

大型望远镜测角系统误差的修正

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Correction of angle measuring errors for large telescopes

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摘要

图/表

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摘要 由于大型望远镜转台轴系对测角精度要求较高,本文研究了测角数据系统的误差修正技术。分析了测角数据误差产生的原因,对测角元件误差、安装误差、被测轴系误差进行了讨论,指出轴系测角分系统的误差规律符合谐波方程,故提出采用谐波方程式来表达误差规律。针对工程应用,建立了基于傅里叶级数的简化谐波方程误差公式,用谐波方程算法和多项式拟合算法对系统误差进行修正。在一个望远镜垂直轴转台进行了试验验证,结果显示测角精度峰值由原来的3.81"提高到了1.06"。实验表明,基于傅里叶级数的修正算法,较好地符合误差分布规律;采用系统误差修正技术,可以对系统综合误差统一修正,能够有效提高系统测角精度。

关键词 : 望远镜, 测角系统, 编码器, 测角精度, 误差修正

Abstract : As the turntable shaft system of a large telescope needs a higher angle measuring precision, this paper explores an error correction method for the angle measuring system. The causes of data errors of angle measuring were analyzed, and the errors of angle measuring device, installation errors and the errors of measured shaft were discussed. It points out that the error rules of the shaft angle measuring subsystem are according with a resonant equation, so the resonant equation was used to explain the error rule. For engineering applications, a simplified resonant equation error formula was established through the research of the Fourier series. Then, the harmonic equation algorithm and the polynomial fitting algorithm were used to correct the system errors. A test was taken on the vertical axis turntable of a telescope and the results show that the peak of angle measurement precision is improved from 3.81" to 1.06". The experiments indicate that the modified algorithm based on Fourier series conforms the error distribution rule better. The error correction method corrects comprehensive errors of the system in a unified way and effectively improves the angle measurement precision of the system.

Key words : telescope angle measurement system encoder angle measurement precision error correction

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