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主动变形扑翼飞行器的设计和风洞测力试验研究

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Design and Wind Tunnel Test of an Active Morphing Wing Ornithopter

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摘要

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摘要

主动变形扑翼可以模仿鸟翼飞行时的复杂运动。为了了解主动变形扑翼飞行器的气动特性,在研究鸟类骨骼结构和翅膀及尾翼运动规律的基础上,设计并制造了一种基于机器人技术的主动变形扑翼飞行器;给出了主动变形扑翼飞行器的机构运动规律函数,并设计出机构运动控制系统;在低速风洞中对此飞行器进行了一系列测力试验,研究了主动变形扑翼的升力、推力特性,以及风速、扑动频率、扑动幅度、伸展相位等参数对升力和推力的影响,并与常规扑翼进行了对比分析。试验结果表明,较之常规扑翼,主动变形扑翼可以显著增加升力和增强对不同飞行状态的适应能力。

关键词: 主动变形 扑翼 扑翼飞行器 仿鸟 运动规律 风洞试验 气动特性

Abstract:

An active morphing flapping wing can mimic the complex movement of a flying bird's wings. In order to understand the aerodynamics of the active morphing wing ornithopter, the bird's bone structure as well as the laws of motion of its wing and tail are studied, and an active morphing wing ornithopter is designed and built based on robotics. The laws of motion of the ornithopter are presented, a control system is designed and built. Wind tunnel tests of the ornithopter are performed in a low-speed wind tunnel. The lift and thrust characteristics are studied. Furthermore, the influence of wind velocity, flapping frequency, amplitude and stretch phase on lift and thrust is investigated. A conventional flapping wing is tested for contrast. The test result shows that the active morphing wing can significantly increase the lift and enhance the ability of the ornithopter to adapt to various flight statuses.

Keywords: active morphing flapping wing ornithopter imitation of a bird laws of motion wind tunnel test aerodynamic characteristic

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