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微纳技术与精密机械

3-PSS并联机构正解及其在坐标测量机中的应用

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摘要： 针对传统坐标测量机和关节臂测量机存在的技术局限,基于3-PSS并联机构原理,提出了只需一只长光栅、一条精密导轨即可实现三维空间精密测量的坐标测量机,并研究了测量系统的测量模型、测量误差模型及并联机构误差平均效应。根据并联机构基本理论建立了测量机的六杆测量模型,在此基础上进行了杆长制造、装配误差和光栅读数误差的理论分析。然后,从理论上展示和说明了并联机构存在误差平均效应的数学本质和依据。最后,介绍了样机的设计及制造,并给出初步的实验结果。在没有进行误差修正和系统标定的前提下,该样机在*X,Y,Z* 3个坐标方向上的测量误差分别为0.029 mm,0.045 mm和0.058 mm。得到的结果可指导新样机的优化设计。

关键词： 并联机构 坐标测量机 测量模型 误差平均效应

Kinematic solution of 3-PSS parallel mechanism and its application in parallel CMM

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Abstract: A new style coordinate measuring system based on 3-PSS parallel mechanism was proposed to overcome the drawbacks and weaknesses of traditional Coordinate Measurement Machines(CMMs) and articulated arm CMMs and to realize 3D measurement with only one linear grating and one precision guide. A measurement model,a measuring error model as well as the error averaging effort of the parallel mechanism were investigated. Firstly,a 6-bar measurement model was achieved based on the theory of parallel kinematic mechanism. Then, the influence of bar length error and reading error from the liner grating were analyzed in detail and the hypostasis why parallel structure posses error averaging effort was revealed mathematically. Finally, the prototype CMM was introduced to its design, manufacturing and assemble and the experiment result was provided too.Results indicate that the measuring errors before compensation and instrument calibration in three dimensions are about 0.029 mm in *x* direction, 0.045 mm in *y* direction and 0.058 mm in *z* direction. Obtained results can provide the direction for the design of new CMM protypes.

Keywords: parallel mechanism Coordinate Measurement Machine(CMM) measurement model error averaging effort

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