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## 基于谐波平衡法的含Iwan模型干摩擦振子非线性振动

### Harmonic balance method for nonlinear vibration of dry friction oscillator with Iwan model

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中文关键词: [Iwan模型](#) [干摩擦振子](#) [非线性振动](#) [谐波平衡法](#) [微滑移](#) [幅频关系](#) [阻尼特性](#)

英文关键词: [Iwan model](#) [dry friction oscillator](#) [nonlinear vibration](#) [harmonic balance method\(HBM\)](#) [microslip](#) [amplitude-frequency relationship](#) [damping characteristics](#)

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中文摘要:

通过谐波平衡法,研究了由Iwan模型和1个质量块构成的干摩擦振子系统的自由振动和受迫振动问题.对于自由振动,推导了系统卸载和加载过程中各自对应的非线性运动方程;通过谐波平衡法,求得了各方程的1阶谐波解;为了得到方程正确的数值解,提出了确定零速度时刻的策略;数值算例结果表明:谐波平衡法与数值方法得到结果吻合较好,从而验证了谐波平衡法求解此类问题的有效性.对于系统微滑移下的受迫振动,采用谐波平衡法求得了系统的幅频关系.最后,对Iwan模型阻尼特性的研究发现,模型等效黏性阻尼比与其振幅存在非线性关系.

英文摘要:

Free vibration as well as forced vibration of a dry friction oscillator which was composed of Iwan model and a mass were investigated by harmonic balance method (HBM). For free vibration, the nonlinear equations of the motion of the system in the processes of loading and unloading were presented respectively. Then, based on HBM, the first-order approximate harmonic solution of each equation was derived. A strategy was proposed to detect the moments of zero velocity so as to achieve the correct numerical solutions. The results of a numerical example show that the solutions of HBM coincide well with those of the numerical method, so the validity of the method for such problem is verified. For forced vibration accompanied with microslip, the amplitude-frequency relationship of the system was derived by HBM. Finally, the damping characteristics of the Iwan model were studied. It is seen that a nonlinear relationship exists between the equivalent viscous damping of the model and its displacement amplitude.

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