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摘要: 考虑大尺寸、高精度要求的飞机或特殊机型飞行器需要采用多仪器组合测量网络来完成数字化测量任务, 本文对测量网络进行了最优布站设计。介绍了传统的飞机调平理论, 提出了飞机数字化调平变换算法, 并建立了其不确定度模型。通过不确定度分析和误差依赖性仿真得出飞机各基准点不确定度和水平点位置对测量不确定度的影响。结合由激光雷达、iGPS组成的飞机数字化测量网络的测量特性, 提出了飞机数字化测量网络的最优布站设计方案。对某机型飞机水平测量实验验证表明, 经布站优化设计后的测量结果精度为0.402 mm, 提高了约20%。结果显示提出的布站设计方案有效、可行, 其分析方法为寻找高准确度、高效率的飞机数字化测量的布站设计提供了参考依据。

关键词: 飞机数字化测量 测量网络 最优布站 激光雷达 iGPS 不确定度模型

Design of multi-station network arrangement for aircraft digital measurement

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Abstract: As some aircrafts with large sizes, high accuracy or special structures need multi-instrument combination measurement networks to complete its digital measurement, this paper researched the optimal arrangement design of measurement networks. The traditional aircraft leveling theory was introduced firstly. A aircraft digital leveling algorithm was put forward, and its uncertainty model was established. Then, the effect of the accuracy of level benchmark points and the location of level points on the measuring accuracy was studied through the uncertainty analysis and error dependence simulation. Based on the measurement characteristics of the aircraft digital measurement network consisted of a laser radar and an iGPS, the optimal multi-station arrangement design of aircraft digital measurement network was put forward. Experimental results of aircraft leveling measurement show that the measurement accuracy of optimal multi-station arrangement design is 0.402 mm, which has improved by 20%. The optimal arrangement design is feasibility and effectiveness, and proposed analysis method provides reference basis for researching the multi-station arrangement design for aircraft digital measurement efficiency and accurately.

Keywords: aircraft digital measurement measurement network optimal multi-station arrangement laser radar iGPS uncertainty model

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