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常开空心轴裂纹转子系统的动力学特性
Dynamic characteristics of a open crack in hollow shaft rotor system

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中文摘要：

　　研究了常开空心轴裂纹转子系统的动力学特性.考虑裂纹单元截面中性轴的时变特性,推导了裂纹转子的刚度矩阵,考虑重力及不平衡激励,采用有限元法建立了常开空心轴裂纹转子系统的动力学方程.采用谐波平衡法对方程进行求解,给出了不同裂纹深度下的三维幅频图,表明在临界转速和亚临界转速处均有峰值出现;分析了裂纹深度、裂纹位置对该系统的临界转速的影响,表明位于跨内靠近惯性量较大圆盘的深裂纹对常开空心轴裂纹转子系统的影响大,临界转速下降快;计算了该系统在亚临界转速时的非线性振动响应,结果表明:亚临界转速下常开空心轴裂纹转子系统会发生超谐共振现象.所提出的空心轴裂纹的建模方法为航空发动机转子系统裂纹故障的非线性动力学分析提供了理论指导.

英文摘要：

　　Dynamic characteristics of a open crack in hollow shaft rotor system was investigated. By using the finite element method, the equations of motion were formulated, where the weight and the unbalanced excitation were considered and the stiffness matrix was derived with the consideration of the time-varying of the neutral axis in the crack element cross-section. By using the harmonic balance method, the equations were solved approximately and analyzed numerically. The three-dimensional amplitude-frequency curves of different crack depth were obtained to indicate that the vertical response peaks were presented at critical rotating speeds and the subcritical rotating speeds. The varying of the critical rotating speed versus different depths and different locations of the crack was analyzed to obtain that the deeper crack which located near the disc with a larger inertia parameter made a greater impact on the system, and the critical rotating speed decrease quick. The nonlinear responses of the system at the subcirtical rotating speeds were investigated respectively, where the super-harmonic resonances were shown correspondingly. The proposed modeling method of the hollow shaft crack provides a theoretical guidance for nonlinear dynamic studying the aero-engine rotor systems with crack faults.

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