The connection between dynamical and radio-sources reference frames obtained from radar and VLBI observations of Phobos-2, Viking-Mars, and Pioneer-Venus spacecrafts

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April 12, 1995

Abstract

The experience of determination of the link between radio-sources and dynamical reference frames is presented. To obtain this connection we used series of Very Long Baseline Interferometry (VLBI) observations of Phobos-2, Viking-Mars, and Pioneer-Venus spacecrafts and angularly nearby quasars. Orbit determination of each spacecraft was carried out by numerical integration of relativistic equations of motion with taking into account all major planet perturbations. The coordinates of perturbing planets were calculated by the DE200/LE200 ephemerides. So the dynamical reference frame is determined by equator and equinox of this ephemeris. The resulting spacecraft orbit was fitted to the VLBI and tracing (range and Doppler frequency shift) data by means of weighted least squares procedure with the uncertainties of a few kilometer level. After precise orbit determination using VLBI measurements only we obtained three rotation angles between two reference systems.The radio and ephemeris dynamical frames were found to be coincident in all three axis to less then 80 milliarcseconds.