The present paper discusses the vibrating behavior of piezoelectric microbeams, with respect to the hydrodynamic forces imposed by a fluid. To do so, considering Hamilton's principle and assumptions of the Euler-Bernoulli theory, the dynamic modeling of a microbeam was carried out and the differential equation of vibrating motion was extracted. As it is very difficult to determine the exact amount of hydrodynamic force imposed on a beam, the hydrodynamic forces were approximated using string sphere modeling. The results obtained from dynamic modeling were compared with experimental ones. The results show that sphere string modeling can favorably model natural frequency and the resonance amplitude of piezoelectric microbeams in a liquid environment. The results show that the vibrating motion (natural frequency and resonance amplitude) of a microbeam in liquid is under the influence of fluid density, due to the damping of liquid and additional mass; it is also seen in the higher vibrating modes. By approaching the microbeam to the sample surface and intensifying squeeze force, the results show further amplitude decrease. The amplitude reduction at higher densities and low angles of the microbeam to the horizon is due to the intensification of compression force. When the interaction force between the probe tip and sample surface is intensified, and when there is a very short distance between the probe tip and sample surface (as small as a nanometer), amplitude is affected. According to the DMT model, there is a direct relationship between the interaction force between the tip and sample surface and the radius of the probe tip. Therefore, the more the radius of the probe tip, the more the interaction force will be. The increase of this force will be followed by a decrease in vibrational motion amplitude.

Key Words: piezoelectric microcantilever, AFM, liquid environment,hydrodynamic force.

AERODYNAMIC DESIGN OF VERTICAL AXIS WIND TURBINES USING BLADE ELEMENT MOMENTUM THEORY AND WIND DATA IN THE PROVINCE OF SOUTH KHORASAN

D. Saeidi
davoodsae@yahoo.com
A. Sedaghat(corresponding author)
sedaghat@cc.iut.ac.ir
A.A. Alemrajabi
rajabi@cc.iut.ac.ir
P. Alamdari
p.alamdari@me.iut.ac.ir
Department of Mechanical Engineering
Isfahan University of Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 97-107, Research Note

- Received 18 December 2011; received in revised form 7 July 2012; accepted 26 December 2012.

Abstract

Recent works in design of small stall regulated wind turbines has indicated the need to provide site-specific small wind turbines which incorporate innovative design and new materials of construction leading to better performance. In this paper, vertical axis wind turbines are considered for simplicity and ease of manufacturing for limited applications in Iran. Blade element momentum (BEM) theory is employed for aerodynamic design and analysis of a vertical axis wind turbine. The design algorithm was programmed in MATLAB routines using an iterative method for calculating axial and swirl induction factors, u and u', respectively. NACA4415 aerofoil is used to provide higher lift to drag ratio and a double multiple stream tube model is used to properly model upstream and downstream of wind turbine in better agreement with some experimental observations. For the airfoil section NACA4415, the lift to drag ratio of 130 is obtained at the angle of attack of 13 degrees. A parabolic fitting function for lift and a cubic fitting function for drag coefficients are used with respect to angle of attack. This approach allows better predictions in high angle of attacks when partial stall may occur over airfoil surfaces. Studying wind energy potential in four stations, Bojnord, Esfaraein, Fadashk and Nehbandan in two provinces of North and South Khorasan in Iran, the results indicated that Fadashk station has better wind potential for setting up wind turbine in the studied provinces. The study was performed based on the annual wind speed data obtained from renewable organization (SUNA) in Iran. Statistical analysis based upon wind data in Fadashk in the province of south Khorasan is used for designing a 1.5 kW vertical axis (H-rotor) wind turbine. Our results for the wind turbine are verified with an existing wind turbine and are parametrically studied. Furthermore, economical aspects of installing wind turbines in Fadashk and re cup from wind energy are investigated. The economical feasibility of the designed VAWT is finally evaluated to predict annual production of electricity that shows 6 cent profit for each kW h generated power.

