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现代应用光学

光笔式大视场三维视觉测量系统

冯萍*，魏振忠

北京航空航天大学 精密光机电一体化技术教育部重点实验室， 北京 100191

摘要： 针对先进制造业对大型装备大范围精密尺寸测量需求，基于双目立体视觉测量原理设计了一种光笔式大视场三维视觉测量系统。基于透视投影变换下的时针顺序和共线性不变量设计了光笔特征点空间分布模式，实现了特征点的准确识别与接触探头坐标的计算。在双目立体视觉传感器的透视投影和齐次坐标三维测量模型基础上，以一维基线尺靶标自由移动和基准长度约束为核心，通过本质矩阵E的线性求解结合非线性优化实现了其结构参数的现场精确标定。研制了由光笔、双目立体视觉测量系统、便携式三脚架、一维基线尺靶标和测量软件构成的大视场三维视觉测量系统，完成了机器人本体表面三维数据的稠密测量实验，在7m×4.7m测量范围内系统测量精度优于0.2mm。

关键词： 三维视觉测量 大视场 光笔 标定 光斑识别

Light Probe Based Large FOV 3D Vision Measurement System

FENG Ping*, WEI Zhen-zhong

Key Laboratory of Precision Opto-mechatronics Technology of the Ministry of Education, Beihang University, Beijing 100191, China

Abstract: To meet the great demand for large scope precise measurement of large-scale equipments in advanced manufacturing industry, a light probe based large FOV 3D vision measurement system based on binocular stereo vision is proposed. The spatial distribution mode of the character points on the light probe is determined according to the invariants of clockwise direction and colinearity under perspective projection, which is helpful to make recognition of character points and coordinates calculation of the probe. Based on the 3D measurement model of binocular stereo vision sensor established on the theories of perspective projection and homogeneous coordinates, the structure parameters of binocular stereo vision sensor is calibrated through linearly solving the essential matrix E further following with nonlinear optimization by freely moving a 1D target with known precise length. A true large FOV 3D vision measurement system is constructed, which consists of a light probe, a binocular 3D vision measurement system, a portable tripod, a 1D target and a set of measurement software. Real experiment to measure the dense 3D data is performed on a robot body surface in the field of 7m×4.7m and an accuracy being better than 0.2mm is achieved.

Keywords: 3D vision measurement large FOV light probe calibration light spot recognition

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通讯作者: 冯萍

作者简介: 冯萍（1982-）,女，山东青岛人，硕士，实验师， 2009年于北京科技大学获得硕士学位，主要从事精密测量及实验研究。

作者Email: fengping_1124@yahoo.cn

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