

电工理论与新技术

磁控形状记忆合金旋转执行器研究

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摘要: 基于磁控形状记忆合金(magnetically controlled shape memory alloy, MSMA)在磁场作用下变形并具有形状记忆功能的特性, 提出一种通过超越离合器将MSMA元件产生的直线运动变为旋转运动的执行器结构, 在永磁体偏置磁场基础上, 通过改变控制磁场励磁电流的大小和频率可实现转速控制。采用有限元法进行MSMA执行器的磁场分析与控制特性仿真, 分析旋转机构的机械特性, 推导了位移与转速表达式。设计并研制MSMA旋转执行器试验样机, 将试验结果与理论计算值进行对比, 并分析二者存在差异的原因。样机试验结果表明MSMA旋转执行器机理和设计方法可行。

关键词: 磁控形状记忆合金 旋转执行器 超越离合器 永磁偏置磁场 差动控制

Study on Rotating Actuator of Magnetically Controlled Shape Memory Alloy

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Abstract: Based on the properties of shape variation and memory effect of magnetically controlled shape memory alloy (MSMA), a MSMA rotating actuator was proposed in which the linear motion produced by the MSMA element could be converted into rotating movement through an overstepping clutch. On the basis of permanent magnet bias magnetic field, the rotating speed could be controlled by changing the amplitude and frequency of the excitation current of the controllable magnetic field. The magnetic field analysis and control characteristic were simulated by means of finite element method. The mechanical property of the rotating mechanism was analyzed. The expressions of displacement and rotating speed were derived. A MSMA rotating actuator prototype was designed and built. The experimental result was compared with the theoretical value and the difference between them was discussed. The experimental results of the prototype machine show the feasibility of the operation principle and the design method of the proposed MSMA rotating actuator.

Keywords: magnetically controlled shape memory alloy rotating actuator overstepping clutch bias field of permanent magnet differential control

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