
A joint Canadian-U.S. experiment is in progress to demonstrate the capabilities of phase-coherent VLBI for the measurement of AstrometricLatitude and Universal Time and polar motion. In order to do this, we have developed a high-precision phase-coherent link between VLBI stations in British Columbia, Ontario, and Maryland using the synchronous satellite ANIK-B. The system uses the 12/14 GHz transponder of ANIK-B in a shared-user mode with television transmissions, and makes only modest power and bandwidth demands on the satellite channel. A two-tone transmission format eliminates the necessity for a coherent satellite local oscillator, and two-way transmission enables elimination of satellite position changes as well as atmospheric effects. Data obtained on link performance during a first experiment lasting several days show a measured phase stability of $2 \times 10^{-15}$ for a period of one day. This is superior to typical VLBI measurements of the performance of separated hydrogen masers. A complete measured Allan variance vs. averaging interval curve has been computed, and clearly demonstrates the long-term stability of the link. It also demonstrates the accuracy relationship of the link to various types of frequency standards over different time intervals. Our first results indicate an internal precision that verifies the ability of this technique to improve on the short-baseline interferometer technique currently used to measure Universal Time.

Mark III VLBI: Astrometry and Epoch J2000.0, C. MA and T. A. CLARK, NASA/GSFC, and D. B. SHAFFER, Phoenix Corp. for the Goddard/Baystack/MIT/Ossian/Bonn VLBI group -- The IAU has recommended that celestial positions be referenced to the FK5 equinox and equator of the rotation year 2000.0 ($\nu_{2000.0}$). We have determined the J2000.0 positions for a set of extensively observed extragalactic radio sources from X-band and S-band VLBI data provided by NASA's Crustal Dynamics Project. The observations were treated as a single data set and all parameters except the absolute right ascension, declination, solid Earth tides, clops, and tropospheric zenith delays were adjusted simultaneously. Typical 3-sigma formal errors are less than 0.005 to 0.006 in declination, except for nearly equatorial sources, and 0.002 in right ascension. J2000.0 positions of some 75 other sources with fewer observations have been determined with somewhat poorer precision from individual experiments.

We have taken the J2000.0 position of 3C273 ($\nu_{2000.0}$), derived from the Baseline year 1950.0 ($\nu_{1950.0}$) position of V273 by Aristarchus, as our right ascension reference. Our reduction procedures used the IAU 1976 constants for precession to/from J2000.0 as developed in expressions by Lisek et al. We derived the initial position of sources other than 3C273 by adopting the FK5 to our $\nu_{1950.0}$ right ascension and then rotating from $\nu_{1950.0}$ to J2000.0 using the matrix developed by Lisek et al. 1) The difference between FK5 and FK5 is the effect of precession (the difference between FK4 and FK5) and 2) the effect of our using the IAU 1976 precession constant with Newcomb's ephemeris for the 1950.0 basal time.

Mark III VLBI: UT1, Polar Motion, and Baselines, T. A. CLARK and J. W. REYNOLDS, NASA/GSFC, and D. B. SHAFFER, Phoenix Corp. for the Goddard/Baystack/MIT/Ossian/Bonn VLBI group -- UT1, Polar Motion, and baseline vectors have been measured with X-band or dual X/S-band VLBI from 36 experiments spanning September 1976 through July 1981. These observations were carried out as a part of the NASA Crustal Dynamics Project. Experiments consisted typically of two long sessions of which a dozen or so radio sources were observed repeatedly in order to obtain a wide sampling of baseline projections. Scan lengths were typically two minutes, and the different sources were observed as rapidly as the telescopes could be slewed from one source to the next. Bandwidth synthesis was used to increase delay observation precision. The resulting delay and delay rate observations were analyzed with an interactive, multi-parameter least-squares program by which source and antenna positions, atmospheric delays, earth tides, and UT1 and polar motion were simultaneously determined.

Experiments after May 1978 were carried out with the Mark-III VLBI system. These experiments produced measurements of the Earth's rotational position, UT1-DT, with formal errors of less than 0.1 millisecond of time; and the VLBI values show the existence of systematic, annual errors in the current IAU data which are as large as 3 milliseconds of time. Polar motion was determined to about 1-2 milliarcseconds. Transcontinental U.S. baselines are sensitive to the Earth's polar motion, and baselines to Europe are necessary for an accurate determination of the X-component vector as well as other baselines. A concentrated period of observations in September/October of 1980, as part of the MERIT campaign to measure earth rotation, showed typical baseline length deviations of 3-4 cm on 14 different baselines. Some of the baselines were determined 14 separate times. This was a period of unusual high solar activity and accurate results were obtained only because the dual-frequency system allowed removal of ionospheric effects. The length of the Baystack-Ossian Valley Radio Observatory baseline shows no significant change between 1976 and 1981, with a limit of less than 1 cm per year.