Goddard Geophysical and Astronomical Observatory

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Abstract

This report summarizes the technical parameters and the technical staff of the VLBI system at the fundamental station GGAO. It also gives an overview about the VLBI activities during the report year. The outlook lists the outstanding tasks to improve the performance of GGAO.

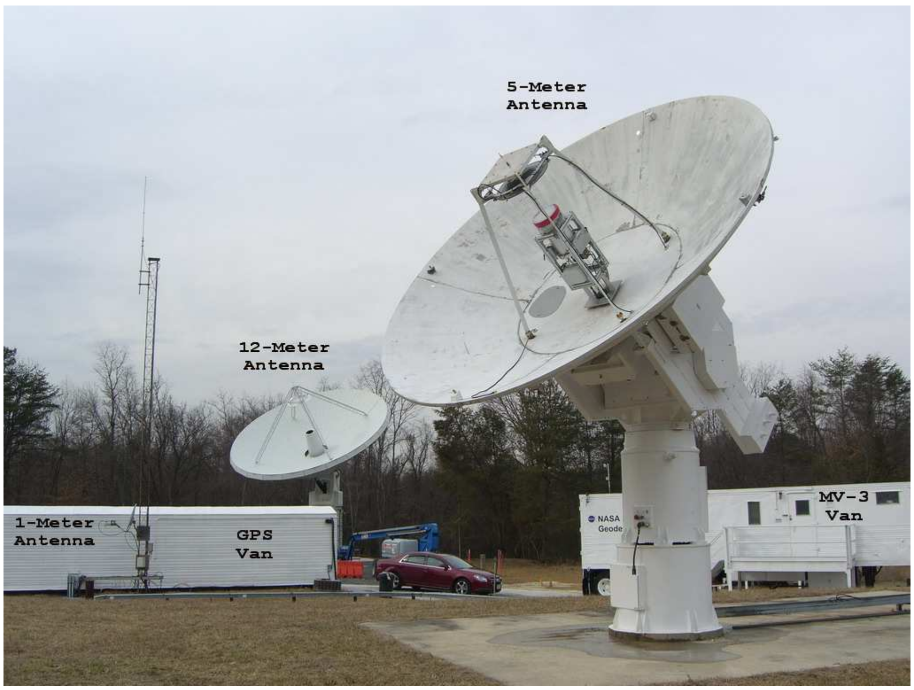

Figure 1. Goddard Geophysical and Astronomical Observatory.

1. GGAO at Goddard

The Goddard Geophysical and Astronomical Observatory (GGAO) consists of a 5-meter radio telescope for VLBI, a new 12-meter radio telescope for VLBI2010 development, a 1-meter reference antenna for microwave holography development, an SLR site that includes MOBLAS-7, the NGSLR development system, a 48″ telescope for developmental two-color Satellite Laser Ranging, a GPS timing and development lab, a DORIS system, meteorological sensors, and a hydrogen maser. In addition, we are a fiducial IGS site with several IGS/IGSX receivers.

GGAO is located on the east coast of the United States in Maryland. It is approximately 15 miles NNE of Washington, D.C. in Greenbelt, Maryland (Table 1).

Table 1. Location and addresses of GGAO at Goddard.

Longitude	76.4935° W
Latitude	39.0118° N
MV3 Code 299.0 Goddard Space Flight Center (GSFC) Greenbelt, Maryland 20771	
http://cddisa.gsfc.nasa.gov/ggao/vlbi.html	

2. Technical Parameters of the VLBI Radio Telescopes at GGAO

The 5-m radio telescope for VLBI at MV3 was originally built as a transportable station; however, it was moved to GGAO in 1991 and has been used as a fixed station. In the winter of 2002 the antenna was taken off its trailer and permanently installed at GGAO.

In October of 2010, construction of the new 12-meter VLBI2010 developmental antenna was completed. This antenna features all-electric drives and a Cassegrain feed system. Integration of the broadband receiver and the associated sub-systems is underway as a joint effort between Exelis and the MIT Haystack Observatory.

The technical parameters of the radio telescopes are summarized in Table 2.

Table 2. Technical parameters of the radio telescopes at GGAO.

Parameter	5-m	12-m
Owner and operating agency	NASA	NASA
Year of construction	1982	2010
Diameter of main reflector d	$5m$	$12m$
Azimuth range	$+/-270°$	$+/-270°$
Azimuth velocity	$3°/s$	$5°/s$
Azimuth acceleration	$1°/s^2$	$1°/s^2$
Elevation range	$+/-90°$	$5-88°$
Elevation velocity	$3°/s$	$1.25°/s(Avg.)$
Elevation acceleration	$1°/s^2$	$1°/s^2$
Receiver System		
Focus	Cassegrain	Cassegrain
Receive Frequency	$2-14GHz$	$2-14GHz$
T_{sys}	$100\,K$	$50\,K(Theoretical)$
Bandwidth	$512MHz$, 4 bands	$512MHz$, 4 bands
G/T	$26\,dB/K$	$43\,dB/K$
VLBI terminal type	CDP	VLBI2010
Recording media	Mark IV	Mark 5C

3. Technical Staff of the VLBI Facility at GGAO

GGAO is a NASA R&D and data collection facility. On April 9, 2011 the NENS contract transitioned to the SCNS contract operated by Exelis Information Systems. The staff at GGAO consists of four people under the contract. Exelis staff includes Jay Redmond and Katherine Pazamickas conducting VLBI operations and maintenance at GGAO with the support of Ricardo Figueroa and Charles Kodak.

