mentioned formulation is also verified by the system's model in software. The system has also been tested, and the data reveals that the presented test rig is capable of reaching power of 390 kw and the losses are about 10.4% of the whole energy circulated. Results show that the closed-loop test rigs are the best for the designed power.

Key Words: Closed-loop test rig, gearbox test, mechanical energy regeneration.

conditions of thermo-electro-mechanical loading. For this purpose, in this study the thermo-electro-elastic behavior of piezoelectric functionally graded thick-walled cylinder subjected to the temperature gradient is investigated. Given the existence of shear stress in the thick cylindrical shell, the governing equations are obtained based on shear deformation theory (SDT). Thus, based on arbitrary higher-order shear deformation theory (HSDT), thermo-electro-elastic equation of functionally graded material axisymmetric thick-walled cylinders in general form is derived. The material properties of the media are assumed to vary continuously according to a power-law formulation. It is assumed that the two-dimensional axisymmetric cylinder is not exposed to any heat source. By the assumption of an element in the cylindrical coordinate system in the steady-state, the temperature distribution has been computed. According to Maxwell electrodynamics equations, the equation of temperature distribution in the cylinder wall thickness under considered boundary conditions and energy method, nonhomogeneous differential equation is derived. These equations are in the form of a set of general differential equations with constant coefficients. Following that, the set of non-homogenous linear differential equations for the cylinder with clamped-clamped ends was solved. The numerical results obtained are presented graphically for special case. The results obtained through the present method are compared to the reported results in the literature. A comparative study of thermo-electro-elastic analysis is given for shear deformation approximation. From the present study, it can be concluded that the higher-order approximations must be applied in order to improve the accuracy of the shear deformation theory. Finally, the effect of loading and supports on the stresses, displacements and electrical potential were investigated. It can be seen that in the vicinity of the axial boundaries of the cylinder, the thermal stresses show a different characteristic from its general behavior over the maximum part of the cylinder. In this very small region, due to edge moments, the absolute value of thermal stresses has a higher value from the points away from boundaries.

Key Words: Thermo-electro-elastic analysis, thick cylindrical shell, arbitrary higher-order shear deformation theory (HSDT), functionally graded piezoelectric material (FGPM).

DESIGN AND CONSTRUCTION OF MECHANICALLY CLOSED LOOP GEARBOX TEST RIG AND POWER LOSS INVESTIGATION OF THESE SYSTEMS

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 137-149, Research Note

- Received 14 September 2016; received in revised form 24 November 2016; accepted 13 February 2017.

Abstract

Rotating components are widely used in industries, and it is necessary to test these components periodically. There are several ways to test rotating equipment like using dyno water, air, water brakes, or using a coupled electrical motor and generator. Rigs for implementing these methods can be categorized as closed loop test rigs, and open loop test rigs. For financial, energy consumption, and maintenance reasons using a system with the ability of energy regeneration is suggested. The gearbox test rig with mechanical regeneration of energy, developed in Sharif University of Technology branch of ACECR (Academic Center of Education, Culture and Research), is studied in this paper. This test rig consists of three similar orthogonal gearboxes, test gearbox, two planetary gearboxes (One for inducing torque in the rig and the other for reducing the speed), and an electromechanical motor connected by shafts and couplings and forming a closed-loop. Mechanical components of the rig can be loaded up to 489 Hp at a maximum speed of 3000 rpm, and the test components can be tested in different testing conditions covering variety of torques and speeds. The energy is circulated in the system's loop, and the motor is responsible for compensation of the losses along the loop and also for initiation of the process. Operation of the closed-loop test rig, its losses, application of torque into the closed-loop, and also procedure of controlling the torque and power in the system can be studied by this test rig. This paper contains the conceptual design of the previously mentioned test rig, including the frame work design, control system and torque inducer design, hydraulic system, as well as dynamic and static analysis of the whole system. A formulation is introduced for modeling the system by making use of the equal stiffness and equal inertia. At last, the

literature. Excellent agreements are observed. Additionally, new results are also presented for plates under different conditions to investigate the influences of different parameters on the vibrational characteristics of the plate. For some plates, mode shapes of free vibration are also shown.

