A NEW CONCEPT OF CONSTRUCTING AN ACCURATE COORDINATE SYSTEM FROM GROUND-BASED OPTICAL OBSERVATIONS

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ABSTRACT. Based on the expected precision and characteristics of the Low Latitude Meridian Circle (LLMC), and the development of CCD astrometry at Yunnan Observatory, an internally consistent and non-rotating optical celestial coordinate system can be set up through observations with the LLMC and CCDs. To obtain this goal, the main work we plan to do are (1) to establish a fundamental stellar reference system of several thousand stars based on the absolute obsrvations with the LLMC; (2) to provide the accurate zero-point corrections for the system from observations of minor planets with the LLMC and CCDs; (3) to determine the precessional rotation of the system with respect to an extragalactic reference system with the LLMC and CCDs, thus transforming the system into a quasi-inertial coordinate system; and (4) to obtain the atmospheric refraciton corrections from the observations with the LLMC.

1. Introduction

It is necessary that a milliarcsecond quasi-inertial celestial coordinate system be realized for the development of astronomy and relevant subjects. However, it is difficult to satisfy this demand only by means of traditional ground-based optical astrometric measurements. Therefore, many astrometrists are investigating space astrometry and VLBI. Undoubtedly, the realization of the new ideas and techniques will bring great changes for fundamental astrometry. Under these circumstances, it is one of the tasks in astrometry whether one could make use of new methods of ground-based optical fundamental astrometry and develop new instruments by new ideas and techniques, and then improve the celestial coordinate system, which can be not only compared with the systems of space astrometry and VLBI, but also be more readily applicable. According to our work during the past decade, we think that this idea can be realized with the LLMC and CCDs.

2. Realization of an internally consistent stellar reference system

The method of meridian absolute determination of the LLMC (Mao *et al.* 1986a) makes it possible to observe absolutely the stars of thirteenth magnitude in low latitude areas (including the equator area). This is very important to link the observations between the northern and the southern hemispheres, and ensures the consistency of the observations. Of course, the method can also be used in higher latitude areas. With the method, we can obtain the absolute azimuth and instantaneous latitude of the instrument through the alternate observation of a star in the prime vertical and meridian directions of the LLMC. Especially, we can determine several absolute latitude values during a night, and then obtain a curve of instantaneous latitude variation after a period of observation. Thus, the

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positions of celestial bodies can be determined absolutely. The method can completely avoid the influence of various errors in the culmination observations of circumpolar stars.

Some instrumental errors, for example, the tube flexure, the circle division errors, etc. of the LLMC can be determined accurately and eliminated based on the practical measurement rather than the mathematical model in various zenith distances. From the charactaeristics of the LLMC, we can determine the corrections of atmospheric refraction in real time and also obtain better corrections even close to 80° zenith distance (Mao *et al.* 1986b). This allows us to obtain the local refraction corrections.

We adopt the full-star-adjustment method in constructing a catalogue (Fan *et al.* 1988). The method overcomes the difficulty due to non-continuous observations. It does not require observation of regular sets of stars, so it raises the efficiency of compiling a catalogue and can eliminate the influence of the variations of clock errors and seasonal variations, which are the main sources of systematic errors in right ascension. Thus, an internally consistent stellar reference system will be obtained.

3. The zero-point corrections and the elimination of precessional rotation of the stellar system

According to the application of CCDs in astrometry, we apply an overlapping exposure method for the observation of a CCD (Mao *et al.* 1989). By means of the method, we can determine the relative positions of fainter extragalactic objects and minor planets with respect to two reference stars (the stars are about tenth magnitude and about one degree apart) provided directly by the LLMC. In the measurement, the influence of atmospheric agitation in low altitude can be eliminated. The accuracy of observations in a night will be able to reach about 0."003. With the LLMC in combination with the CCD, we are going to observe minor planets in the same instrument system in order to determine the zero-point corrections to the stellar system (Xu *et al.* 1989; Hu *et al.* 1989). We also plan to observe extragalactic objects for obtaining the corrections of lunisolar, planetary precession and nutation constants with the LLMC and the CCD in order to determine the rotation of the system. The position errors of reference stars can be eliminated in the determination of the objects (Guo 1989).

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