传感技术学报
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一种新型磁电感应式转矩传感器的研制

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摘　要：

旋转机械设备转矩的准确测量对实现设备的状态监测和故障诊断有重要的作用，为此，设计了一种基于电磁感应原理的新结构转矩传感器。方法是将负载转矩产生的扭角信号转化成传感器励磁绕组和输出绕组的角位移，励磁绕组建立脉振磁通，经过电磁耦合输出绕组会产生与该角位移成正比的感生电动势。推导了传感器的输出特性，构建了传感器的数学模型，包括传递函数和状态空间描述。分析了传感器工作时的能控性和能观性，根据李雅普诺夫稳定判据，证明了传感器工作时的渐进稳定性。最后对传感器进行了标定，实验结果是传感器的灵敏度约为，最大重复性误差约为1.244%，最大非线性误差约为0.7895%，最大迟滞误差约为0.7917%。

关键词：电磁感应 转矩传感器 数学模型 李雅普诺夫 标定

Research on A Novel Electromagnetic Induction Torque Sensor

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Abstract:

It is important to measure the rotating machinery torque accurately for its condition monitoring and fault diagnosis, therefore, a new structure torque sensor based on electromagnetic induction principle is designed in this paper. The method is to convert torsion angle produced by load torque into the angle displacement of sensor excitation windings and output windings, the excitation windings set up pulsating flux, then output windings produce induction potential which is proportional to the angular displacement through electromagnetic coupling. The output characteristic of sensor is deduced, and its mathematical models are constructed, including the transfer function and state space description. The controllability and observability of sensor are analyzed, and its asymptotic stability is proved according to Lyapunov stability criterion. The sensor is calibrated by torsion testing machine, the experimental results indicated the sensitivity of the sensor is, the maximum repeatability error is 1.244% , the maximum non-linear error is 0.7895% , the maximum hysteresis error is 0.7917%.

Keywords: Electromagnetic induction Torque sensor Mathematical model Lyapunov Calibration

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