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信息科学

基于自适应算法的单目视觉系统的姿态解算

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摘要：提出了自适应总体最小二乘法，以进一步提高单摄像机视觉测量系统光学特征点的姿态解算精度，研究并对比了常用的总体最小二乘法及自适应总体最小二乘法在测量系统中的应用。首先，根据空间几何位置关系构建光学特征点、像点及摄像机位置的坐标系及三维空间模型，并建立关于光学特征点及像点的矩阵方程。然后，应用常用的总体最小二乘法及自适应总体最小二乘法进行优化求解。最后，基于优化的总体最小二乘法确定光学特征点相对世界坐标系的姿态。应用三坐标测量机进行仿真对比实验，结果表明：常用的总体最小二乘法得出的姿态坐标的标准差为0.055 7 mm，自适应总体最小二乘法得出的姿态坐标的标准差为0.041 4 mm。相比之下，自适应总体最小二乘法有更高的收敛速度及收敛精度，且解算速度优于常用总体最小二乘法，满足单目视觉测量系统的稳定、可靠和精度高等要求。

关键词：视觉测量 单目视觉系统 光学特征点 总体最小二乘法 姿态解算 自适应算法

Attitude calculation of single camera visual system based on adaptive algorithm

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Abstract: An adaptive total least square algorithm was proposed to further improve the attitude calculation accuracy of optical characteristic points, and the total least square algorithm and adaptive total least square algorithm were researched and compared. Firstly, the coordinate system and 3D model among optical characteristic points, image points and the position of camera were established according to the space position relationship, and the matrix equation between optical characteristic points and image points was created. Then, the two algorithms mentioned above were used to get an optimization solution. Finally, the attitude of optical characteristic points relative to the world coordinate system was obtained based on the optimization solution. The simulation comparison experiment was performed in a coordinate measuring machine, and the experimental result indicates that the standard tolerance of attitude coordinate calculated by total least squares is 0.055 7 mm, and that by adaptive total least squares is 0.041 4 mm. The compared results show that the adaptive total least square algorithm has higher convergence rate and precision, and its calculation speed is better than that of total least square algorithm. It satisfies the system requirements for stabilization, reliability and high precision.

Keywords: visual measurement single camera visual system optical characteristic point total least squares attitude calculation adaptive algorithm

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