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整圈自带冠叶盘系统斜碰撞振动局部化研究

Study on vibration localization of oblique impact of whole-circle bladed disk with tips system

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中文关键词: 自带冠叶盘 斜碰撞 失谐 振动局部化 耦合刚度

英文关键词:bladed disk with tips oblique impact mistuning vibration localization coupling stiffness

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中文摘要:

为研究整圈自带冠叶盘系统斜碰撞振动局部化问题,建立了整圈自带冠叶盘系统斜碰撞振动的集中参数模型动力学方程,计算不同耦合刚度下的各阶固有频率.分析了存在冠间间隙失谐情况下,叶片的各阶次振动响应特性和碰摩力,以及叶片刚度失谐情况下,不同耦合刚度叶盘系统的斜碰撞/无斜碰撞振动局部化因子.对比分析了叶片刚度、冠间间隙分别存在随机失谐时,不同耦合刚度叶盘系统的斜碰撞振动局部化因子.研究发现:在出现斜碰撞和轮盘共振情况下,即使是谐调叶盘系统也会出现振动局部化现象.而在各阶共振情况下,失谐叶盘系统都会出现振动局部化现象.计算表明:碰摩力与振动局部化的产生有直接关系,斜碰撞使叶片对失谐的敏感程度更大.另外,弱耦合叶盘系统比强耦合叶盘系统的振动局部化因子相对更大,叶片振动对于叶片刚度失谐比对冠间间隙失谐的敏感程度更大.

英文摘要:

Vibration localization of oblique impact of whole-circle bladed disk with tips was studied. Lumped parameter dynamical model of whole-circle bladed disk with tips was developed to calculate the natural frequencies under varying coupled stiffness. Vibration characteristics and rub-impact force of the blade at different orders were computed under mistuning tip clearance. Then, oblique impact/non-impact vibration localization factors with different coupling stiffnesses were analyzed under blade mistuning stiffness. Differences of vibration localization factors for two types of coupling stiffness were studied under random mistuning stiffness and tip clearance. The result shows that when the oblique impact or disk resonance occurs, even the tuning bladed disk system may have vibration localization phenomenon. On the other hand, vibration localization happens at every order of resonance for mistuning systems. Computations suggest that rub-impact force is directly associated with vibration localization. Blades turn more sensitive to mistuning due to the oblique impact effect. In addition, systems with weaker coupling stiffness often have relatively larger vibration localization factors. Also, mistuning stiffness has more influence on blade vibration localization sensitivity than the mistuning tip clearance.

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