Measurement Principle Analysis and CAA Technology of the Intelligent Articulated CMM

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ABSTRACT

The mechanical structure and principle of a kind of articulated arm CMM with 6 DOF is introduced. The measurement equation is deduced, and the architecture design, which makes the measurement space as large as possible and reduce the number of unreachable areas. At the same time, the design of arms is optimized. CAA is used in the application to improve its accuracy. First the least squares method is applied to amend circular grating measurement errors and to improve the angle measurement accuracy. Subsequently a calibration method based spatial distance between two points is proposed. With the laser tracker form API as a benchmark, the method employs the nonlinear least-squares Gauss-Newton method to identify the parameters of the machine. The experimental results show, that Error Correction Technology can effectively improve the overall precision of the articulation-type CMM.

INTRODUCTION

A CMM is a precise measurement instrument, which has developed rapidly in the recent several years. Because of its versatility, it can conveniently be used to measure the geometrical parameters of workpieces in manufacturing. Traditional orthogonal CMMs are clumsy, expensive and require exquisite environmental control.

Along with science and technology development, there appears one kind of articulated arm CMM on the market. Regarding a study of this kind of coordinate measuring system (Zhang, 2000), which is a non-orthogonal series space structure, the key is to address the following three aspects. Firstly, we must expand the survey scope of the measuring engine as far as possible and reduce the number of unreachable areas. Secondly, we must increase the measurement precision of the CMM to meet the requirements. Thirdly, we must reduce the manufacturing cost as much as possible.

THE BASIC STRUCTURE OF AN ARTICULATED ARM CMM

The structure of an articulated arm CMM is shown in Figure 1.

The measuring machine is composed of three flexible measuring arms, six active joints and a contact measuring head. Three arms are connected to each other, one of them is the fixed arm, which is mounted on the base for to support the other parts of measuring machine. The other two active arms move in different spatial positions. The measuring head is installed at the end of the terminal arm. The joint connection between the two measuring arms
智慧關節式座標測量機的量測原理分析及誤差修正技術

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摘要
本文在介紹一種六自由度智慧型關節式座標測量機的機械結構和量測原理，推導出其量測方程，重點在進行整體方案設計，增大座標測量機的整體量測空間，減少量測死角，同時對傳達進行優化設計。文中並將誤差修正技術(CAA)應用於該型座標測量機中；首先運用最小二乘法修正了光柵之量測誤差，提高了測角精度，然後再提出一種基於兩點距離的標定方法，該方法在使用API雷射跟蹤儀作為基準，運用非線性最小二乘中的高斯-牛頓法，來解測量機量測方程的參數值。實驗結果證明，誤差修正技術能夠有效的提高測量機的整體精度。