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基于双圆特征的无人机着陆位置姿态视觉测量方法

张广军, 周富强

北京航空航天大学 仪器科学与光电工程学院, 北京 100083

Position and Orientation Estimation Method for Landing of Unmanned Aerial Vehicle with Two Circle Based Computer Vision

ZHANG Guang-jun, ZHOU Fu-qiang

School of Instrument Science and Opto-Electronics Engineering, Beijing University of Aeronautics and Astronautics, Beijing 100083, China

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摘要 提出了一种无人机自主着陆位置姿态的单目视觉测量方法,建立了机载摄像机的运动和投影模型。设计了新型双圆图案着陆平面靶标,采用双圆的8个公切点,产生21个具有透视投影不变性的特征点,并提出了在复杂背景中全自动双圆特征的图像提取新方法及标记特征点的方案,实验表明,768×576像素大小的图像,特征提取及标记耗时小于9ms。仿真试验表明,摄像机距离靶标10m左右,噪声偏差达到1.5像素时,单轴位置RMS误差小于6cm,单轴姿态RMS误差小于0.7°,所提出的算法具有很强的抗噪声能力,能够满足无人机自主着陆位置姿态实时测量的要求。

关键词： 无人机 位置 姿态 特征点 透视投影

Abstract： A novel monocular vision method for landing of unmanned aerial vehicle (UAV) to estimate its state relative to a known two-circle planar target is proposed. The motion and projection model of the camera on-board of UAV is established. Twenty-one control points with invariance of perspective projection are generated with eight common tangent points of two coplanar circles onto the designed target. The position and orientation of the camera can be computed with the world coordinates of twenty-one control points and the corresponding image coordinates. The feature extraction of two circles and control points labeling in a 768×576 pixel size image with complex background may be completed within 9ms. Simulation test results show that the proposed vision-based state estimations are accurate to within 6cm refered to each axis of translation and 0.7 degrees refered to each axis of rotation when the distance between the camera and the landing pad is about 10m and the Gaussian white noise level is 1.5 pixels. The proposed technique is robust to noise and reliable, and it can meet the demand of the real time measurements of the position and orientation for control of UAV.

Keywords： unmanned aerial vehicle position orientation feature point perspective projection

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