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Vibration Control using Electro-Magnetic Actuator: A Review

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Abstract: ***Vibration is the main cause of failure in many systems, these systems must be designed in such a way that there is no resonance where many such systems fails. Many Actuators are used to control the vibration of such systems like piezoelectric actuators, magneto rheological actuators, and electromagnetic actuators. In electro-Magnetic actuators the coils around the magnets are energized and plunger gets actuated. This working principal can be used in vibration actuation. This Paper gives an overview of the research in the field of vibration control using electro-magnets.***
Keywords: ***Electro-Magnet, Plunger, Vibration, Actuation etc.***

I. INTRODUCTION

Since long back vibration is always considered as the cause of failure of many system including vehicles, building, monuments etc. the failure of all these systems caused due to resonance or unbalance in the system. The resonance is caused when there is maximum levels of vibration due to applied frequency which is same as that of the natural frequency of the system. In order to reduce the structural of vibration and the acoustic noise, the damping control of the flexible structures such as beams, plates and shells has been considered as an important problem in the practical design of the mechanics, aerospace and electrical products.

In an electro magnet coils are connected around the iron core, which is made up of Ferromagnets, it increases the magnetic field which is created already. The strength of magnetic field depends upon current passing through the coils. Electric current provided adds the extra magnetic strength around the magnet. These two magnetic fields combine to effectively increase the strength of the magnet to attract oppositely charged magnetic forces to it, or repel magnets and charges of the same charge. Many researchers worked on the electro magnets to control the vibrations some are described below.

Giovanni Caruso et. al, In this paper the energy harvesting from wind induced vibrations of long-span bridges has been described. A coupled model, describing the bridge structure excited by aeroelastic wind forces and equipped with harvesting devices mounted along the bridge girder, is derived by reducing bridge dynamics. Dynamics of the bridge structure has been reduced to a two degrees-of-freedom system, taking into account the first bending and the first tensional vibration mode of the structure [1].

Yao Zhang et. al In this paper, a new kind of vibration isolation platform is de-signed and analyzed, which has better performance than the traditional mechanical platform. This paper firstly gives the derivation of the electromagnetic force between two coils with currents, and a simplified expression of the force is given. With this result, the model of single strut is introduced and its dynamic model is given. Next, the control currents in the coils of the strut are designed based on minimizing the power to realize vibration isolation [2].

Rodrigo Nicoletti et. al have designed an energy harvester is for converting the mechanical energy of the lateral vibrations of shafts into electrical energy. For that, permanent magnets are mounted in the shaft and coils are mounted in a fixed structure. A configuration analysis is performed to find the appropriated polarization of the magnets and orientation of the coils in order to have electromagnetic induction without resisting torque on the shaft. Experimental tests are done for different electrical configurations of the coils: independent, in series and, in parallel. Series configuration gives better results than parallel configuration [3] .

Prof. Ankita Kumar et. al. This paper proposes design and analysis of electromagnetic energy harvester using MEMS technology. The energy harvester is intended to harvest energy from low frequency ambient vibrations that is less than 100Hz. The design would consist of a cantilever which is the simplest MEMS structure which can further be used to power the amplifiers [4].

Zeljko V. Despotovic et. al. This paper describes vibratory feeders with electromagnetic excitation which are also called electromagnetic vibratory feeders (EMVF) are commonly used for performing gravimetric flow of granular and particulate materials in processing industry. This operation is highly efficient, because large output displacement is provided by small input power. An optimal and efficient operation requires tracking of resonant frequency. This paper presents possible solution of the amplitude frequency control of EMVF and corresponding simulation and experimental results [5].

Taihong Cheng et.al. In this paper, the Parallel electromagnetic resonant RLC circuit was developed to reduce the vibration of the flexible structures. The mechanical vibration of the cantilever beam was minimized through the energy dissipation in electro-magneto-mechanically coupled system. Analytic model to predict the frequency response function for parallel type RLC shunt damper was formulated and validated in comparison with experimental results [6].

Marcin Hoffmann et. al. In this paper use of vibration absorber during machining to suppress work piece vibration is presented. The work piece exhibits low stiffness on one axis and therefore is responsible for chatter vibration which occurs on this direction. Active vibration absorber is attached to increase vibrostability limit. Two different types of absorbers were examined with piezostack and electromagnet. The first piezostack is used as the active element, whilst second is constructed with electromagnet [7].

