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INACCURACIES AFFECTING THE CALCULATION OF ORBITAL ELEMENTS

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ABSTRACT

The quality of orbital elements determination, both of minor planets and artificial satellites, depends on the quality of input data. In this paper the basic difficulties of obtaining reliable input data for such calculations are described.

Orbital elements are essentially calculated from precise astrometric data. Each measurement is determined with its own accuracy, which depends on several input data - time, topocentric coordinates, quality of used astrometric catalog, pixel size of CCD detector, astronomical seeing, quality and speed of CCD shutter, computational method of coordinates determination and also of orbit calculation. The basic difficulties of obtaining these input data are described here.

Precise astrometry does not include only coordinates information (right ascension and declination), but also information about time of the measurement. The precision of the final calculation depends also on the determination of the time. In Central Europe, there are several ways to determine precise time of observations, although precision of Internet time servers is arguable and will be discussed.

Another important data input are topocentric corrections. All ephemerides, both of natural and man-made objects with either heliocentric or geocentric orbit, are

primarily calculated as geocentric. Astrometric measurements of these objects on the sky are made as topocentric, i.e. site dependent, and then from these topocentric coordinates the geocentric orbit is determined. The ephemerides, i.e. predictions of position of the object, are calculated both geocentric and topocentric. The topocentric coordinates of the observer must be determined with accuracy better than 0.1 arc seconds for reliable astrometric measurement, the usual assessment is within 15 meters accuracy.

Precision of astrometric measurement depends also on the quality of the astrometric catalog used. The most common catalogs used for minor planet astrometry are USNO-A2.0, USNO-B1.0 and UCAC3 catalogs.

The quality of astrometric measurement depends not just on the astrometric reference catalog, but also on the computational method of astrometry, seeing and pixel size of the detector and quality (and speed) of the detector shutter.

The input for the orbit determination is as follows: time with precision at least to 1 second, two precise astrometric coordinates measured for time of observation - i.e. right ascension (R.A.) with precision at least 0,01 sec and declination (Decl.) with precision at least 0.1". The last input data are topocentric coordinates of astrometric observatory with precision to at least 15 meters.

Presented paper is based especially on long-term experience obtained in the framework of the Klet Observatory minor planet astrometric programme. It will discuss particular sources of inaccuracies in output astrometric data, options of their elimination as well as the implication of all these inaccuracies to final orbit determination.