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微纳技术与精密机械

敏捷小卫星对地凝视姿态跟踪控制

陈雪芹, 耿云海, 王峰, 李冬柏

哈尔滨工业大学 卫星技术研究所,黑龙江 哈尔滨 150080

摘要： 研究了基于双框架控制力矩陀螺(DGCMG)的敏捷小卫星对地凝视成像过程中的姿态跟踪控制。首先,根据敏捷小卫星的特点和凝视成
任务需求设计执行机构配置方案。然后,根据轨道信息计算地面凝视目标的相对姿态和角速度;为避免控制力矩陀螺(CMG)奇异性的影响,同时
计了适当的控制律和操纵律。最后,通过在"试验三号卫星"的姿态轨道控制系统仿真平台上增加凝视成像任务需求并调整执行机构配置,建立敏
小卫星姿态控制系统,对文中设计的方案和控制方法进行了数学仿真验证。仿真结果表明,该算法简单有效,能够实现敏捷小卫星对地凝视姿态跟
踪,同时给出了DGCMG能够输出的最小框架角速率指标决定了姿态跟踪精度的结论。

关键词： 敏捷卫星 控制力矩陀螺 操纵律 凝视成像 姿态跟踪

Staring imaging attitude tracking control of agile small satellite

CHEN Xue-qin, GENG Yun-hai, WANG Feng, LI Dong-bai

Research Center of Satellite Technology, Harbin Institute of Technology, Harbin 150080, China

Abstract: The attitude tracking control of staring imaging of an agile small satellite driven by Double-Gimbaled Contro
Moment Gyroscopes (DGCMG) was investigated. Firstly, an actuator configuration scheme was developed according t
the characteristics of agile satellite and the staring imaging mission requirements. Then, the orbit information was
used to compute the relative attitude angle and attitude angular velocity of a staring imaging target with respect to
the satellite body reference frame, and the proper control law and steering law were introduced to avoid the
singularity of Control Moment Gyroscope(CMG). Finally, based on the "SY-3" satellite attitude and orbit control
simulation platform, the agile small satellite closed-loop control simulation system was established by taking the
mission requirements and the actuator adjustments into account and the proposed design scheme and control meth
were verified in a mathematical simulation. Obtained results show that the presented solution is effective for staring
imaging attitude maneuver control of the agile small satellite and the least gimbal angle rate of DGCMG is the most
important factor to determinate attitude tracking precision.

Keywords: agile satellite control moment gyroscope steering law staring imaging attitude tracking

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通讯作者: 陈雪芹

作者简介: 陈雪芹 (1982-),女,四川广元人,博士,副研究员,2003年、2005年、2008年于哈尔滨工业大学分别获得学士、硕士、博士学位
主要研究方向为故障诊断与容错控制。 E-mail: cxqhit@hit.edu.cn
作者Email: cxqhit@hit.edu.cn

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