4. Status of MV3 at GGAO

Having ceased VLBI operations in May 2007, MV3 continues on a full time basis to be a major component in the program to demonstrate the feasibility of the VLBI2010 broadband delay concept. Working under the guidance of the Exelis team, MV3's S/X components are currently in the process of being upgraded to provide additional support to the VLBI2010 System. The 2012 accomplishments for the 5-m antenna include:

- The ACU and Control Panel was completely rebuilt.
- The Cryogenic Dewar and the components required for restoration of the X-band have been located, and the wiring of the 017 box was upgraded.
- The feed assembly was repaired and is ready to be placed back on the antenna. The FSS has been recoated with a highly reflective surface.

Much of the 2012 activities at GGAO have been focused on performance testing and upgrading of the VLBI2010 12-m antenna. However, there were some other activities worth noting:

- Wideband system testing and characterization of the 12-m antenna.
- Procurement of new test equipment for characterization of the wideband RF hardware.
- Broadband Phase Cal performance testing.
- Performance testing of the 16 Gbps VLBI recording, demonstrated using Mark 6.
- Installation of the high frequency optical fiber link system.

Activities to understand antenna deformations that could potentially dilute the accuracy of the VLBI2010 system started in 2012. Initially, survey data collections were performed using the 5-m dish as the antenna to be tested and a 1-m satellite receiving dish as the phase reference. Preliminary results from 2010 data collection show that the imaging technique was able to faithfully reconstruct deformations in the aperture of the primary reflector. These deformations included GPS antennas mounted on the rim of the dish, an RF absorbing block, the offset feed Water Vapor Radiometer (WVR) cover, and the subreflector in the center of the primary as shown in Figure 2.

5. Outlook

GGAO will continue to support VLBI2010, e-VLBI, and other developmental activities during the upcoming year. Tentative plans for 2013 include:

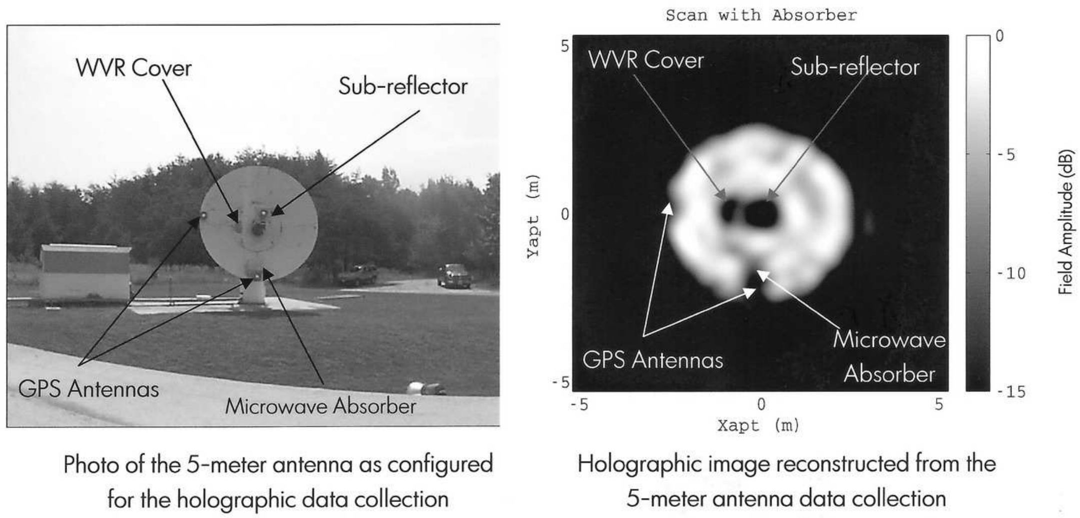

Figure 2. Holographic imaging of the 5-m antenna.

- Continue to upgrade the VLBI2010 broadband receiver system on the 12-m antenna and the new self-retractable feed positioner.
- Conduct IVS observations using the Mark 5C and Mark 6 recorders to demonstrate the VLBI2010 capabilities.
- Continue testing of the new broadband phase calibrator for the VLBI2010 system.
- Continue the upgrade of the 5-m antenna and initiate testing of the S/X band.
- Continue the use of the RDBEs, Mark 5Cs, and Mark 6s, replacing the DBE1s and Mark 5B+s.
- Continue to measure the baseline between the 5-m and the 12-m antennas for position ties to the reference frame.
- Try to understand the source of the elevation creep, which appears to have stopped.
- Try to understand why the antenna will not move in elevation under computer control when first started up on cold mornings.