Full interaction of a vibrating elastic structure with an energy source of limited power supply

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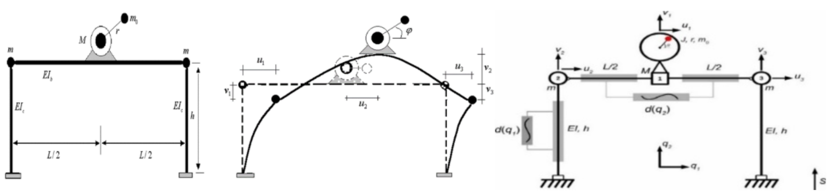
Abstract. This lecture overviews recent developments related to a portal frame foundation, with the conditions of saturation phenomenon, considering the existence of a full interactions with an energy source of limited power supply (RNIS), including discussions of a kind of nonlinear piezoelectric energy harvesting from environment.

Introduction

In this lecture, we always consider the excitation having limited power, limited inertia and its frequencies varies according to the instantaneous state of the vibrating system. We reviewed recent results, restricted to a portal frame foundation, with 2:1 internal resonance [1-6], taking into account the existence of saturation phenomenon (Fig 1(a) and 1(b)) , including the performance of the process of capturing electricity through piezoelectric materials given by (Fig 1(c)) placed on both beam and column. Here, the piezoelectric material is considered as a nonlinear device proposed by $d(x) = \beta(1 + \Theta|x|)$, where β is the linear piezoelectric strain coefficient and Θ is the nonlinear piezoelectric strain coefficient. Its representation is an RC circuit with capacitance C, resistance R, and electrical charge Q.



(a) (b) (c)

Figure 1: (a) and (b) Portal Frame with two degree of freedom with unbalanced DC motor with $2:1$ internal resonance and (c) the piezoelectric layers will be considered both on the beam $(d(q2))$ and on the column $(d(q1))$.

Results and discussion

For $\beta = 0.3$, the dimensional harvested power is given in the Tab. (1) below. Note that, when the nonlinear piezoelectric coefficient is considered, it increases the harvested power. In addition, as the supported beam is excited, there is a great contribution of the column on the energy harvesting of the system, due to the saturation phenomenon and the considered unbalanced motor.

Nonlinear Piezoeletric Cofficient Θ		0	0.1	0.5	1.0
Position of the	Beam + Column	47.47nW	50.01 nW	58.52nW	70.85nW
Piezoeletric	Beam	33.24 nW	34.96nW	42.26nW	52.39nW
Material	Column	14.23 nW	14.64nW	16.28nW	18.46nW

Table 1: Positioning of the Piezoelectric Material for $0 < \Theta < 1$

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