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形状记忆合金扭力驱动器的力学模型和实验研究

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MECHANICAL MODEL AND EXPERIMENTAL ANALYSES ON SHAPE MEMORY ALLOY TORSION ACTUATOR

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摘要

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摘要 扭力驱动是自适应翼面驱动技术中的一个关键问题。将镍钛形状记忆合金 (Ni Ti SMA)丝与薄壁圆管相结合,可以构成 SMA扭力驱动器。介绍了 SMA扭力驱动器的构造,建立了扭力驱动器在激励过程中的力学模型,分析了驱动器的扭转角与温度之间的关系,并进行了实验验证

关键词: 形状记忆合金 扭力驱动器 力学模型 实验分析

Abstract: Adaptive wings may promise a significant improvement in aerodynamic performance of airplanes. The shape memory alloy (SMA) torsion actuator is one of the key issues in actuator technologies for adaptive wings. Nickel-Titanium alloy wire is the sort of SMA in common use, and it possesses special mechanical properties. SMA torsion actuator has been made up of NiTi wires and a thin-walled tube, in which plastically elongated wires are wound on a tube with a certain angle referenced to the generatrix of the tube, and pasted on its surface. By controlling recovery strain and recovery force of SMA wires, SMA torsion actuator can yield torsion deformation and moment, thus can manage the wing spanwise torsion. In this paper, a primary mechanical model of SMA torsion actuator is established, and the relationship between the torsion angle of the tube and the temperature is analyzed theoretically and verified by experiments. In an experimental system, the AOA of a wing model connected with SMA torsion actuator can be changed continuously up to 15°, and good agreement is obtained between analytical and experimental data.

Keywords: SMA torsion actuator mechanical model experimental analysis

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