Key Words: vertical axis wind turbines, blade element momentum theory, aerofoil, Khorasan province, wind potential.

and propagation of the wave coincides with the direction of normal stress, then, the velocity of the longitudinal mode will decrease in tension and increase in compression. On the other hand, the velocity of shear wave will increase in tension and decrease in compression. These conclusions agree with the results in other references. Comparing the slope of relative velocity diagrams in a stressed body, we conclude that the velocity of longitudinal waves that are incident along the normal stress component, is greater than other wave modes, although the magnitude of this change is very small for either modes; say, about 0.6 percent for longitudinal waves at 70 MPa tension in aluminum. Therefore, precise measurement of the flight time of the wave is necessary.

Key Words: residual stress, ultrasonic wave, non destructive test, acoustoelasticity.

EFFECT OF CURVED CRACK FRONT ON STRAIN ENERGY RELEASE RATE OF UNIDIRECTIONAL DCB SPECIMENS

M. Heidari-Rarani
heidarirarani@iust.ac.ir
M.M. Shokrieh(corresponding author)
shokrieh@iust.ac.ir
Dept. of Mechanical Engineering
Iran University of Science and Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 81-86, Research Note

- Received 18 July 2011; received in revised form 5 June 2012; accepted 15 July 2012.

Abstract

Delamination is a typical fracture mechanism in fiber reinforced composite laminates that occurs due to low interlaminar strength. Some well-known sources of delamination under different loadings are free edges, cut out, low-velocity impact and fabrication defects. This damage may considerably reduce global stiffness and strength, leading to a catastrophic structure failure. Therefore, characterization of delamination resistance, based on fracture mechanics, is of great importance in engineering design. Regarding the experimental point of view, the double cantilever beam (DCB) specimen has been widely used to measure mode-I critical strain energy release rate (G_{Ic}). Many factors may affect the strain energy release rate of a composite DCB specimen. Among these factors, initial crack length has a significant effect on the interlaminar fracture toughness (G_{Ic}) of unidirectional, double cantilever beam (DCB) specimens. Crack propagation is not self-similar in composite DCB specimens, due to bending-bending coupling. As a result, straight crack front changes to thumb-nail shape during the propagation .The difference between analytical and experimental (G_{Ic}) results is related to the use of critical load or displacement during data reduction. In this study, at first, the effect of using critical load, critical displacement and critical load-displacement is examined in experimental calculation of (G_{Ic}).Results show that using only critical load underestimates initial fracture toughness, whereas using only critical displacement overestimates it. Afterwards, the influence of crack length correction on fracture toughness is experimentally investigated. The proposed relations, by other researchers, for crack length correction, are assessed by experimental results. Results showed that crack length correction, based on the Timoshenko beam on a Winkler elastic foundation model, are in good agreement with experimental ones. Finally, engineers can predict the (G_{Ic}) value of a unidirectional DCB specimen with good accuracy using a simple beam theory with correction in initial crack length.

Key Words: delamination toughness, DCB, curved crack front.

INVESTIGATION OF VIBRATION BEHAVIOR OF AFM PIEZOELECTRIC MICRO-BEAM IN LIQUID

M. H. Korayem(corresponding author)
hkorayem@iust.ac.ir
R. Ghaderi
reza.ghaderi@ymail.com
M. Haghpanahi
mhaghpanahi@iust.ac.ir
Department of Mechanical and Aerospace Engineering, Science and Research Branch, Islamic Azad University,Tehran, Iran

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 87-96, Research Note

- Received 14 November 2011; received in revised form 23 June 2012; accepted 15 October 2012.

Abstract

Piezoelectric microbeams are special types of beams applicable to the atomic force microscope (AFM). Having piezoelectric layers, they are capable of selfactuating using the voltage imposed on the piezoelectric layer.

Dept. of Aerospace Engineering
Maleke-ashtar University of Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 65-73, Original Article

- Received 3 January 2012; received in revised form 6 October 2012; accepted 20 April 2013.

