

ON-LINE CALIBRATION OF SLIDING STAR

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The paper deals with the calibration methods for machines with parallel kinematics. The procedures are based on Newton method for numerical solution of overconstrained system of nonlinear equations. The methods are applied on redundantly actuated machine with planar kinematics named 'Sliding Star'. The redundant measurements of relative motions in joints allow on-line calibration in real time of machine tool operation. This could significantly improve the thermal inaccuracy of machine tools with parallel mechanisms.

Key words: parallel kinematics, calibration, non-redundant calibration, redundant calibration, on-line calibration, Sliding Star

1. Introduction

During last decade there has been intensive development in machine tool concepts in order to increase their productivity. The most innovative concepts were based on parallel kinematic structures. There have been developed many experimental parallel machines, however only recently there have been designed and built such parallel kinematics that can simultaneously improve all mechanical properties compared to traditional designs of machine tools, for example horizontal machine tool TriJoint 900H [1] manufactured by Kovosvit MAS. Parallel kinematics offers solution to many design problems of machine tools, but it suffers from serious problems due to singularities, limited workspace and non-homogenous mechanical properties. This can be solved by the concept of redundantly actuated parallel kinematics [2–4].

Even despite very accurate manufacture of machine tool it is not possible in case of parallel kinematics to use the design dimensions for the nonlinear kinematical transformation in control system. It is necessary to determine the really manufactured dimensions as accurate as possible. In case of parallel kinematics it is not possible to determine the real dimensions by direct measurement, therefore these dimensions must be computed from some indirect measurements. It is so-called calibration well known from robotics applied to machine tools.

2. Principle of non-redundant and redundant calibration

The different bases of division of types of calibration can be applied. Concerning our paper we will mainly distinguish so called redundant and non-redundant calibrations (Fig. 1). The nonredundant calibration (Fig. 1a)) is characterized by situation, when the number of variables measured inside the machine structure is equal to the number of DOF. The external calibration device (e.g. pin plate) is necessary and calibration of dimensions isn't possible

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