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iGPS测量场精度分析及其应用研究

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Precision Analysis of iGPS Measurement Field and Its Application

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摘要 为了支持iGPS测量系统在航空、航天、船舶等大型复杂产品装配过程中的布局优化和系统选型,提高测量效率和精度,对其测量精度分布规律进行了研究。阐述了iGPS测量系统的工作原理,构建了其计算机仿真模型;根据其布局形式的特点,提出了iGPS测量单元与测量网络的概念;给出了一种iGPS测量场精度分析方法,并通过实例对测量单元和测量网络的测量场精度与发射器布局及目标点空间位置间的量化关系进行分析。试验结果表明,当发射器间距为20 m时,iGPS测量场的测量精度在垂直方向上的波动范围在0.01 mm内,在水平方向上测量精度呈线性变化,最高测量精度为0.12 mm,出现在测量场的中心,最低测量精度为0.25 mm,出现在测量场的边界处。在iGPS测量场精度分析的基础上,提出了一种基于精度约束的测量方案评估方法及其实施步骤,为iGPS测量系统的选型和工程应用提供支持。

关键词：　iGPS　测量系统精度分析　单元测量场　网络测量场　测量方案评估　iGPS布局优化

Abstract： To support the layout optimazation and system selection of an iGPS measurement system in the assembly of large complex products in aviation, aerospace, shipbuilding and other industries, and improve the measuement efficiency and precision, the characteristics of its measurement precision is studied. This paper presents a method for the precision analysis and the transmitter layout optimization of an iGPS measurement system. First, the working principle of the iGPS measurement system is investigated, and a simulation system model is constructed.The concepts of the iGPS measurement unit and measurement network are discussed, and a precision analysis method of the iGPS measurement field is studied. A case study is carried out for analyzing the quantitative relationship between the measurement precision of an iGPS measurement field and its transmitter layout. The results indicate that, when the distance between the transmitters is 20 m, the vertical fluctuations of measurement precision is less than 0.01 mm, and the horizontal measurement precision is linear, the maximum value of measurement precision is 0.12 mm, which appears in the center of the measurement field, while the minimum value of measurement precision is 0.25 mm, which occurs in the boundary of the measurement field. Finally, a precision constraint based measuring schema evaluation method and its implementation is developed to support the selection and industrial application of the iGPS measurement system.

Keywords： iGPS　precision analysis of measurement system　unit measurement field　network measurement field　measuring schema evaluation　optimization of iGPS layout

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引用本文:

杜福洲, 陈哲涵, 唐晓青. iGPS测量场精度分析及其应用研究[J]. 航空学报, 2012, 33(9): 1737-1745.

DU Fuzhou, CHEN Zhehan, TANG Xiaoqing. Precision Analysis of iGPS Measurement Field and Its Application[J]. Acta Aeronautica et Astronautica Sinica, 2012, 33(9): 1737-1745.