Abstract

Abstract - In the past, the field of missile guidance and control system design has been dominated by classical control techniques. Typically these techniques are either time domain or frequency domain based, are applicable to linearized and time-invariant plants. Nonlinearities and time-varying effects must be coped with by a robustness margin of the control loop. The performance of the loop is hence not constant but will change with the operating point. When the time variation and nonlinearities are severe, it may not be an easy task to find a controller that can cope with it all. In recent years, we have seen a growing interest in applications of robust, nonlinear, adaptive and intelligent control theories to missile flight guidance and control systems. The main advantage of intelligent over classical control is that the former can provide robust systems when there are model and environmental uncertainties. Fuzzy logic, by giving control laws based on input-output relationships, avoids the need for accurate knowledge of system dynamics, and is thus insensitive to their changes. In simple systems the classical controller may be preferred while systems with more complex requirements and capabilities, the increased abilities of the fuzzy controller may be useful. In such a system, it is frequently advantageous to use hybrid intelligent systems. The resulting control system can incorporate many desirable qualities, such as robustness, ease of adaptability to new tasks, and is faster to produce than traditional methods that are heavily model dependent. Another feature of intelligent systems is that they could combine knowledge, techniques, and methodologies from various sources. These intelligent systems supposed adapt themselves and learn to enhance the performance in changing environments. In this paper, an adaptive control structure based on fuzzy logic theory is presented. In this structure the control objective is track the command of Euler angles. In the aforementioned control system, fuzzy controller's knowledge-base, rule base are updated with continuous adjustment of membership function and weight of fuzzy controller though online learning. In this approach, fuzzy systems are used to approximate unknown ideal controllers. The adjustable parameters of the fuzzy systems are updated by an adaptive law based on a Lyapunov approach, i.e., the parameter adaptive laws are designed in such a way to ensure the convergence of a Lyapunov function. Finally the Simulation results for an air to ground short range missile with uncertain aerodynamic coefficients are presented to proof the proposed control law.

Key Words: autopilot, air to ground missile, intelligence control, direct adaptive fuzzy controller.

RESIDUAL STRESS FIELD ESTIMATION BY ULTRASONIC WAVES

K. Naderan Tahan(corresponding author)
naderan_k@scu.ac.ir
E. Delkhosh
ehsan.delkhosh@gmail.com
Dept. of Enginnering College of Mechanics, Shahid Chamran University of Ahvaz

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 75-80, Original Article

- Received 7 January 2012; received in revised form 7 April 2012; accepted 24 June 2012.

Abstract

In certain cases, the presence of residual stress reduces the strength of parts, hence, its detection and estimation is of great importance. Ultrasonic waves have the potential to be employed in nondestructive tests to do this task. The analysis is based on the acoustoelasticity properties of the material that studies changes in wave velocity when passing through a stressed medium. To derive the equations of motion for a particle in a stressed elastic solid, it is supposed that the displacement vector consists of two parts: a static part, which may be developed by a residual or applied stress field, and a dynamic part, which is produced due to wave propagation and is considered a small amplitude harmonic motion. The finite displacement theory is employed to derive the general form of the non linear equations of motion in three dimensions for an incident wave at various angles, which are made linear by the Taylor expansion method. Various components of the wave velocity are computed from linear equations as an eigenvalue problem. Relative velocity changes versus one dimensional stress and strain in an aluminum block, and the effect of wave incidence angle on the propagation velocity are established and plotted .It is shown that the speed of wave in a stressed elastic solid depends not only on the material properties of the solid, but, also, on the wave incidence angle and the propagation and particle displacement direction relative to the stress direction. From the presented diagrams, it is revealed that if the direction of incidence

