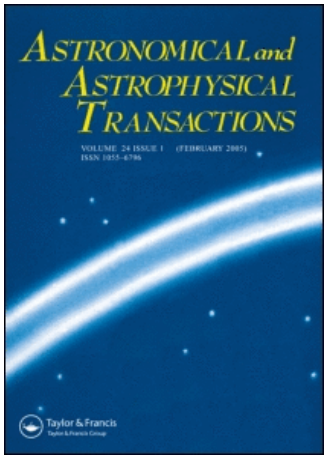


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# Computing apparent places of stars with a personal computer

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# COMPUTING APPAREST PLACES OF STARS WITH A PERSONAL COMPUTER

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**An algorithm for calculating apparent places of stars with an IBM PC-compatible computer is suggested. Precession and nutation are computed with certain mean places and proper motions for some standard epoch and equinox using analytical expressions by time. Reduction of other parameters (parallax, aberration, account for light deflection) is given in the form of exact vectorial formulae. Maximum differences 0.004s in right ascension and 0.02″ in declination were obtained from comparison of the apparent with those computed using the ephemeris DE200/LE200 (JPL, 1981).**

KEY WORDS **Apparent places of stars, astrometric observational reductions**

Computations of apparent places of stars is the most complicated problem in reduction of astrometric observations. This problem is solved with reductions for proper motion, parallax, aberration, gravitational light deflection, precession, and nutation.

Precession and nutation, under known mean places and proper motions for some standard epoch and equinox, are accounted for using known analytical expressions depended on time (USSR Astronomical Annual, 1987). Reductions of other parameters are obtained from strict vector relations described in USSR Astronomical Annual, (1987) and Abalkin (1979). Vectors of heliocentric Earth's position, heliocentric position of the barycentre, and barycentric Earth's velocity are obtained by integrating the equations of motion of the Solar system bodies (Abalakin, 1979).

In calculations of apparent places for astronomical annuals, the ephemeris DE200/LE200 (JPL, 1981) is traditionally used. In this ephemeris, the components of the mentioned vectors are tabulated for any time moment within the period from 1900 to 2050. The ephemeris was obtained directly by numerical integration of the equations of motion of the Solar system bodies. Unfortunately, the volume of the part of the ephemeris necessary for practical work is several dozens megabytes, which is too large for personal computers with a small size of hard disk.

Soma *et al.* (1988) published analytical expressions for the necessary vectors. The components of the vectors are presented by sums of 15 to 189 trigonometrical terms, dependent only on time and enabling one to calculate these components

with RMS error of 2.4E–7 a.u. (35 km) and 1.5E–7 a.u. (23 km) respectively for heliocentric positions of the Earth and of the barycentre and 2.3E–8 a.u. per day (3.9 cm/s) for the barycentric Earth's velocity (in comparison with the ephemeris DE200/LE200).

Using these data, a batch of programs for calculations of apparent places of stars on IBM PC-compatible computers was developed. This batch is oriented on calculations of apparent places of stars included in the catalogues FK5 and RRS2; this is connected with the necessity to process observations of stars of the above catalogues. However, it can be easily adjusted for processing observations of stars from other catalogues. To do this, it is sufficient to prepare data files containing mean places and proper motions, as well as parallaxes and radial velocities (for nearly stars only).

From comparison of apparent places computed by us with those computed with the DE200/LE200 ephemeris (Apparent places of fundamental stars, 1988), maximum deviations of 0.004s in right ascension and 0.02″ in declination were found, which completely satisfies the required accuracy of calculations.

The batch is realized using the Borland C++ 2.0 programming system. The volume of the executable file is 77 kB, the volume of data files is 21 Bytes per each star. The volume of the source texts of the programs is 110 kB. The time needed for calculating the apparent place of one star, including time of searching for it in the catalogue, is about 1.5s.

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*References*

Abalakin, V. K. (1979) *Fundamentals of Ephemeris Astronomy*, Moscow, Nauka, 45–210 (in Russian).

*Apparent Places of Fundamental Stars 1989* (1988) Heidelberg.

*Jet Propulsion Laboratory. Numerical Integration DE200/LE200* (1981) Magnetic Tape.

Soma, M., Hirayama, Th., Kinoshita, H. (1988) Analitical expression of the Earth's position and velocity for the calculation of apparent position, *Celesial Mechanics* **41**, 389–410.

*USSR Astronomical Annual for 1989* (1987) Moscow, Nauka, 692–694.