

Italy INAF Analysis Center Report

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Abstract

This report summarizes the activity of the Italian INAF VLBI Analysis Center. Our Analysis Center is located in Bologna, Italy and belongs to the Institute of Radioastronomy, which is part of the National Institute of Astrophysics. IRA runs the observatories of Medicina and Noto, where two 32 m VLBI AZ-EL telescopes are situated. This report contains the AC's VLBI data analysis activities and shortly outlines the investigations carried out at Medicina and Noto concerning gravitational deformations of the VLBI telescopes.

1. Current Status and Activity

Data analysis of terrestrial surveys carried out during 2008 focused on the investigation of deformation under the effects of gravity and, in particular, on the possibility of inferring a general model for gravitational deformations of large VLBI telescopes. The strategy used relies on the combination of different metrological approaches applied to the antennas: on one hand, classical terrestrial surveys executed via forward intersections on some specific targets located on the telescope's primary reflector and on the quadrupod; on the other, laser scanning surveys which allow analysts to infer a more continuous representation of the parabolic mirror deformation. A third kind of information was derived from Finite Element Modelling (FEM) which provides a scenario of feasible deformations of the antenna structure at its peculiar nodes under the influence of its own weight. The joint usage of these data types permitted us to identify, quantify and detach the effects of gravitational deformations: according to [1], these latter can be decomposed into a *(i)* paraboloid's vertex displacement, *(ii)* relative motion of the S/X receivers placed in the primary focus with respect to the antenna primary reflector, *(iii)* a focal length variation induced by deformations of the VLBI reflector. This combination approach might offer valuable help for estimating a signal path variation model induced by gravity to be applied within VLBI data processing.

Concerning the laser scanning measurement analysis, a specific focal length variation model, valid for the Medicina and Noto antennas, was derived with the aim of supplying a model which can account for the relative change in focal length as the VLBI antenna is steered in elevation; results of these considerations can be found in [2], which has been reviewed and is in the course of publication.

2. Data Analysis and Results

The IRA started to analyze VLBI geodetic databases in 1989, using a CALC/SOLVE package on the HP1000 at the Medicina station. In subsequent years, the same software was installed first on an HP360 workstation and later on an HP715/50 workstation. In more recent years, two HP785/B2600 workstations and an HP282 workstation were used. In 2007, a new Linux workstation was set up for the migration of all the VLBI data analysis, and Mark 5 Calc/Solve was installed. During 2008, we stored all the 1999–2008 databases available on the IVS data centers. All the databases were processed and saved with the best selection of parameters for the final arc solutions. Moreover, because of the new server, all the missing databases were downloaded from the IVS data centers in order to complete the IRA catalogue. In the meantime, databases

already analyzed and archived on HP workstations were copied to the Linux workstation and analyzed in order to create new Mark 5 Solve superfiles for global solutions.

Our Analysis Center has participated in the IVS TROP Project on Tropospheric Parameters since the beginning of the activities. Tropospheric parameters (wet and total zenith delay and horizontal gradients) of all IVS-R1 and IVS-R4 24-hour VLBI sessions were regularly submitted in the form of SINEX files. During the past year, due to several problems, we did not regularly submit results, but we continued our analysis in order to submit new Mark 5 solutions. We have computed a long time series of troposphere parameters using all VLBI sessions available in our catalogue in order to estimate the variations over time of the content of water vapor in the atmosphere.

3. Outlook

For the time being, our catalogue finally contains all available experiments. In 2009, using our new Linux workstation and the up-to-date Mark 5 Calc/Solve software, we plan to analyze all available databases, thus completing the catalogue. The regular submission of INAF tropospheric parameters to the IVS data centers will resume as soon as possible.

References

- [1] Clark, T.A., P. Thomsen, Deformations in VLBI antennas, Technical Report: 100696, NASA, Greenbelt, MD.
- [2] Sarti, P., L. Vittuari, C. Abbondanza, Laser scanner and terrestrial surveying applied to gravitational deformation monitoring of large VLBI telescope's primary reflectors, in Journal of Surveying Engineering (*accepted*).