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微纳技术与精密机械

并联式六维加速度传感器的参数辨识

尤晶晶1，2*，李成刚1，2，吴洪涛1，2

1.南京航空航天大学 机电学院，江苏 南京 210016；
2.江苏省精密与微细制造技术重点实验室，江苏 南京 210016

摘要： 针对六维加速度传感器的输入、输出量较多，且其动力学方程的解耦参数难以辨识的问题，提出了“四步法”对并联式六维加速度传感器的25个解耦参数实施分组辨识。设计并加工了基于双曲柄滑块机构的标定平台，为参数辨识提供外部激励；在LabVIEW平台上开发了虚拟仪器，为参数辨识提供软件支持。在静态情况下对预处理后的采集数据求均值得到“零值漂移”，完成第一组参数辨识；将传感器安装在标定平台上做1~2 Hz的纯线性运动，使动力学模型简化成关于“刻度质量比”的线性代数方程，运用最小二乘法完成第二组参数的辨识；做1~2 Hz的纯角运动，将动力学模型简化成关于“惯性质量比”的线性代数方程，完成第三组参数的辨识；做4~5 Hz的纯线性运动，通过关于“刚度质量比”的一维搜索完成第四组参数的辨识。试验结果表明：运用辨识后的参数对六维加速度实施解耦，最大误差为7.479%，比参数辨识前的解耦误差降低了1个数量级。结果验证了基于“四步法”实现并联式六维加速度传感器的参数辨识是有效、可行的。

关键词： 六维加速度传感器 参数辨识 标定平台 虚拟仪器 最小二乘法

Parameter identification of parallel type six-axis accelerometer

YOU Jing-jing1，2, LI Cheng-gang1，2, WU Hong-tao1，2

1. College of Mechanical and Electrical Engineering, Nanjing University of Aeronautics and Astronautics, Nanjing 210016,China;
2. Jiangsu Key Laboratory of Precision and Micro-manufacturing Technology, Nanjing 210016, China

Abstract: The parameter identification of a six-axis accelerometer is a difficult problem due to its higher input and output volumes and linear dynamic equation. According to this, a four-step method was proposed to identify the 25 decoupling parameters of a parallel type six-axis accelerometer. A calibration platform based on double slider-crank mechanisms was designed and processed to provide the external stimulation and a virtual instrument based on LabVIEW was developed to provide the software support for the parameter identification. The first sets of parameters were identified by averaging pretreatment data in static state. By putting the sensor on the platform to do a pure line movement with the frequency of 1-2 Hz, the dynamic equations were simplified to linear algebraic equations, then the second set of parameters were identified by using the least square method. Similarly, the third set of parameters were identified when the sensor did a pure angular movement with the frequency of 1-2 Hz. The fourth set of parameters were identified by one-dimensional searching about stiffness to mass ratio when the sensor did the pure line movement with the frequency of 4-5 Hz. Experimental results indicate that the maximum relative error is 7.479% after using the identified parameters to decouple the six-axis acceleration, which reduces a magnitude compared to that before parameter identification. Above results verify that the proposed four-step method is correct and feasible.

Keywords: Six-axis accelerometer Parameter identification Calibration platform Virtual instrument Least square method

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通讯作者: 尤晶晶

作者简介: 尤晶晶(1985-)，男，江苏南通人，博士研究生，2010年于南京航空航天大学获得硕士学位，主要从事六维加速度传感器和并联机器人这两方面的研究。
作者Email: youjingjing251010@126.com

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