PMD IVS Analysis Center

Vincenza Tornatore

Abstract

The main activities carried out at the PMD (Politecnico di Milano DIIAR) IVS Analysis Center during 2012 are briefly higlighted, and future plans for 2013 are sketched out.

We principally continued to process European VLBI sessions using different approaches to evaluate possible differences due to various processing choices. Then VLBI solutions were also compared to the GPS ones as well as the ones calculated at co-located sites.

Concerning the observational aspect, several tests were performed to identify the most suitable method to achieve the highest possible accuracy in the determination of GNSS (GLOBAL NAVIGATION SATELLITE SYSTEM) satellite positions using the VLBI technique.

1. General Information

The Department DIIAR (Dipartimento di Ingegneria Idraulica, Ambientale, Infrastrutture viarie e Rilevamento) belongs to the Technical University of Milan (Politecnico di Milano). The 'Rilevamento' research unit deals with various areas of research that concern, e.g., classical topography and photogrammetry surveying, numeric cartography, GIS (Geographic Information Systems) data processing, remote sensing, GNSS static and real time positioning, and mathematical and physical geodesy (space geodesy included). In this framework, the PMD IVS AC and the IAG (International Association of Geodesy) Service: IGES (International Geoid Service) are hosted and operated.

DIIAR continues to support all office supplies, hardware, and personnel necessary to manage the PMD IVS AC since its establishment in October 2010 [1]. Part of the work here described was developed also with the support of MIUR (Ministry of Education, University, and Research) under the framework of a project with considerable national interest.

2. Current Status and Activities

All the European sessions available since 1990 through the end of 2011 have been processed under the same modeling conditions and analogous parameterizations. To calculate solutions, we used the VieVS (Vienna VLBI Software) software [2] developed by the members of the VLBI group of the Institute of Geodesy and Geophysics (IGG) at the Vienna University of Technology (TU Wien).

Among the different approaches used to process European sessions, we report on the investigations made on seven VLBI stations that had longer historical data series and were co-located with GPS stations. The period used in this preliminary study starts in 1993 and ends in 2007. European site coordinates and baseline lengths (with respective variance-covariance matrices), have been estimated to study their temporal evolution. The adjustments were performed using the single session approach. The baseline lengths, used to infer European crustal deformations, were calculated with respect to the Wettzell station due to its stable position in the European network and its barycentric location with respect to the other six stations selected for the study (Onsala, Ny-Ålesund, Madrid, Medicina, Matera, and Noto).

The results were compared with those calculated in another previously performed study [3].

The principal crustal motions identified in that work were post-glacial rebound in Northern Europe (baseline Wettzell-Ny-Ålesund) and compression motion in southern Europe (baselines of Wettzell with the Italian stations). These motions were also confirmed by our investigations.

Another analysis of GPS and VLBI time series was performed on the velocities estimated by a least squares adjustment for each of the seven selected VLBI European stations using a linear trend as a deterministic model. Once the estimated trend was removed, the method of Empirical Covariance [4] was applied to the residuals, to look for the presence of a possible residual signal; it was found only for the Matera, Medicina, Noto, and Wettzell GPS stations, but not for the co-located VLBI ones. This difference in behavior between the VLBI and the GPS time series was reported also in other studies, e.g. [5], that made the comparisons using the SLR series also, and residual correlation was not found in the SLR time series either. According to these studies, it is possible to confirm that the presence of residual correlation in the GPS series does not indicate possible geophysical reasons but could instead be related to intrinsic GPS data processing.

During 2012, a strong activity to realize observational tests of GLONASS satellites with VLBI techniques took place. In contrast to previous years, when only two VLBI stations (Medicina and Onsala) were used during the tests (see for example [6] and [7]), another VLBI antenna, Noto, was added to increase data redundancy and to make it possible to cross-check among different baselines. Data are still undergoing processing, but one of the main problems that was found is related to a strong emitted satellite signal that entered through the secondary lobes during the observation of a nearby calibrator (a natural radio source). Usually natural calibrators have a flux lower than that of the GNSS satellites by about six orders of magnitude. Therefore the contamination due to the caught satellite signal made the data from the calibrator, which had been observed with the aim of correcting main systematic effects that were corrupting satellite observations, useless also.

3. Future Plans

Completion of the study described for European time series of baselines and site coordinates for data analysis is foreseen. A comparison with results of other ACs also involved in the studies of Europe campaigns would be worthwhile. The upgrade to the new VieVS version 2.0 is devised, and comparisons with results obtained with the previous VieVS version are also foreseen.

Concerning the problem of the observation of GNSS satellites through the VLBI technique, one objective is to use the same experience gained for GLONASS satellite observations to observe also the GPS constellation. The installation under the FS (Field System) of software dedicated to satellite tracking is of very high priority.

Simulations to evaluate the best procedure to be followed to observe GNSS satellites and nearby natural calibrators are also under development to gain the possibility of using the precious information coming from calibrator observations to correct systematic effects common to the satellites and the calibrators in L-band.

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