

电工理论与新技术

考虑附加涡流损失的超磁致伸缩执行器动态模型

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摘要：超磁致伸缩执行器在高频下工作时，能量损失不仅包括磁滞损失、Terfenol-D棒涡流损失，还包括Terfenol-D棒附加涡流损失。该文考虑到执行器的惯性、阻尼、Terfenol-D棒涡流损失及附加涡流损失，建立了超磁致伸缩执行器的动态模型。其磁滞特性由Berqvist和Engdahl磁滞模型来描述，材料非线性由输入到模型静态实验数据体现。模型求解使用有限差分方法，在Matlab/Simulink中建立相应模型仿真结构框图。对执行器不同工作频率情况进行模型的仿真计算，并与实验结果对比，发现模型与实验吻合较好。表明所建立动态模型能较好地描述执行器输出位移与驱动电流之间的关系。该模型对优化设计超磁致伸缩执行器有指导意义。

关键词：超磁致伸缩执行器 附加涡流损失 动态模型 Terfenol-D棒

Dynamic Model of Giant Magnetostrictive Actuator Considering Excess Eddy Current Loss

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Abstract: The losses in giant magnetostrictive actuator not only include magnetic hysteresis loss and eddy currency loss, but also include excess eddy current loss of giant magneto-strictive actuator at high frequency. A dynamic model of magnetostrictive actuator is developed, which accounts for inertial effects and mechanical dissipation as the actuator deforms, eddy current losses and excess losses in addition to the classical eddy current loss for Terfenol-D rod. The magnetic behavior is characterized by considering the Berqvist and Engdahl' stress dependent magnetic hysteresis model for ferromagnetic hysteresis. The nonlinear properties of Terfenol-D, obtained from static material characterizations, is used as numerical input to the models. The model is solved by finite difference method and the model block diagram is constructed in Matlab/Simlink module. A comparison between the calculating result and the experimental result at different frequency for the actuator is carried out and it is found that they are in agreement well. This indicates that the model can describe the relation between the applied current and the output displacement. The model can be used for the optimization design of giant magnetostrictive actuator.

Keywords: giant magetostrictive actuator excess eddy current loss dynamic model Terfenol-D rod

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