

Italy INAF Analysis Center

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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 Radio Astronomy (IRA), which is part of the National Institute of 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 were a number of experiments to test the correlation pipeline for geodesy. These VLBI experiments were performed mainly on the single baseline Medicina–Noto and subsequently extended to Matera after seeking a collaboration with ASI, who manages the antenna facility. The VITA (ITALian VLbi network) project was launched as a national pilot project, obtaining observing time at the stations. We obtained first successful fringes on the three baselines in April 2015, and carried out five 24-hour experiments until the end of 2018.

In these last years the group was involved in the LIFT (Italian Link for Frequency and Time) project in collaboration with INRIM (National Institute of

Metrology), which set up a distributed time and frequency optical link in Medicina. VLBI tests in a geodetic setup were performed, to verify the accuracy and reliability of their solution compared to standard maser clock timing in use at the antenna. After the first VLBI experiment, during EUR137 in 2015, VITA experiments were set up to try to solve the issues raised after the first tests. There were updates to the INRIM system in Medicina, so the infrastructure has become much more reliable. A detailed description of the optical fiber link is provided in [1] and [2]. Results of this test are published in [3].

In November 2018, the Matera antenna was connected to the distributed time and frequency link, thanks to the new founded MeTGeSp (Metrology for Geodesy and Space) project. The link serves the Milan Financial District, the Medicina observatory, the Italian Laboratory for Non-linear Spectroscopy (LENS) in Florence, and the Telespazio Facility in the Fucino Plain, where one of the main stations of the European Galileo satellite network for global navigation is located to reach finally the Matera fundamental geodetic station.

Moreover, a new type of experiment (Timing VLBI) was carried out with the aim of comparing the synchronicity of atomic clocks located at a few European stations (Medicina, Noto, Yebes, Torun, and Matera) by means of the interferometric phase RMS noise statistics. VLBI clock timing should be a valid alternative to satellite-based techniques such as the Global Navigation Satellite System or the Two-Way Satellite Time and Frequency Transfer. First results were presented at the IVS 2018 General Meeting.

The presence of the LIFT infrastructure linking Medicina to Turin, where an optical clock was developed, allowed the installation of a Japanese small an-

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tenna (NICT's Marble 2.4-m antenna) with the aim of comparing optical clocks at intercontinental scale via VLBI.

2 Data Analysis and Results

The IRA started to analyze VLBI geodetic databases in 1989, using the CALC/SOLVE package on an 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 the CALC/SOLVE software was installed. During the last years, our Analysis Center had some internal problems and we did not participate regularly in IVS activities. However, we continued to update the catalog and we installed and tested the latest releases of CALC/SOLVE and vSolve.

3 Outlook

We hope that in the next few months, we will start contributing again to IVS activities, submitting INAF tropospheric parameters to the IVS Data Center, regularly. We will also produce an updated long-term geodetic solution.

In 2019, a VITA experiment with a remote common clock, delivered by INRIM at both Medicina and Matera stations, will be performed, involving other European VLBI antennas.

Further VLBI timing experiments will be performed, with local or remote clocks, to exploit this promising technique.

In the framework of the collaboration between NICT - INRIM - INAF, observations collected with the small Japanese antennas will be analyzed as feedback analysis for the clock comparison project.

References

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