Finite-volume spatial discretization based on central differences is used. To avoid unwanted spurious oscillations, artificial dissipation terms are applied. A dual-time implicit method is applied for time discretization of equations. In order to model the turbulent terms, a two-equation turbulence model (k-ε) is used. The wall function approach is applied to investigate near wall treatment. To optimize and gain the best grid, a grid sensitivity test is applied. Several test cases are applied and the results are compared with experimental data. Results show that the presence of wind tunnel walls not only increases the lift and drag coefficients of the airfoil, but also affects flow separation on the surface of the airfoil. Flow inside the wind tunnel, in both steady and unsteady regimes, has been numerically simulated. Also, the sensitivity of the numerical results to the distance of wind tunnel walls, for a spatial case, is obtained. Wall effects on lift, drag and pressure coefficients are investigated separately. Finally, the corrections are presented and the results are compared with free-stream results .

Key Words: wind tunnel wall effects, numerical solution, turbulent compressible flow, oscillating airfoils.

WELDING BUCKLING PREDICTION OF THIN SHELLS BASED ON ENTROPY GENERATION

S. Ziaee(corresponding author)
ziaee@mail.yu.ac.ir
Dept. of Mechanical Engineering
Yasouj University
K. Jafarpour
kjafarme@shirazu.ac.ir
School of Mechanical Engineering
Shiraz University

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 57-63, Original Article

- Received 29 October 2011; received in revised form 17 November 2012; accepted 10 December 2012.

Abstract

Welding has been employed at an increasing rate for its advantage in high joint efficiency, water and air tightness, weight saving, reduction in fabrication cost and design flexibility. However, welded structures are not free from problems. Residual stress and distortion are major difficulties with welded structures. The buckling distortion of welded structures caused by welding stress is seen in relatively thin welded structures. Buckling distortion causes loss of dimensional control, structural integrity and increased fabrication costs. Thus, it is necessary to achieve a predictive analysis technique to determine the susceptibility of a particular design to buckling distortion. This paper presents a predictive buckling distortion method to determine if welded structures buckle during welding or not. In this method, a 3D thermal transient process is coupled to a 3D eigenvalue analysis to determine the total entropy generation due to welding and critical total entropy generation, respectively. In this work, because of the small size of the melted region (weld pool), the heat source model developed by the "moving isotherm pool" is used. Welding time in this work is calculated by dividing the welder speed obtained from the practical welding characteristics data by the length of the welded region. The temperature dependent thermal properties of material were also incorporated into the model. In this research, temperature distribution producing the minimum value of longitudinal stress to cause the buckling of welded shells is predicted by 3D eigenvalue analysis. This temperature distribution creates negative longitudinal strains in the welded region, causes tensile longitudinal stress in regions close to the weld line and compressive stress in regions away from the weld line. Total entropy generation, due to this temperature distribution, which is named critical entropy (S_{cri}), is calculated. The comparison between total entropy generation due to completely welding shells (S_W) and critical entropy is a good criterion to predict the possibility of buckling welded shells. In this method, the computational time is much less than in the previous methods because of omitting the mechanical analysis of welding. The correctness of this predictive method is proved by analytical results.

Key Words: welding buckling, entropy generation, thin shells, eigenvalue analysis, 3D thermal transient analysis.

ADAPTIVE SYSTEM CONTROL DESIGN USING FUZZY LOGIC THEORY FOR AN AIR TO GROUND MISSILE

S. Saeedy
saeedsaeedi.eng@gmail.com
S. H. Sadati(corresponding author)
hsadati@hotmail.com
M.A.Shahi Ashtiani
ma_shahi@yahoo.com

S.A. Hosseini
hosseini.mechanic@gmail.com
M. Maerefat(corresponding author)
marefat@modares.ac.ir
A. Zolfaghari
alireza.zolfaghari@yahoo.com
Dept. of Mechanical Engineering
Tarbiat Modares University

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 39-46, Original Article

- Received 11 September 2011; received in revised form 24 June 2012; accepted 14 July 2012.

