (Figure 2). It is planned to use holography to determine the overall shape of the dish during 2004. 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.

Figure 2. The final panel has been installed and we are all milling around in confusion or relief.

5. Future Plans

During 2003 we acquired a Mark 5 upgrade. Several parallel experiments using tapes and Mark 5 have been completed with no technical problems and we will phase out the tapes as soon as it is appropriate.

We have started initial steps towards the development of a new integrated Space Geodesy Facility which will support SLR, LLR, VLBI and GPS as well as host a multitude of earth science instrumentation. This will mean the construction of a new site, development and implementation of new state of the art equipment and will place the southern hemisphere and especially Africa

Table 3. Geodetic VLBI experiments HartRAO participated in during 2002.

Experiment	**Number of Sessions**
SUR	3
CRF	5
OHIG	6
R1	35
SYOWA	4
T2	5
Total	58

securely in the space geodesy arena for the next several decades. We would like to invite possible participants in this venture to contact us.

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.