Key Words: Laminated composite trapezoidal plate; pasternak foundation; ritz method; series with orthogonal terms.

PERFORMANCE REVIEW OF EXERGY EFFICIENCY AND ENTROPY GENERATION BY OPTIMIZATION OF WIND TURBINES BY PSO OPTIMIZATION ALGORITHM

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 117-124, Original Article

- Received 5 November 2016; received in revised form 25 January 2017; accepted 11 February 2017.

Abstract

One of the optimization methods is exergy analysis. It uses the conservation of mass and conservation of energy principles, together with the second law of thermodynamics, for the analysis, design and improvement of energy and other systems. Exergy is defined as the maximum amount of work which can be produced by a system or a flow of matter or energy as it comes to equilibrium with a reference environment. Unlike energy, exergy is not subject to a conservation law (except for ideal, or reversible, processes). Rather, exergy is consumed or destroyed, due to the irreversibility in any real process. The exergy consumption during a process is proportional to the entropy created due to the irreversibilities associated with the process. Exergy is a measure of the quality of energy which, in any real process, is not conserved but, rather, is in part destroyed or lost. Many research studies have been carried out on the exergy analysis of wind energy. The purpose of this paper is to develop an improved approach to the exergy analysis and optimization of a wind turbine and find a way to decrease average Entropy generation and increase exergy in ' Bergey Excel-S ' wind turbine through Cut-in, Rated, Furling speeds optimization, using Particle swarm optimization algorithms. Firstly, we would go for mathematical modeling of wind turbine exergy which results in objective function. Then, by means of nerve web computer code in collecting statistical data of so called turbine, it would be modeled in Matlab program and the output results will be covered in tables and diagrams in this paper. This results shows a relation between inlet air speed, Entropy generation, and the efficiency of second law. By studying optimization results from pso algorithm, we have observed a 24.53 % decrease in Entropy generation and 41.67% increase in exergy efficiency.

Key Words: Entropy, exergy efficiency, pso algorithm.

THERMO-ELECTRO-MECHANICAL ANALYSIS OF CYLINDRICAL SHELL MADE OF FUNCTIONALLY GRADED PIEZOELECTRIC MATERIALS USING ARBITRARY HIGHER-ORDER SHEAR DEFORMATION THEORY

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 125-135, Original Article

- Received 5 November 2016; received in revised form 21 January 2017; accepted 11 February 2017.

Abstract

The shells are the engineering structures that create the highest mechanical efficiency with minimal materials. with high mechanical efficiency and the least materials. Given that they are commonly used in most industrial equipment, it is necessary to gain insights into the

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 97-104, Original Article

- Received 14 September 2016; received in revised form 23 November 2016; accepted 24 December 2016.

Abstract

Computational fluid dynamics (CFD) has been known as a technique that has massive floating point operations, since the most of its problems require a fine computational mesh with an appropriate distribution of grid points and also need sufficient numerical solution iterations to yield an accurate solution. As a result, even by employing supercomputers, the run time of these problems will still be significantly high. Several techniques and ideas have been suggested for reducing the run time of differential equations governing the fluid flow. In general, these methods are divided into two main categories, i.e., software and hardware methods. Based on recent studies, the computational power of FPGA (Field Programmable Gate Array) chips has shown a promising future for speeding up CFD computations. FPGA is an integrated circuit containing a number of logic blocks. The architecture of this hardware can be reprogrammed and configured after manufacturing. So, it is possible to design and implement complex circuits for various applications using an FPGA. The hardware used in this paper is SoC FPGA, which integrates both microprocessor and FPGA architectures into a single device. Consequently, they provide higher integration density, lower power consumption, smaller board size, and higher bandwidth communication between the processor and FPGA. In the present study, an algorithm is proposed that is tailored for configuring Xilinx Zynq-7000 family of chips. The ability of FPGAs in mathematical operations on floating point numbers is studied. Then, typical CFD problems, such as Laplace problem and unsteady coquette flow, are implemented and solved numerically on a specific FPGA hardware with different mesh sizes and numerical methods. The run time and precision results of the calculations are compared to the results from a conventional CPU. Some analytical solutions are used to validate the precision of the results. The calculation procedure on the FPGA hardware is up to ten times faster than calculations on the CPU, with the same data precision.

