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Employing Artificial Bee Colony In MathematicalModelling Designing For Predicting Settling Time

P.D. Darade[a1], Bimlesh Kumar[b]

[a]Assistant Professor, Mechanical Engineering Department, Sinhgad Institute of Technology & Science, Narhe, Pune 411041, India.
[b]Principal, J.T. Mahajan College of Engineering, Jivramnagar, Faizpur, Dist:-Jalgaon India

Abstract

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. A good vibration isolation system will lower the natural frequency of a mechanical system below the excitation frequency. This research paper embrace designing a mathematical model for foresee settling time, holding input parameters such as piezolocation, displacement and velocity. The significant intention of this research papers is to reduce time consumption and cost consume conserve in experimentation process. Here, Genetic algorithm (GA), cuckoo search (CS) and artificial bee colony (ABC) are the optimization techniques involve in this designing process to frame the mathematical model. Among, involved optimization techniques artificial bee colony behaves literally in minimizing error; this model will reveal settling time value as that of measured value in experimentation process by feeding input parameters such as piezolocation, displacement and velocity.

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1. Introduction

Piezoelectric materials have been extensively utilized as sensors and actuators in control systems due to their exceptional electromechanical properties, design flexibility, and efficiency to renovate electrical energy into mechanical energy or vice versa. Established piezoelectric sensors and actuators are frequently complete of several layers of different piezoelectric materials [1]. Piezoelectric materials hold excellent electromechanical properties namely fast response, uncomplicated fabrication, design flexibility, stumpy weight, low cost, large operating

1 * P.D. Darade[a]. Tel.: +919822623024.
*E-mail address:*daradepd@gmail.com

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bandwidth, low power consumption, cohort of no magnetic field while converting electrical energy into mechanical energy etc. So, they are extensively utilized as sensors and actuators in Active vibration control (AVC) [2]. Piezoelectric materials have been utilized to make various smart devices due to their intrinsic electromechanical coupling effect, such as sensors, resonators, actuators, transducers, harvesters and so on. Piezoelectric nanostructures have fascinated marvellous concentration due to their superior physical properties and potential submission in modern science and technology [3].They might locate an attractive overview of some works done on this field, especially in sizing and shape optimization. To optimize piezoelectric structures based on the minimization of the global displacement residual error between the desired and the current structural configuration for a beam in static and dynamic cases [4]. With the maturity on robots in recent years, flexible-link manipulators have demand more awareness of researchers as their favourable kind such as faster operational speed, lighter weight, lower energy expenditure, etc [5]. However, there are also disadvantages such as the undesirable distributed vibration basis by their flexible inherency, which escort to the failure of elevated precision control [5].Varun Kumar *et al.* have proposed vibration of the plate with the assist of fuzzy logic controller. The involvement of piezoelectric sensor and actuator layers on the mass and stiffness of the plate is painstaking. Tip displacement and tip velocity are taken as the inputs and the control forces are engaged as the output to tune the fuzzy logic controller [6]. Sérgio L. Schulz *et al.* have proposedoptimization of piezoelectric patches allocation in composite structures is investigate. The finite element means and a linear quadratic regulator are utilized to revise the electro-mechanical behaviour and the gain calculation. Due to the discrete nature of the crisis, an uncomplicated binary Genetic algorithm is utilized as an optimization tool. Three examples are accessible connected to the optimal portion pedestal on Lyapunov functional [7].Shun-Qi Zhang *et al.* deals with simulations of the static and dynamic response, together with shape and vibration control, for piezoelectric attachment smart structures utilizing an assortment of geometrically nonlinear shell theories based on the first-order shear deformation (FOSD) hypothesis. The nonlinear theories comprise refined von Kármán nonlinear shell theory (RVK5), moderate rotation shell theory (MRT5), fully geometrically nonlinear shell theory with modest rotations (LRT5), and completely geometrically nonlinear shell theory with large rotations (LRT56). Furthermore, the results demonstrate that by applying an appropriate voltage, a required shape can be achieved, as well as the vibration can be significantly suppressed [8].Moon K. Kwak*et al.* Have proposed an active vibration control of a rectangular plate moreover partially or fully inundated in a fluid was investigate. Piezoelectric sensors and actuators were bonded to the plate, and the supposed mode technique was utilized to receive a dynamic model for the submerged plate. The experimental results illustrate that piezoelectric sensors and actuators along with the control algorithm can successfully suppress the vibration of a rectangular plate both in air and submerged in a fluid [9]. Zhang Shunqi*et al.* proposed an electro-mechanically coupled finite element (FE) model of smart structures was developed support on first-order shear deformation (FOSD) hypothesis. Taking into account the vibrations engender by diverse disturbances, which comprise free and forced vibrations, a PID control is implemented to damp both the free and forced vibrations [10]. Y.S. Li *et al*. have proposed a tailored strain gradient theory and Timoshenko beam theory. The material properties of functionally graded piezoelectric beam are thought to diverge through the thickness according to a power law [11]. Dunant Halim *et al.* aimed to investigate the employ of a decentralized control system for suppressing vibration of a multi-link flexible robotic manipulator using embedded smart piezoelectric transducers. To attain this, a non-linear dynamic model of a flexible robotic manipulator with smart piezoelectric actuators/sensors, is developed based on the co-rotational finite element method [12].

2. Mathematical modelling based on artificial bee colony

The significance intension of this model is to predict settling time by feeding piezolocation, displacement and velocity as input. The prediction model is done by utilizing artificial bee colony optimization algorithm to design mathematical model. In conventional research process in vibration control mostly deals with experimental analysis to predict settling time that implies as vibration measures. Here, Piezo -Patches as Sensor /Actuator is utilized as an active element in this experimental process. In conventional method piezoelectric patches is varied in difference