School of Astronomy & Space Science

Future Improvement of the International Celestial Reference Frame

Lecturer： Dr. Oleg Titov
Host： Dr. Niu Liu
Date & Time： Sep 6 (Fri.), 10:00 am.
Location： Room 302

Profile

Dr. Oleg Titov got his Bachelor's degree from St. Petersburg University in 1991, followed by a period of work at the Institute of Applied Astronomy in Saint-Petersburg, Russia, from 1991 to 1997. During this time, Dr. Titov also achieved his PhD in 1996. His academic prowess was further recognized when he was appointed as an Assistant Professor at Saint-Petersburg University from 1997 to 2001. Dr. Titov's expertise and dedication to his field led him to Geoscience Australia in Canberra, Australia, where he has been serving as a VLBI (Very Long Baseline Interferometry) Scientist since 2001.

Abstract

Wet tropospheric component and clock phase variations are the most important factors that limit the accuracy of the geodetic VLBI products. These fast fluctuations can be introduced into the parametric model as a correlated stochastic noise and treated in a special way using the least square collocation method (LSCM). An a-priori covariance function is used to construct the non-diagonal covariance matrix. We have developed a procedure to calculate the wet troposphere delay and the clock offset for each observation epoch. The wet troposphere delays calculated by the LSCM are in perfect agreement with the water vapour radiometer (WVR) data, within the uncertainty of 2-3 mm. This information is then incorporated into the NGS data file and used in the second iteration. As a result, the procedure for analysing the VLBI data becomes simpler and faster, since the remaining observational error is Gaussian, and the matrix of the observational covariance can be treated as diagonal. For the calibrated VLBI data, the simple LSQ method (without breaking the 24-hour experiment into small bins) is applied, followed by a reduction in the number of estimated parameters. All VLBI data between 1993 and 2023 were processed with pre-calibrated tropospheric and clock delays. The result was tested with two independent software packages, OCCAM and VieVS, and showed a good efficiency with respect to the traditional approach. The accuracy of the estimates reaches: 1 mm for VLBI site positions, 3 μs for UT1-UTC values, 40 mas for X- and Y-pole components. A 30-year set of geodetic VLBI observations was processed with self-calibration of the wet troposphere delay and gradients along with reference clock offset variations. The formal accuracy of all astrometric parameters is improved by a factor of three with respect to the standard solution. We analyzed more than 15 million group delays and provided high precision coordinates of 5428 radio sources with the best formal positional error of a few μas.