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微纳技术与精密机械

飞机航炮的数字化校准分析

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摘要： 为了提高航炮安装的精度和效率，提出了一种基于激光跟踪仪的飞机航炮数字化测量方法，并给出了相应的构建测量精度场及计算安装偏差的策略。首先，将由公共点构建的现场坐标系作测量基准，采用航炮测量工装提取航炮实际瞄准轴线。然后，根据机身参考点获取机身对称轴线，计算实际瞄准点位置及安装偏差， 并详细说明测量工装设计方案及靶标位置误差补偿方法。最后，利用误差椭球描述空间点的位置精度，建立航炮瞄准轴线的不确定度模型；通过不确定度分析得出工装标定误差及跟踪仪测量误差对测量结果的影响。实验结果显示，测量得到的安装偏差的重复性精度为±4.813 mm，瞄准点的位置精度约为±3 mm。结果表明了所提出的方法可以满足航炮安装速度、精度和实时现场测量的要求。

关键词： 数字化装配 航炮 校准 激光跟踪仪 校准 测量不确定度

Accuracy analysis for digital boresighting of aircraft gun

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Abstract: To improve the accuracy and efficiency of setting an aircraft gun, a digital boresighting measurement method based on the laser tracker was proposed. Some topics on the establishment of the measuring precision field and the calculation method of installation deviation were discussed. Firstly, a local coordinate system built by common points was taken as the measuring basis and the actual gun aiming axis was extracted by a Cannon measurement instrument. Then the body axis of symmetry was got by reference points to calculate the actual position of the aiming point and installation deviation according to the assembly requirements. Furthermore, the measurement instrument design and error compensation method of a reflector holder were described in detail. Finally, the position accuracy of measure points was analyzed by the uncertainty ellipsoid, and an uncertainty model based on the theory of stochastic process was introduced to describe the position error of the bore axis. Experimental results indicate that the repeatability precision of the installation deviation is ±4.813 mm and the position accuracy of aiming point is about ±3 mm, which meets the assembly requirements of aircraft guns in real time, high-precision, high-speed and stabilization.

Keywords: digital assembly aircraft gun calibration Laser tracker boresighting measurement uncertainty

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