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现代应用光学

基于嵌入式的角度视觉检测及误差补偿

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摘要： 建立了基于DM642的嵌入式线结构光角度视觉检测系统, 用于精确实时地在线检测线结构光角度。首先，将以CCD为图像传感器的装置与基准平面固定，以线结构激光发生器为光源的装置与被测平面固定；用CCD采集投影屏上的线结构光图像，再由DM642进行实时处理得到线结构光的角位置，并对角位置进行标定来获得被测平面与基准平面的夹角。然后，分析系统误差源，得出系统主要误差是由CCD感光面阵平面与投影屏平面之间的夹角α所致。最后，针对此误差项建立数学模型，并根据模型采用圆光栅控制激光发生器精确转动3个角位移，由圆光栅所得的精确角位移值和对应的图像检测值计算出标定夹角α的大小和方向，并对由此夹角误差导致的检测误差进行精确补偿。实验结果表明：在α为0.331 97° 时，经误差补偿后的圆光栅角位移值和对应的图像检测值之间的转角误差由22.522%减小到0.595%，系统测量的不确定度为0.051 44° 。

关键词： 角度检测 机器视觉 线结构光 误差补偿 DM642

Embedded angle vision inspection and error compensation for line structured lights

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Abstract: An embedded angle visual inspection system for line structured light was established based on DM642 to detect the angle of the line structured light in real-time accurately. Firstly, a device using the CCD as its image sensor was fixed on a datum plane, and the other one using a line structured laser as its light source was fixed on the plane to be measured. The image of the line structure laser on a screen was acquired by the CCD and its angular position value was obtained by on-line processing of DM642.The angle between the datum plane and the measured plane could be gotten through calibration of the angular position value. Then, the angle α between CCD surface and projection screen surface was proved to be the dominant error source by an error analysis. For compensating the error, a mathematical model was established. On the basis of the model, a calibration method was used as follows: the circular grating was used to control the laser generator to rotate accurately three angular displacements, and the angle value of α and its direction were calculated according to the angular displacement value and the corresponding image detection, then the detection error brought by the angle could be compensated. The experimental results show that the angle error is reduced to 0.595% from 22.522% after compensation when α is 0.331 97° and the measuring uncertainty of the system is 0.051 44° .

Keywords: angle detection machine vision line structured light error compensation DM642

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