Key Words: FPGA, CFD, reconfigurable hardware, hardware definition language, accelerating numerical solutions.

FREE VIBRATION ANALYSIS OF LAMINATED COMPOSITE TRAPEZOIDAL PLATE RESTING ON THE PASTERNAK FOUNDATION

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 105-115, Original Article

- Received 14 September 2016; received in revised form 28 December 2016; accepted 5 February 2017.

Abstract

Trapezoidal fiber reinforced composite plates are important structural elements in modern engineering industries. In this paper and for the first time, the free vibration analysis of laminated composite trapezoidal plate resting on the Pasternak type foundation has been presented. First, the kinetic and strain potential energies of the laminated composite plate based on the classical plate theory are formed. Then by using the change of variables, the trapezoidal plate is mapped into the rectangular one. Next, we have assumed the deflection of the plate as a series having orthogonal terms and unknown coefficients. It is worth mentioning that the admissible polynomials for all possible combinations of classical boundary conditions have been presented in the paper. The deflection is approximated by a set of beam characteristic orthogonal polynomials generated using the Gram-Schmidt procedure. A sufficiently large number of truncated series have been worked out to make sure the convergence criteria. These polynomials have to satisfy the essential boundary conditions of the plate. Upon substituting the above stated response in the energies terms, they have been rewritten in terms of the unknown coefficients. At the end by applying the Ritz method, a standard eigenvalues problem is obtained out of which the frequencies and corresponding mode shapes can be obtained. The obtained algorithm is very general and it is attractive regarding its versatility in handling any classic boundary conditions. Besides, it allows taking into account a great variety of anisotropic characteristics and geometric planforms. In order to establish the validity, accuracy and applicability of the described approach and self-developed computer program, numerical results have been computed for a number of plate problems for which comparison values are available in the

ground robots makes obstacle avoidance a crucial function for their flight. Furthermore, these robots are employed frequently in urban environments where there are numerous obstacles. A multi-agent mission is a virtuous notion that improves the effectiveness and range of aerial robots in their applications. As a result, robots have to get far from their reference to be able to avoid the obstacle. A guidance system is ideal for these robots, which can maintain their path close enough to the original reference and at the same time avoiding obstacles safely. In this paper, the behavioral algorithm is utilized to simultaneously realize the leader following and obstacle avoidance behaviors in order to complete the formation flight successfully .Control system has to be consistent with the produced reference of the guidance system. Moreover, the main challenge in designing the control system is the underactuated-ness of quadrotors; this dynamical concept means that quadrotor has limited inputs and is not able to straightforwardly track three-dimensional trajectories. In this work, the control system is designed based on dynamic inversion approach and is consistent with the guidance system. Performance of guidance and control systems is examined in a detailed simulation environment, which enjoys the incorporation of the noise of sensors and lag of rotors. For this purpose, the flight dynamics of quadrotors is carefully modeled to make simulation outcomes more realistic. The simulation results specify that the guidance and control systems are capable to follow the leader while attaining 2 m accuracy in position and 3.5 m in altitude.

Key Words: quadrotor, behavior-based approach, obstacle avoidance, dynamic inversion.

EXPERIMENTAL STUDY AND FINITE-ELEMENT SIMULATION OF FATIGUE IN OUTER TIE ROD OF STEERING SYSTEM FOR PEUGEOT 405

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 87-96, Original Article

- Received 30 August 2016; received in revised form 16 January 2017; accepted 5 February 2017.

