On energy harvesting with time-varying frequency by using magneto piezo elastic oscillators with memory

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Abstract. This work aimed to investigate the performance of the process of capturing electricity through piezoelectric ceramic materials, installed in one and two elastic beams due to the action of magnetic field forces, of non-linear behaviour and subject to different forms of excitement of the environment.

Introduction

Here, we discuss the dynamic behaviour, by modeling the forced oscillator [1, 3] when subjected to different amplitude variation situations and the excitation frequency of the base and the resistive and reactive loads that make up the electrical circuit that is coupled to the beam. It is including memory through the inclusion of a Bouc-Wen damping. The main results are discussed with the purpose of defining the most appropriate configuration and defining the operating parameters of the system so that the excitation frequency approaches the oscillator's resonance range, where maximum system efficiency for electricity generation [4]. Furthermore, using the nonlinear dynamics tool considering the resonance curves, bifurcation diagrams, Lyapunov Exponent and the Time Series, showed the performance of the voltage output in the resonance passage.

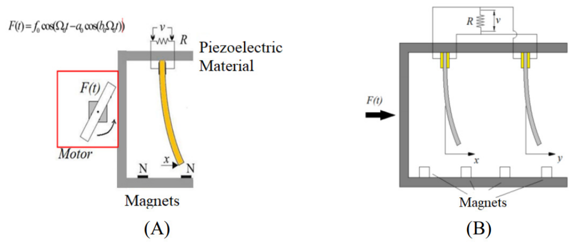

Figure 1: Scheme of system. (A) the magnetoelastic structure with force $F(t) = f_0 cos(\Omega_0 t - a_0 cos(b_0 \Omega_0 t))$ and (B) two systems coupled with force $F(t) = f_0 cos(\Omega_0 t - a_0 cos(b_0 \Omega_0 t))$. Where Ω_0 is a constant obtained from averaging of the angular frequency at resonance

Results and discussions

We determine the regions in which the system has a chaotic and periodic behavior, for the parameters a_0, b_0 and ω_0. Thus obtaining the regions of greatest power. The figure 2 (A) illustrates the behavior of the power $P \approx < \nu^2 >$ for $b_0 = 0.2$ and $\omega_0 \in [0.2]$ and $a_0 \in [0, 1]$. The figure 2(B) for $a_0 = 0.5$ and $\omega_0 \in [0.2]$ and $b_0 \in [0.1]$

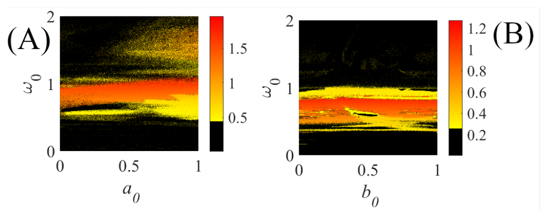

Figure 2: Power.(A) for $P \approx < \nu^2 >$ for $b_0 = 0.2$ and for $\omega_0 \in [0.2]$ and $a_0 \in [0, 1]$ and (B) for $a_0 = 0.5$ and $\omega_0 \in [0.2]$ and $b_0 \in [0.1]$. Black region below average power, yellow to red region maximum power.

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