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主动电磁轴承失效后柔性转子坠落在备用轴承上的瞬态响应实验研究

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Experimental Investigation into the Transient Response of a Flexible Rotor Dropping on a Back-up Bearing After Active Magnetic Bearing Failure

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摘要

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摘要 测量了主动电磁轴承支承的柔性转子系统在主动电磁轴承失效后转子坠落在带有固定间隙滚动型备用轴承上的瞬态响应,分析了转子的工作转速、转子不平衡量以及备用轴承碰撞面上的润滑条件等对转子瞬态响应的影响。结果表明,大多数情况下在主动电磁轴承失效后转子系统出现了在间隙圆底部的摆动以及在整个间隙圆范围内的碰撞型回转运动。主动电磁轴承失效后转子系统瞬态响应的大小与转子在电磁轴承失效前的振动、转子的转速以及备用轴承碰撞面上的润滑条件等密切相关。通过适当改变备用轴承碰撞面上的润滑状态,可以有效地控制电磁轴承失效后转子系统瞬态响应的大小,降低电磁轴承失效后转子在整个间隙圆范围内的碰撞型回转运动以及全间隙圆范围内的摩擦型回转运动的可能性,从而减小碰撞对转子及其备用轴承的影响。

关键词: 转子动力学 主动电磁轴承 备用轴承 瞬态响应 碰撞实验

Abstract: The transient responses of a rotor dropping on a rolling element back-up bearing with a fixed radial clearance after the active magnetic bearing (AMB) failure are measured in a flexible rotor on the AMBs, and the effect is investigated of rotational speed, rotor imbalance and lubrication condition in the contact surfaces of the back-up bearing on the transient response of the rotor system. It is found that in most cases, the motion of the rotor system after the AMB failure is a back and forth oscillation motion with bounces in the bottom half of the clearance circle and a full clearance whirl motion with impact. The transient motion of the rotor system after the AMB failure depends greatly on the vibration of the rotor system, rotational speed at dropping, and lubrication condition in the contact surfaces of the back-up bearing. Changing the lubrication condition in the contact surfaces of the back-up bearing can effectively affect the transient response of the rotor system after the AMB failure, significantly reduce the possibility of the occurrence of full clearance whirl motion with impact and full clearance whirl motion without impact, and reduce the effect of the impact on the rotor and the back-up bearing.

Keywords: rotordynamics active magnetic bearings back-up bearing transient response impact testing

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