Simeiz VLBI Station

N. Nesterov, A. Volvach

Abstract

This report summarizes the technical parameters of the "SIMEIZ" VLBI station. It also gives an overview about the VLBI activities during 5 years. Horizontal station velocity was determined and estimates its accuracy are obtained.

1. General Information

The Laboratory of Radioastronomy of the Crimean Astrophysical Observatory (CrAO) with its 22-m radio telescope is located near Simeiz 25 km to the west of Yalta.

Figure 1. Simeiz VLBI station

The 22-meter radio telescope is situated on the banks of Blue Gulf of Black Sea in South part of Crimea peninsula. It was constructed in 1965 and participated in the first VLBI observations in 1969 in cooperation with USA.

RT-22 operation is supported by control system, consisting of two encoders with accuracy about 3 arcsec (rms), personal computer, CAMAC, quartz time standard, electric engines and other needed equipment and software. The fast RT-22 movement is supported by 2 engines with 20 kW power each, they are used for rapid change of the pointing or to move RT-22 from one source to another. 2 kW engines are used for tracking of the source.

Table 1 shows the antenna parameters.

Table 1. The antenna parameters of the Simeiz station.

Diameter D, m	22
Surface tolerance, mm (root mean square)	0.25
Wavelength limit, mm	2
Feed System	Cassegrain system or primary focus
Focal length F, m	9.525
Focal ratio F/D	0.43
Effective focal length for Cassegrain system, m	134.5
Mounting	Azimuth-Elevation
Pointing accuracy, arc sec.	10
Maximum rotation rate, degree/sec	1.5
Maximum tracking rate, arcsec/sec	150
Working range in Azimuth, degrees (0 to South)	-270 - +270
in Elevation, degrees	0 - 85

The Laboratory provides observing facilities for astronomers from international community and for its own staff:

a) Very Long Baseline Interferometry (both astrophysical and geodetic projects);

b) multi wavelength monitoring of Active Galactic Nuclei (AGN) in millimeter domain;

c) solar and stellar activity investigations at mm-dm wavelengths;

d) molecular lines observations at mm wavelengths.

2. Status

VLBI observations at the radio telescope were started in 1969 using the Mark I system and Rubidium standard. Further the antenna was included in the global VLBI network for the study of astrophysical objects. The observations were carried out by CrAO and Institute of Space Research at 1.35, 2.8, 6, 18, 49 and 92 cm. The Simeiz station was equipped with MARK-2 system and hydrogen maser frequency standard with stability 10^{-14}.

In June of 1994 the Simeiz station was equipped with terminal Mark IIIA supplied by NASA GSFC with low noise receiver of S/X bands supplied by Institute of Applied Astronomy. That gave the possibility to start fundamental geodetic study and to continue astrophysical VLBI observations with higher sensitivity. Table 2 shows the system parameters of the Simeiz station. Table 3 shows the station activity in 1994-1998.

Hydrogen maser standard at the station had unsatisfactory performance during 1996-1997. Moreover, the electric power was switched off at station often for two or more hours. These two factors resulted in degradation of quality of the data. New maser standard was installed at the

Table 2. The system parameters of the Simeiz station.

F, GHz	0.3	0.6	1.6	2.3	5.0	8.4	22
λ, cm	92	49	18	13	6	3.6	1.3
Tsys, K	150	120	120	80	150 (30)	60	80

Table 3. Simeiz antenna activity.

Years	1994	1995	1996	1997	1998
Number of GEO experiment	8	8	7	4	12
Number of ASTRO experiment	4	31	8	25	10

station in 1998. Time standard and Mark III formatter were supplied by power using UPS device. The observations in 1998 showed that data quality became much better.

3. Analysis

Determination of vertical position during this interval is unreliable while precision of horizontal coordinates of the station was quite satisfactory. Horizontal station velocity and its accuracy was determined using 4.5 years of data. The position of the station at 1997.0 are:

$X = 3785231.073 \pm 0.004\dot{X} = 5.5 * 10^{-10} \pm 0.2 * 10^{-10}$

$Y = 2551207.417 \pm 0.003\dot{Y} = 4.9 * 10^{-10} \pm 0.1 * 10^{-10}$

$Z = 4439796.362 \pm 0.006\dot{Z} = 2.3 * 10^{-10} \pm 0.2 * 10^{-10}$

The final proccesing of the data was made by Leonid Petrov from the Geodaetische Institut in Bonn.

Table 4 shows the residual velocities with respect to Eurasian plate.

Table 4. Residual velocities respect to Eurasian plate.

Stations	Up(mm/yr)	East(mm/yr)	North(mm/yr)	Corr	D
CRIMEA	**3.9 ± 4.5**	**1.5 ± 1.0**	**1.9 ± 0.9**	**0.09**	
EFLSBERG	-0.3 ± 0.6	0.5 ± 0.2	-0.4 ± 0.2	0.01	*
MATERA	0.8 ± 0.5	1.1 ± 0.2	4.7 ± 0.2	0.53	
DSS65	2.2 ± 1.2	0.1 ± 0.2	0.1 ± 0.3	-0.27	*
MEDICINA	-2.8 ± 0.5	1.8 ± 0.2	2.1 ± 0.2	0.26	
NYALES20	2.0 ± 1.0	0.0 ± 0.2	0.0 ± 0.2	0.00	*
ONSALA60	3.0 ± 0.3	-0.9 ± 0.2	-0.7 ± 0.2	-0.22	
SESHAN25	0.9 ± 3.7	0.7 ± 2.1	-4.4 ± 2.4	-0.60	
WETTZELL	-0.1 ± 0.3	-0.1 ± 0.1	0.2 ± 0.2	0.12	*

RMS difference of horizontal velocity over defining stations: 0.3 mm/yr. Stations DSS65, EFLSBERG, NYALES20, WETTZELL define plate rotation. Station WETTZELL defines vertical reference.

Figure 2 shows the field of residual velocities with respect to Eurasian plate. Four and one-half years of geodetic VLBI observation at the station Simeiz allow us to conclude that the station moves at azimuth $39° \pm 22°$ with respect to a Eurasian plate with velocity 2.4 ± 1.0 mm/yr where the uncertainty is the estimate of accuracy. Vertical motion is not yet reliably detected.

4. Outlook

New operational system LINUX and Field System were prepared for use with our hardware.

Figure 2. Field of residual velocities with respect to Eurasian plate

■ denotes a defining station
● denotes a free station