

Jniversität Stuttgart

Institut für Nichtlineare Mechanik		Masterarbeit	Stability analysis
			of a forced system
Themengebiete:	Dynamik mech. Systeme,		with vibro-impact
	Stabilität von Lösungen		
Betreuer:	Balkis Youssef,		nonlinear energy sink
	balkis.youssef@inm.uni-stuttgart.de		
Verantwortlicher Professor:	Prof. Dr. Leine		
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A Nonlinear Energy Sink (NES) is a small single DOF structural element attached to a primary oscillating structure via a nonlinear coupling. When activated, the NES absorbs the unwanted vibration energy causing a damping effect on the system's oscillations. This energy transfer, also called energy pumping, has been mainly applied to protect structures when subjected to external harmonic excitation, especially when the main system is excited at a frequency near its natural frequency, i.e. near resonance. The type of the nonlinearity involved in the NES mechanism is crucial since it influences the dynamics of the overall system. For instance, the presence of a vibro-impact (VI) NES renders the dynamics nonsmooth, and the derivation of the solution becomes a complex task. In this case, the multiple scales method (MSM) is used to derive an approximate solution to the problem in hand. This yields to a direct analytical approach that permits the further analysis of the system's behavior.

In this thesis, the examined mechanical sytem is composed of a primary damped linear oscillator and a VI-NES, built as a small particle moving freely within a straight cavity. The system is modelled and its solutions are approximated using the MSM. The aim of this thesis is to determine all possible response regimes of the examined system and the asymptotically stable regions of the corresponding solutions. First, the concept behind the MSM and its application in this framework have to be reviewed and understood. Then, the stability of the derived solutions have to be analysed. Additionally, the stability boundaries have to be identified in order to allow an optimal design of the VI-NES. In a next step, the obtained results have to be verified through simulations. Lastly, the possible extension of the results on a multiple DOF system, such as a vibrating beam, should be considered.



Forced 1-DOF oscillator with a VI-NES.



Forced beam with a VI-NES.