Abstract

Engineering components and structures are often subjected to cyclic loads. Vehicle manufacturers continuously develop new vehicles with more luxury, convenience, performance, and safety. Vehicle components are redesigned which results in increased performance. Therefore, the design should be implemented based on conflicting constraints, designing conditions and uncertain factors to obtain optimized and feasible performance. The interaction of the vehicle and steering system is important to evaluate the vehicle on-center handling. The outer tie rod is one of the important parts in the steering system. It plays a crucial role in vehicle safety and stability and implies a good driver experience. An outer tie rod as the part of the steering kinematic chain is employed to transfer the motion to tires and to support the load and torque induced by bumping, braking, and accelerating conditions. Fatigue cracks are initiated and grown in the outer tie rod due to the effects of cyclic loads. This phenomenon has created serious problems in the safety of passengers. The fatigue of outer tie rod in Peugeot 405 steering system was studied by the finite-element simulation and the experimental testing. The chemical composition and mechanical properties for the material of outer tie rod were determined. Then, fatigue under conditions similar to reality was simulated by the finite-element software ABAQUS. Three different modes of the loading with the 23, 28, and 57 kN were simulated in the same condition and the fatigue life was calculated in each of these three cases. In experimental study, the specimens were tested under the similar conditions with the simulations of determining the fatigue life. The fatigue life was measured in fatigue test with a constant load for all specimens. The good agreement was observed between the numerical and the experimental results. Finally, the fracture surface of the specimens was studied.

Key Words: Fatigue life, outer tie rod, experimental study, finite- element simulation.

SPEED-UP NUMERICAL SOLUTION OF STEADY AND UNSTEADY FLOWS WITH FPGA HARDWARE

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and then transferred to the computer. Necessary codes are written in the Matlab software. Despite its computational complexity, this method is preferable compared to classical methods such as envelop, since it does not need to determine the frequency band for the filter and it can show more details. The spectral correlation density function proves to be a more accurate method and provides comprehensive information about the signal.

Key Words: Rolling element bearing, fault detection, cyclostationary, spectral correlation density.

FLIGHT OPERATION IMPROVEMENT OF VARIABLE PITCH QUADROTORS WITH H ∞ OPTIMIZATION AND μ SYNTHESES

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 63-72, Original Article

- Received 8 August 2016; received in revised form 8 November 2016; accepted 5 December 2016.

Abstract

This study aims to improve operational efficiency and enhance the flight performance of variable pitch Quadrotors in hover with the scope of achieving sustainable inverted flight, or fulfilling a special mission in automated mass flights. The objectives of this study, a robust control system design for a candidate variable pitch quad rotors is paced classically. The methodology is based on mathematical modeling developments extracted specifically for a candidate variable pitch Quadrotors. Trim calculation and linearization of equations along with design, implementation and integration of a robust controller for the quad rotor are therefore following steps in this study. The challenges associated with the dynamic modeling of rotors, aerodynamic modeling in small Reynolds numbers and modeling of the electric propulsion system are removed using the Blade Element-Momentum Theory (BEMT). To improve the performance, two control loops including an attitude control system and a control motion were implemented using H∞ optimization and μ synthesis. Results showed that H∞ optimization is a suitable approach to reducing the unstructured uncertainties, and thus it can be used for control system design with 30 percent of uncertainty relevant to the aerodynamic coefficients. Results also revealed that the stabilized inverted flight as a novel ability of operation in variable pitch Quadrotors could be obtained. In both approaches Bilin transformation is aimed to pole shifting and avoidance of singularity in H∞ optimization and μ synthesis. By using the Bilin transform, design of weight functions is avoidable, thus controller design would be easier. On the other hand, robust controllers frequently have the high order transfer functions which make the implementation of it difficult, thus the model reduction approach was applied to reduce the order of controller designed with μ synthesis method. Overall, without problem caused from gyroscopic effect in fixed pitch Quadrotor, a variable pitch mechanism to develop the bigger Quadrotor, with the less problems in control system.

Key Words: Variable pitch quadrotor, hover flight, aerodynamic modeling, robust control, optimization.

A BEHAVIOR-BASED APPROACH TO SIMULTANEOUS REALIZATION OF LEADER-FOLLOWING AND OBSTACLE-AVOIDANCE BEHAVIOURS FOR A FLYING ROBOT

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 73-85, Original Article

- Received 30 August 2016; received in revised form 17 January 2017; accepted 30 JAnuary 2017.

