李朝峰,周世华,刘文明,任朝晖,闻邦椿.齿轮-转子-滚动轴承传动系统的弯扭耦合振动[J].航空动力学报,2014,29(7):1543~1555

齿轮-转子-滚动轴承传动系统的弯扭耦合振动

Vibration of bending-torsion coupling gear-rotor-rolling bearing transmission system

投稿时间： 2013-04-18

DOI：10.13224/j.cnki.jasp.2014.07.005

中文关键词： 齿轮-转子 弯扭耦合 啮合频率 接触 振动响应

英文关键词:gear-rotor bending-torsion coupling meshing frequency contact vibration response

基金项目:国家自然科学基金青年科学基金（51105063）；中央高校基本科研业务费专项资金（N120403004）

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中文摘要：

考虑齿轮啮合及扭转作用，建立齿轮-转子-滚动轴承传动系统的弯扭耦合非线性动力学模型.考虑输入/输出端、齿轮轴的弯曲/扭转振动等问题，推导了不平衡齿轮-转子-滚动轴承弯扭耦合的动力学微分方程.在考虑齿轮偏心和滚动轴承非线性接触特性的情况下，分析了转速、偏心量以及轴承游隙等参数对系统振动响应的影响规律.研究发现：由于弯扭耦合的作用，在主动轴中有着非常明显的从动轴转频成分.而在扭转振动中则各轴转频和啮合频率表现得更为清晰；滚动轴承有其自身的谐振频率，在系统设计阶段需要注意避开滚动轴承的变刚度频率对系统的影响；随着齿轮偏心量的变化对系统的时域和频域响应也有着很大的影响.另外，轴承游隙对系统的振动响应也有着较大影响，应选择合适的轴承游隙，以减小系统各处的振动幅值.

英文摘要：

A nonlinear dynamic model of bending-torsion coupling for gear-rotor-rolling bearing transmission system was estabished, with consideration of the gear meshing, torsion effect, input/output, and bending/torsion vibration of gear shaft. The dynamic differential equation was deuced based on the imbalanced gear-rotor-rolling bearing of bending-torsion coupling. Considering the gear eccentricity and nonlinear contact of rolling bearing, the influence law of parameters, including the speed, eccentric distance and bearing clearance, etc, on the system vibration response was analyzed. Result show that, an obvious component of rotational frequency of driven shaft existed in the driving shaft, due to the effects of bending-torsion coupling. However, the frequency of every rotation and engagement of shaft was more obvious in the torsional vibration. Given the rolling bearing's own resonance frequency, the effect of the variable stiffness frequency of rolling bearings on the system should be avoided during the system design. The change of gear eccentric distance also affects the time and frequency response of system. Besides, the bearing clearance also affects vibration response of the system. So a suitable bearing clearance is suggested to reduce the vibration amplitude of every part of system.

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