SHAO Analysis Center 2006 Annual Report

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Abstract

Our research activities in 2006 were mainly focused on the reduction of tracking data of satellite by VLBI, ranging and Doppler, which will be continued for the first half of the next year. In 2007 we will do some data analysis and experiments on the application of differential VLBI and phase-referencing VLBI. We will do a local survey at Sheshan.

1. General Information

As one of the research groups of Shanghai Astronomical Observatory (SHAO), we focus our activities on the studies of Radio Astrometry and Celestial Reference Frames. We use CALC/SOLVE system in the routine VLBI data analysis. We are now developing softwares coded in FORTRAN to deal with the tracking data of satellite by VLBI, ranging and Doppler. The members involved in the IVS/IERS activities are Jinling Li, Guangli Wang, Bo Zhang, Li Guo, Jing Wang and Zhihan Qian.

2. Activities in 2006

We participated in some IERS/IVS campaigns aimed at comparisons of reference frames and/or Earth Rotation Parameters (EOP). Now we have the ability to do the VLBI solutions on a regular base.

Differential VLBI plays an important role in the deep space exploration. However, the application of this technique is restricted due to the prerequisite that the angular distance between the target and the reference objects should be very small in order to maintain a high precision. A strategic design of the implementation of differential VLBI is developed by using observations of several reference sources spread out in a specially selected circular band and interpolating the non-geometric delay to the target object. Real data analysis of astrometric and geodetic VLBI experiments shows that by using our design a precision of about $1ns$ in the correction of the non-geometric delay could be obtained at S-band. We will check the performance of the design by experiments using the four Chinese antennas.

The dominant error source in VLBI phase-referencing is the model error of atmospheric delay during correlation. The most common approach to correct this error is measuring directly the vertical atmospheric delay by geodetic-like VLBI observations before, during and after the phase-referencing. However, this approach is limited by the fluctuation of dynamic atmospheric delay at each antenna. Atmospheric delay is dominated by the troposphere at frequencies higher than 5GHz. The comparison between atmospheric delay derived by GPS and VLBI observations at sites with co-located VLBI and GPS systems shows that the standard deviation of the difference is about several millimeters after a systematic bias is removed. This suggests that GPS could be used to monitor the large scale fluctuation of dynamic tropospheric delay and to increase the precision of correction of the atmospheric delay model error. Model and software development and application of experiments are continuing.

We take part in the Chinese lunar project Chang'E. We are developing softwares to process VLBI, range and Doppler satellite tracking data. We have examined the software by tracking data in the modes of real-time and post-stage processing both for geo-satellite and lunar satellite (SMART1). At present the software is very near to the status of being applicable to the mission. The next step is to do the synthesis reduction of VLBI observations of satellite and quasars.

3. Plans for 2007

We will continue to focus our efforts on the application studies of VLBI to satellite positioning and orbit determination. We will try to be closely involved in IERS/IVS analysis activities. We will do some data analysis and experiments on VLBI phase-referencing and differential VLBI. We will do the local survey at Sheshan observation site to connect the reference markers of SLR, VLBI and GPS.