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现代应用光学

线结构光传感器模型的简易标定

陈新禹, 马孜, 陈天飞

大连海事大学 自动化研究中心,辽宁 大连 116026

摘要： 为了现场完成线结构光视觉传感器中摄像机和光平面的同时标定,提出了一种基于单一圆形标靶标定线结构光视觉传感器的方法,该平面标靶包含一个同心圆以及过圆心的两条正交直线。通过共轭点原理线性计算摄像机内参数的初值,并根据正交性约束进行迭代优化。然后,多次移动传感器,保持结构光与同心圆相交,使其构成三点透视模型(P3P),依此计算光平面上标定点的三维坐标。最后,利用最小二乘法拟合出光平面方程,从而完成光平面方程的标定。实验结果表明:该方法具有较高的精度,平均测量精度为0.036 82 mm,相对测量误差为0.277 13%。该标定方法仅需同一标靶即可完成摄像机内参数和光平面方程的标定,降低了标定成本,且计算简单、操作灵活,适宜现场环境标定。

关键词： 线结构光传感器 摄像机标定 光平面标定 共轭点 三点透视模型

Calibration model for line structured light vision sensor

CHEN Xin-yu, MA Zi, CHEN Tian-fei

Automation Research Center, Dalian Maritime University, Dalian 116026, China

Abstract: To realize the calibration of a camera and a light plane in the line structured light sensor simultaneously, a calibration method was proposed based on a single plane calibration target which contains a concentric circle and two orthogonal lines passing through its center. Firstly, several images of model plane were captured from different orientations, and the camera parameters were determined via computing conjugated points linearly and were optimized according to the orthogonal constraints. Then, by moving the sensor for several times freely and keeping the light plane intersecting with the concentric circle, the perspective-three-points (P3P) model was implemented, and the 3D coordinates of calibration points on the light plane were computed. Finally, the light plane equation was derived eventually using the least square algorithm. Experimental results indicate that this calibration method has high accuracy, its average measuring accuracy is 0.036 82 mm, and relative error is about 0.277 13%. This calibration method requires only one target to complete the calibration of camera parameters and light plane equation, therefore, the calibration cost is reduced. It is characterized by simple calculation, easy operation and suitable for calibration in fields.

Keywords: line structured light sensor camera calibration light plane calibration conjugated point perspective-three-point model

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通讯作者: 陈新禹

作者简介: 陈新禹 (1986-),男,辽宁海城人,博士研究生,2009年、2011年于大连海事大学分别获得学士、硕士学位,主要从事机器视觉、视觉测量等方面的研究。E-mail: chensavvy@163.com
作者Email: chensavvy@163.com

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