Kinematic Calibration and Forecast Error Compensation of a 2-DOF Planar Parallel Manipulator

CHANG Peng[1, *], LI Chengrong[1], and LI Tiemin[2]

1 Hi-tech Innovation Center, Institute of Automation Chinese Academy of Sciences, Beijing 100190, China

2 Department of Precision Instruments and Mechanology, Tsinghua University, Beijing 100084, China

Received January 28, 2010; revised December 17, 2010; accepted **, 2011; published electronically **, 2011

Abstract: This paper presents a method combined step kinematic calibration and linear forecast real-time error compensation in order to enhance the precision of a two degree-of-freedom (DOF) planar parallel manipulator of a hybrid machine tool. Due to large workspace, heavy-duty and over-constrained mechanism, a small deformation is caused and the precision of the 2-DOF planar parallel manipulator is affected. The kinematic calibration cannot compensate the end-effector errors caused by the small deformation. In the step kinematic calibration phase of the method, the end-effector errors caused by the errors of major constant geometrical parameters is compensated. The step kinematic calibration is based on the minimal linear combinations (MLCs) of the error parameters. All simple and feasible measurements in practice are given, and identification analysis of the set of the MLCs for each measurement is carried out. According to identification analysis results, both measurement costs and observability are considered, and a step calibration including step measurement, step identification and step error compensation is determined. The linear forecast real-time error compensation is used to compensate the end-effector errors caused by other parameters after the step kinematic calibration. Taking the advantages of the step kinematic calibration and the linear forecast real-time error compensation, a method for improving the precision of the 2-DOF planar parallel manipulator is developed. Experiment results show that the proposed method is robust and effective, so that the position errors are kept to the same order of the measurement noise. The presented method is attractive for the 2-DOF planar parallel manipulator and can be also applied to other parallel manipulators with fewer than six DOFs.

Key words: parallel manipulator, kinematic calibration, error compensation, minimal linear combinations (MLCs)

* Corresponding author. E-mail: changpeng@tsinghua.org.cn
This project is supported by National Natural Science Foundation of China (Grant No. 50805140), and National Hi-tech Research and Development Program of China(863 Program, Grant No. 2007AA04Z227)

浏览（下载）论文全文（PDF格式）

地址: 中国北京百万庄大街22号 **邮编:** 100037 **电话:** 8610-88379907 **传真:** 8610-68994557
E-mail: cjme@mail.machineinfo.gov.cn **http:** // www.cjmenet.com.cn