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微纳技术与精密机械

微纳卫星姿控软件实时测试系统

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摘要： 为了在硬件有限的条件下测试微纳卫星姿态控制软件的实时控制性能，建立了微纳卫星姿态控制软件实时测试系统，并使用该系统对微纳卫星姿态控制软件进行了测试实验。根据卫星姿态动力学与运动学、轨道环境信息与姿态控制算法数学模型，在PC机上设计开发了微纳卫星模拟飞行平台。使用控制器局域网络（CAN）和串口建立了连接星载计算机与PC机微纳卫星模拟飞行平台的高效通讯链路，并对姿态控制软件主程序进行必要的修改。最后，基于该实时测试系统，完成了星载计算机上姿态控制软件的实时控制性能测试实验。实验结果表明：姿态控制软件在星箭分离后18 446 s完成初始控制阶段并进入偏置对地三轴稳定模式，实现了微纳卫星的稳态控制目标。偏置对地三轴稳定模式中卫星最低单轴姿态精度与角速度稳定度分别优于±1.86°和±0.048(°)/s，满足该模式控制精度与收敛时间的要求。

关键词： 微纳卫星 姿态控制 实时控制 实时测试

Real-time testing system for attitude control software of micro-nano satellite

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Abstract: To test the control performance of attitude control software in real time for a micro-nano satellite under hardware limited, a real-time testing system for the attitude control software of micro-nano satellite was established and the control software was tested with the proposed system. Based on the dynamics and kinematics of satellite attitude, the environment information of satellite trajectory, and the mathematical model of an attitude control algorithm, a flight imitation platform for the micro-nano satellite was developed on a PC. Then, the efficient communication link between on-board computer and PC was established by a Controller Area Network(CAN) and serial communication. The main program of the attitude control software was also modified as required. Finally, the real-time control performance of the attitude control software for on-board computer was tested with the real-time testing system. Experimental results indicate that the attitude control software can complete the initial control stage and enter the bias three-axis stabilization mode by 18 446 s after the separation of satellite and rocket, which achieves the stabilization control of micro-nano satellite attitude. In the bias three-axis stabilization mode, the minimum one-axis attitude accuracy and the angular velocity stability of the satellite are within ±1.86° and ±0.048(°)/s, respectively, which meets the requirements of attitude accuracy and converge time of the control mode.

Keywords: Micro-nano satellite Attitude control Real-time control Real-time test

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