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论实验确定转子临界转速的方法

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ON EXPERIMENTAL METHODS FOR DETERMINING CRITICAL SPEEDS

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摘要 本文研究转子系统临界转速的实验测定法。分析、评述了振幅峰值法和根据滞后相角为90°及其在临界附近急速变化（“质心转向”）现象确定临界转速的方法。包括将用于柔轴平衡的振型圆法改变用来测定临界转速的方法。提出一种简便安全的低速测定临界转速的方法。最后论述了转子不旋转测定临界转速的方法。用物理概念和简单数学公式阐明所依据的原理,指出了各种方法的优、缺点和适用范围。

关键词:

Abstract: In this paper the experimental methods for determining the critical speeds of rotor systems are investigated. The methods reviewed here are the peak amplitude method and those based on the charateristics of critical speeds, such as the 90 degree phase lagging, and the rapid change of phase angle.The peak amplitude method commonly used will introduce significant error in practice if the shaft is out of round or initially bent, or it is observed under the condition of acceleration. Even if the tests are performed at constant speeds the undamped critical speed will still be much higher in case of heavily damped rotors, while the method based on the 90 degree phase shift is more suitable for these cases.For the lightly damped rotors, which are just the cases for manypractical rotors, the method based on the rapid change of phase angle when passing through critical speed is more applicable, since the rotors may be more safely tested with accelaration which does not affect the measured results of critical speeds by using this method.A modified Nyquist plotting procedure is presented, in which a trial weight is put on the node section of the higher order mode shape, and necessary tests are made only at some speeds near the critical. The vibration vectors without error are then obtained and a circular polar plot can be made. With the aid of the plot the critical speed can be calculated in accordance with the fact that the increment of speed is nearly proportional to the increment of phase lagging angle in the vicinity of a critical speed.It is suggested that the first critical may be experimentally determined at lower speeds for the rotors with assymmetric stiffness, these are the cases for many real rotors. The sub-critical is measured in this method and its double is then the first order critical speed. It is known that at sub-critical the vibration frequency is twice the speed, while at critical the vibration frequency is equal to the speed. Therefore, it is possible to distinguish the sub-critical from the first critical by comparing the measured frequency with speed. This method is considered as a safer and simpler method.Finally the feasibility of the method to determine the critical speeds in the static states of the rotors is discussed.

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