Italy INAF Analysis Center

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Abstract This report summarizes the activity of the INAF VLBI Analysis Center. Our Analysis Center is located in Bologna, Italy and belongs to the Institute of Radio Astronomy (IRA), which is part of the National Institute for Astrophysics (INAF). IRA runs the observatories of Medicina and Noto, where two 32-m twin VLBI AZ-EL telescopes are located. This report contains the AC's VLBI data analysis activities and illustrates the latest experiments involving the Italian antennas and correlator carried out in the last two years.

1 Current Status and Activity

Following the installation of the software correlator DiFX in 2012 in Bologna, there have been a number of experiments to test the correlation pipeline for geodesy. These VLBI experiments were performed at first on the single baseline Medicina–Noto and subsequently extended to Matera after seeking a collaboration with ASI, which manages the antenna facility. The ITAlian Vlbi network (VITA) project has been launched as a national pilot project, obtaining observing time at the stations and successful experiments.

In these last years, the group has been involved in the Italian Quantum Backbone (IQB) development, in collaboration with the National Institute of Metrology (INRiM), which set up a distributed time and frequency optical link to some scientific and commercial facilities, such as the Milan Financial District, the Medicina Radioastronomical Observatory, the Italian Laboratory for Non-linear Spectroscopy (LENS) in Florence, the Telespazio Facility in the Fucino Plain (where one of the main stations of the European Galileo satellite network for global navigation is located), and the National Institute of Optics in Pozzuli, to finally reach the Matera Center for Space Geodesy.

In 2023–2024, our group continued the Italian-Korean collaboration over intercontinental distances, aiming at the characterization of atomic clock synchronization and frequency transfer. The first 24-hour K-band geodetic VLBI experiment was performed in December 2021, involving six antennas, where the Medicina and Sejong antennas were connected via optical fiber to the INRiM and KRISS, respectively, hosting their optical clocks. The data was correlated by the Bologna DiFX correlator and analyzed via νSolve. The solution was compared with the KASI ones performed with VieVS, too. The results were presented at the EVGA 2025 meeting [1] and submitted to AJ.

A new 24-hour K-band geodetic VLBI experiment has been performed in March 2024, involving six antennas, where the Medicina and Sejong antennas were connected via optical fiber to the INRiM and KRISS, respectively, hosting their atomic clocks. In 2025, the data will be correlated by the Bologna DiFX correlator and analyzed via νSolve and VieVS software. Future optical clock frequency comparison will make use of the Korean-designed Compact Triple-band Receiver to also be installed in 2025 on the Italian antennas as part of a major infrastructure upgrade.

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2 Data Analysis and Results

The IRA started to analyze VLBI geodetic databases in 1989, using the Calc/Solve package on the HP workstation, first located at the Medicina observatory and later at the Bologna headquarters. Since 2007, Linux workstations have been set up for the migration of all the VLBI data analysis, and Mark 5 Calc/Solve has been installed. During the last years, our Analysis Center had some internal problems, and we did not participate regularly in the IVS activities. But we continued to update the catalog, and we installed and tested the latest releases of Calc/Solve and νSolve.

References

1. M. Negusini *et al*. Geodetic K-band VLBI observations for the clock comparison, *Zenodo*, https://doi.org/10.5281/zenodo.15389274, 2025.