Abstract

With the purpose of performing successful realization of multi-robot missions, an accurate guidance and control system is needed to enable the robots to simultaneously follow a leader and avoid obstacles. In this research, a modular guidance and control system is proposed, which considers the dynamics of quad-copters to perform flight behaviors formation. Hovering in the air and the higher speed of aerial robots in comparison to

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 45-54, Original Article

- Received 20 April 2016; received in revised form 12 November 2016; accepted 6 March 2017.

Abstract

Aerodynamics of high-speed train is of interest to the world researchers in recent decades. High-speed railways shows a continuous growth over the last few years in many parts of the world, both in terms of speed of the train and the number of lines. The world record for the highest speed achieved on a conventional high-speed railway line is currently held by the modified version of Alstom's TGV, which reached close to 575 km/h on a test run. The aerodynamic forces generated at such high speeds would be very significant as they are proportional to the square of the train speed. It is not surprising that there are many problems that need to be addressed. The operation of these high-speed trains can be unsafe if certain requirements are not fulfilled.

One of the aerodynamic problem, engaged to the high-speed train passage, is flying ballast. The flying ballast is the rotation or jumping of the ballast due to the produced high-speed train pressure wave. The flying ballast may damage the wheel system, the infrastructure, stations and structures close to the rail. The purpose of this research is to determine the critical velocity of aerodynamic wind for flying ballast and to introduce a strategy of risk reduction. The flow problem under train is modeled analytically as a turbulent Couette flow. The air velocity profile solution is compared with two-dimensional model using Gambit & fluent software. Three-dimensional modeling of ballast under wind profile is done analytically and numerically (fluent) to determine the critical wind speed. Wind tunnel test is done, for the ballasts in range of 30 to 170 gr, and critical velocity is compared. The results show good agreement with the analysis and test. Finally, the ballast flying possibility factor (BFPF) is shown, and strategies to reduce risk factors and strategies to control flying ballast are introduced.

Key Words: Flying ballast, high-speed trains, wind tunnel test, couette flow, critical velocity.

CYCLOSTATIONARY METHOD IN FAULT DETECTION OF ROLLING ELEMENT BEARINGS

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 55-61, Original Article

- Received 31 May 2016; received in revised form 22 January 2018; accepted 8 April 2017.

Abstract

Rolling element bearing are one of the most commonly used components in the rotating machines and early detection of bearing faults can prevent potential catastrophic failures. Various methods in time, frequency and frequency-frequency domains are expressed for the fault diagnoses of rolling element bearings. In this paper, a frequency-frequency domain method by means of cyclostationary concept is used to calculate spectral correlation density (SCD) function. SCD is used to detect bearing fault signature in vibration signal of the machine. In this method, signal is assumed stationary in the cyclic periods. Using this method, three-dimensional diagram of spectral correlation density function is generated on a dual frequency axis for spectral and cyclic frequency. Using this method, the hidden cycles in the presence of noise, which cannot be seen in conventional Fourier transform, become clear. There is a difference between meaning of spectral frequency and cyclic frequency. The spectral frequency shows resonance frequency excited by periodic impacts, but cyclic frequency shows the frequency of impacts itself. SCD can be seen as a tool for generalization of the detection of amplitude-modulated signals. SCD can show both carrier and modulating frequency of the signal. The possibility of application of this method in rolling element bearing fault detection is shown in a practical example, and the results have been presented. The practical example is a bearing with inner ring fault used in a centrifugal pump. The vibration is measured by an accelerometer in high frequency band

