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十字弦耦合结构非线性自由振动的频率分析

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FREQUENCY ANALYSIS OF NONLINEAR FREE VIBRATION OF A CROSS STRING

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摘要

该文研究了十字交叉弦几何大变形的非线性自由振动问题。首先根据哈密顿原理推导了控制其自由振动的运动方程, 然后采用摄动方法求解了该弦的非线性耦合固有频率。通过将求得非线性耦合固有频率解析解与各单弦的非线性频率解析解进行比较发现, 非线性耦合频率的解析解除了具有非线性特性, 还反应了各子结构对整体结构频率的影响, 即存在耦合特性。并且, 当一个子结构自身参数改变时, 整体结构的频率也会发生变化, 但是变化的幅度小于子结构的变化幅度, 即耦合特性增加了十字弦系统的稳定性。

关键词: [十字弦](#) [非线性](#) [自由振动](#) [摄动方法](#) [耦合特性](#)

Abstract:

This work concerns nonlinear free vibration of a cross string with large amplitude. The equations governing the nonlinear vibration of the cross string are derived firstly from Hamilton Principle, which take the form of Duffing equation. Then the perturbation method is used to solve the non-linear coupling natural frequency of the cross string. Our results show that the frequency of the cross string is affected by the vibration amplitude, the cross-section diameter and the ratio of the string length. And the nonlinear coupling natural frequency not only has the characteristic of nonlinearity, but also reflects the coupling property. That is to say, the frequency of the cross string will change when its part changes, however, the changing amplitude is smaller than that of the sub-structures. This indicates that the coupling characteristic can increase the stability of the whole cross string.

Key words: [cross string](#) [nonlinearity](#) [free vibration](#) [perturbation method](#) [coupling effect](#)

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