E. Suzuki, J. Shirasaki et. al. have worked on The superconducting magnetically levitated transport (Maglev) system is future mode of transport at high speeds of over 500 km/h. In this paper, electromagnetic system is used as primary suspension system and mechanical system is used as secondary suspension system. primary suspension system is attached to bogie-integrated linear generator device, combined with a frequency-shaped optimal preview control of the secondary suspension system[8].

Hans Sollander et. al. have worked on ABB corporate research of Sweden has developed the electromagnetic strip stabilizer for reducing vibration in operation of galvanization of sheet metal . In this process they have used three sets of electromagnets the gap between metal sheet and magnets is kept small so that to reduce vibration in more amount. But this produces more heat to reduce this amount of heat cooling water and cooling air is used. An frequency converter issued to manage frequency of vibration and all these process are controlled by an plc controller [9].

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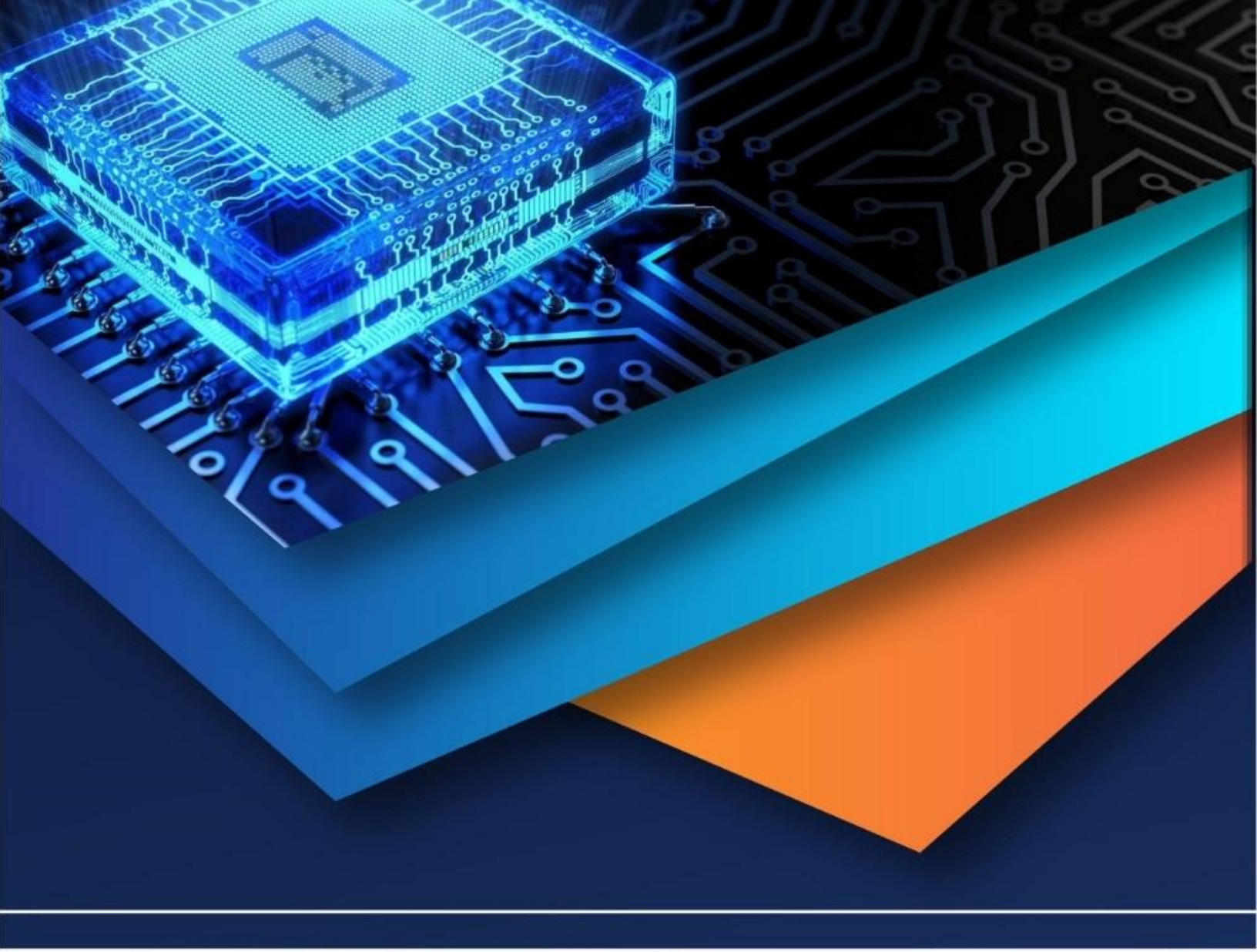

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