ing the drag, postponing the laminar to turbulent flow transition, suppressing the separation and noise reduction. Here, a Single Dielectric Barrier Discharge (SDBD) plasma actuator, installed at the leading edge of a NACA0015 airfoil, was used to control the flow separation at a high angle of attack in a steady condition. The actuator was supplied with a 9kV voltage. The air flow was considered turbulent incompressible flow with a Reynolds number of about 500,000. An SDBD plasma actuator can generate a wall-bounded jet without any mechanical moving parts. Lack of a reliable simulation model prevents wider application of such DBD actuators. A complete numerical simulation of interactions of the electrostatic and the fluid flow field is very time-consuming. In this study, a semi-empirical Electrostatic model, with the plasma actuator induced body force, with two simple equations to predict the electrostatic filed, is used. To describe the two-dimensional flow field induced by the actuator, the body force is added to the CFD solver as a source term. The Electrostatic model solves the electrical potential and plasma concentration equations around the DBD electrodes by rectifying the plasma distribution over the aerodynamic surface, a modified form of the model is utilized which is shown to produce results close to the experimental data. The accuracy of the used model is indicated with the validation of fluid flow solution and modified electrostatic model with credit experimental results in the literature. It is shown that by employing a plasma actuator, the separation angle of attack increases from 15 to 21 degrees. The maximum lift coefficient is improved about 30-percent, while the maximum lift to drag ratio is improved more than 15%.

Key Words: Electrostatic Model, DBD plasma actuator, flow separation control, NACA0015 airfoil.

DETERMINATION OF THE OPTIMAL VALUES OF STIFFNESS FOR ELASTOMER ENGINE MOUNT BASED ON DECOUPLING THE VIBRATIONAL MODES

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 35-43, Original Article

- Received 31 December 2015; received in revised form 18 December 2016; accepted 30 January 2017.

Abstract

In this paper, the optimum values of stiffness coefficients of elastomer engine for EF7 engine have been determined. For this purpose, at first, a six_ degree_ freedom model of engine has been considered. This engine includes three engine mounts named: hydraulic engine mount, gear box engine mount, and torque engine mount. Using Lagrange method, the equations of motion have been derived and the stiffness matrix and mass matrix of the system have been determined. Then, the torque roll axes of the engine considering the output torque along the crank shaft have been determined. Decoupling the vibrational modes along this axes causing the best values of stiffness coefficient have been calculated. According to some constrains in design and manufacturing of the engine and engine mount position, the complete decoupling of vibrational modes is impossible; the optimization methods have been used for maximum decoupling of modes. So, by defining a relation named distribution of kinetic energy of modes, the percentage of decoupling the vibrational modes has been calculated. Then, four strategies for the optimization of stiffness coefficient of engine mounts, considering the percent of decoupling of modes, have been defined. A sensitive analysis has been done to determine the effective stiffness coefficient in each strategy. Using MODEFRONTIER software, which is adaptable with the MATLAB software, and is based on genetic algorithm method, the optimum values of effective stiffness coefficient for engine mount have been calculated. Then, the frequency response function of the center of mass for engine using these evaluated stiffness coefficients have been plotted and compared with the current values.
By comparison of these graphs, finally, the best values for the stiffness coefficient have been selected. The results show that using the new optimum values of stiffness of engine mount, the displacement of mass center for engine and transferred forces have been reduced, and vibrational behavior of engine has been improved properly.

Key Words: Vibration, engine mount, national engine, stiffness, decoupling, optimization, frequency response.

AERODYNAMIC ANALYSIS AND SIMULATION OF FLYING BALLAST IN HIGH-SPEED TRAINS

influence of different vacancy defects on the shift in the resonant frequency of grapheme nano-resonators is studied as well.
Results clearly show that pinhole vacancies can decrease or increase the natural frequencies of graphene sheets depending on ratio of the hole diameter to the side length and chirality. The fundamental natural frequency of a graphene sheet with a big vacancy defect is higher than that of a sheet with several small vacancy defects when both lose the same number of atoms. It is also seen that the effect of nanopore on the natural frequencies decreases when a nanopore becomes closer to the supported edges. It also seems that zigzag graphene is more sensitive to the attached external mass compared to armchair graphene.

Key Words: Natural frequency shift; defective graphene sheet; engineered defect; molecular structural mechanics; defective nano-resonator.

