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Monte Carlo simulations for the next generation VLBI system VLBI2010

J. Wresnik, J. Boehm, A. Pany, and H. Schuh

TU-Vienna, Institute of Geodesy and Geophysics, Vienna, Austria (wresnik@mars.hg.tuwien.ac.at)

Main goal of VLBI2010 is to design a new Very Long Baseline Interferometry (VLBI) system that will provide baseline length repeatabilities of better than 1mm for longest global baselines. To support this task, VLBI2010, simulations were carried out at the Institute of Geodesy and Geophysics (IGG), Vienna. Main part of these simulations is a Monte Carlo simulator which produces artificial group delays by modeling the stochastic processes caused by station clocks, wet zenith delays, and additional system errors. The limiting factor of the VLBI system is the influence of the wet part of the troposphere. Therefore, turbulence models using wind speed and wind direction information from numerical weather models were used in the Monte Carlo Simulator to simulate realistic wet zenith delays. The clocks were simulated with a random walk plus integrated random walk. The Monte Carlo simulator was implemented in a modified version of the VLBI analysis software package OCCAM. Baseline length repeatabilities and rms values of station position residuals were compared for schedules with antennas of different slew speeds (from 1.5 °/s to 12°/s in azimuth and 0.7 °/s to 3.1 °/s in elevation). This investigation shows that fast antennas (6°/s in azimuth and 2.1°/s in elevation) are needed to be able to provide baseline length repeatabilities of high accuracy.
Different scheduling strategies, such as those achieving uniform sky coverage, were tested, too. The uniform sky scheduling strategy requires antennas with a slew speed of 12°/s in azimuth and 3.5°/s in elevation to enable a source switching rate of 30 s. This yields to an observation density for a 16 station network of $\sim$ 140 000 observations in 24 hours. The influence of the network size (16, 24, and 32 VLBI2010 sites) was tested with respect to RMS errors of EOP and scale determination, which shows that the VLBI2010 goals can be achieved.