



航空学报 » 2009, Vol. 30 » Issue (3) :444-449 DOI:

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### 周边桁架可展天线展开过程动力学分析及控制

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### Deployment Dynamic Analysis and Control of Hoop Truss Deployable Antenna

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摘要

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**摘要** 基于多刚体系统动力学的Lagrange方法, 采用独立的Lagrange广义坐标, 考虑耗散力、铰链处扭簧的驱动力及索网预张力对展开过程的影响, 建立了周边桁架可展天线展开过程的动力学模型, 给出了基于力控制的展开过程控制策略, 得出了展开过程驱动力的变化与天线位形变化之间的关系, 根据所规划好的天线展开运动得出相应的驱动力。编制了仿真程序进行算例分析, 研究了初速度、阻尼及重力对天线展开过程的影响, 实现了考虑驱动扭簧的刚度、关节中的阻尼、重力及索网预张力影响的周边桁架可展天线展开过程的动力学分析与控制。实验仿真结果验证了该方法的有效性。

**关键词:** 天线 动力学 运动控制 运动规划 力控制

**Abstract:** Based on the Lagrange method in multibody dynamics systems and using absolute generalized coordinates, a dynamics model for the hoop truss deployable antenna is established which takes into consideration the dissipative force, torque of torsional spring in hinges and the pre tension forces in cables. The force controlled method is presented to control the deployment motion, and the relation between the driving force and the deployment motion is derived. The variation of the driving force is obtained according to the planned deployment motion. The deployment dynamic of a hoop truss deployable antenna is simulated, and the effects of initial velocity, damp, and gravity upon deployment are summarized. Deployment dynamic analysis and control of the hoop truss deployable antenna are carried out taking into account the stiffness of torsional spring, damp in hinges, gravity, and the pre tension forces in cables. The results of experiment simulation validated the proposed method.

**Keywords:** antennas dynamics motion control motion planning force control

Received 2007-12-17; published 2009-03-25

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#### 引用本文:

李团结;张琰;李涛. 周边桁架可展天线展开过程动力学分析及控制[J]. 航空学报, 2009, 30(3): 444-449.

Li Tuanjie; Zhang Yan; Li Tao. Deployment Dynamic Analysis and Control of Hoop Truss Deployable Antenna[J]. Acta Aeronautica et Astronautica Sinica, 2009, 30(3): 444-449.

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