APPLICATION OF GENETIC ALGORITHM TO MODEL THE SLOSHING PHENOMENON IN THE RECTANGULAR STORGE TANKS

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 13-22, Original Article

- Received 23 August 2016; received in revised form 15 February 2017; accepted 21 February 2017.

Abstract
In this paper, genetic algorithm has been used for liquid sloshing modeling in the rectangular storage tanks. For this purpose, a numerical model was developed to model the sloshing phenomenon in the rectangular storage tank with different widths and water depths exposed to the horizontal periodic sway motion with different amplitudes and angular frequencies. In the numerical model, coupled finite element and boundary element methods were used to solve the governing equations. The governing equations are the Laplace equation and the dynamic free surface boundary condition. In order to validate the model, a rectangular tank with 0.9 m width and 0.6 m water depth was exposed to a horizontal periodic sway motion with 0.002m amplitude and 5.5 rad/sec angular frequency. Finally, the results of the numerical model were compared with those of Nakayama and Washizu. Then, the numerical model was used to model the sloshing phenomenon in the rectangular storage tanks with different widths and water depths exposed to horizontal periodic sway motions with different amplitudes and angular frequencies. In the next step, a genetic algorithm method was used to model the sloshing phenomenon using the results of numerical model, and some relationships are presented to estimate the maximum free surface and the horizontal force is exerted on the tank perimeter. The correlation coefficient is used to evaluate the accuracy of the presented relations. The results show that genetic algorithm has good accuracy in predicting these two parameters. However, the accuracy of the model in the prediction of the maximum horizontal force exerted on the tank perimeter is more than that of prediction of the maximum free surface displacement. Because the correlation coefficient in the training and testing steps are 82 and 93 percent and 99 and 5 percent for these parameters, respectively. Furthermore, the percent relative errors of prediction of maximum free surface and horizontal force exerted on the tank perimeter are 11 and 5 percent, respectively. Therefore, the present model can be a power tool to model the sloshing phenomenon in the storage tanks.

Key Words: Rectangular storage tank, maximum free surface displacement, horizontal force, genetic algorithm.

NUMERICAL SIMULATION OF PLASMA ACTUATOR IN BOUNDARY LAYER SEPARATION CONTROL BY UTILIZING THE MODIFIED ELECTROSTATIC MODEL

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 23-33, Original Article

- Received 18 October 2015; received in revised form 3 December 2016; accepted 5 February 2017

Abstract
Currently, the Dielectric Barrier Discharge (DBD) plasma actuators are going to be one of the most promising active flow control devices. They have a significant effect on the flow characteristics such as reduc-

Abstracts of Papers in English

THE EFFECT OF VACANCY DEFECTS ON LINEAR VIBRATION OF GRAPHENENANO-RESONATOR SENSOR VIA MOLECULAR STRUCTURAL MECHANICS METHOD

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Sharif Mechanical Engineering Journal
Volume 34, Issue 1, Page 3-12, Original Article

- Received 12 June 2016; received in revised form 10 November 2016; accepted 3 December 2016.

Abstract

Graphene sheets, the two-dimensional carbon nanostructures, amazingly exhibit electrical, mechanical, thermal, and optical properties so that they can be considered as a promising material for a wide range of applications such as composites, chemical sensors, ultra capacitors, transparent electrodes, photovoltaic cells, bio-devices and gigahertz oscillators. Although there have been numerous studies carried out on the simulation of vibrational behavior of perfect graphene sheets, notable studies representing the effects of nanopores on linear and/or nonlinear vibration responses of graphene sheets do not exist, while the existence of nanopores in graphene lattice can be essential based on the desired functionality of graphene sheets in different nano-devices. Therefore, the simulation of dynamic response of graphene sheets with nanopores to determine how the size, the position and the shape of cut-outs influence the natural frequencies is important. On the other hand, previous researches show that graphene vacancies can be used as anchoring points for nanoparticles or some molecules. Then, graphene nano-resonator sensors with designed vacancy defects may perform better than perfect ones because of the designed location of external mass instead of a randomly location. Therefore, the investigation of the impact of vacancy defects on natural frequencies of graphene sheets is the main objective of this article. The