Abstract

Radiant ceiling cooling (RCC) systems have gradually attracted the attention of HVAC engineers because of the possibility of providing good thermal comfort conditions without the need for large energy consumption. It should be mentioned that the RCC systems are constructed from flat ceiling-mounted radiant panels with a high absorption coefficient. In these systems, the chilled water is passed through the cooper tubes and causes the panel temperature to decrease. Although the RCC systems have many advantages, like high thermal efficiency, by providing good thermal comfort conditions, the performance of these systems can be limited by the condensation of water vapor on the chilled ceiling. Therefore, radiant ceiling cooling systems may be impracticable in hot and humid climates.

The main aim of this study is to analysis the performance of the RCC systems at the vicinity of dew point temperature and under conditions wherein the risk of condensation is very high. For this purpose, the average value of condensation rate in a wide range of temperature and relative humidity has been numerically calculated by developing a CFD code for simulating heat and mass transfer over the chilled panel. The mentioned CFD code can solve four main governing equations; continuity, momentum, energy and concentration equations, by the finite-difference technique. Results indicate that air speed, dew point temperature and surface temperature of the chilled panel are the most effective parameters to affect the condensation rate on the chilled panel. After finding these important parameters, a simple, non-differential correlation has been proposed by linear regression on the basis of the mentioned effective parameters. The correlation has been defined using the analogy between the heat and mass transfer phenomena. The correlation has been verified in two different ways. First, by comparing the dimensionless velocity profile inside the boundary layer with the similar analytical solution, and second, by comparing the results of the correlation with a mass transfer correlation proposed by Robert E. Treybal, in 1981. Both validations show very good agreement between the mentioned comparative results. Therefore, the mentioned simple correlation can be extensively utilized for designing a radiant ceiling cooling system under various climactic conditions.

Key Words: Radiant ceiling cooling, condensation, applicable correlation.

NUMERICAL ESTIMATION OF WALL EFFECTS ON FLOW CHARACTERISTICS OF PITCHING AIRFOILS

A.R. Sanaeikia
sanaeikia.alireza@gmail.com
A.R. Jahangirian(corresponding author)
ajahan@aut.ac.ir
Dept. of Aerospace Engineering
Amirkabir University of Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 47-56, Original Article

- Received 25 September 2011; received in revised form 19 June 2012; accepted 6 November 2012.

Abstract

Implementing wind tunnel tests is still required for better understanding of the flow characteristics of aerodynamic shapes. The finite scales of wind tunnels usually lead to models smaller than their prototypes. Thus, in order to match the Reynolds Number, wind tunnel velocity should be increased. However, engineers prefer large models because increasing speed is not always possible. Enlarging models, compared to test section scales, may introduce higher experimental error. Different approaches for estimating these errors are given. But, in the range of oscillatory airfoils, there is not any well known method. The purpose of this study is to provide a numerical method for estimation of wind tunnel wall errors in the case of oscillating airfoil tests.

In this study, wall effects on the aerodynamic characteristics of a pitching airfoil have been numerically investigated. The unstructured mesh is used to discretize the flow field. In the vicinity of the airfoil surface, and up/down walls, boundary layer grids are used. By maintaining the quality of the grid, the grid moves with the movement of the airfoil. An edge-base data structure is used, in which fluxes are also calculated in an edge-by-edge manner. The governing equations are two-dimensional compressible Navier-Stokes equations.

gered arrangement, is numerically studied. The Navier-stokes and Brinkman-Forchheimer equations are used to model fluid flow in open and porous regions. The flow is assumed to be laminar. A finite volume based method, in conjunction with the SIMPLE algorithm, is used to solve the equations. The local thermal equilibrium model is adopted in the energy equation to evaluate solid and fluid temperatures. The effect of parameters, such as baffle height, baffle spacing, Reynolds number and thermal conductivity ratio between the porous baffles and the fluid, on the flow field and local heat transfer rate is analyzed at two values of Darcy number. Considering the effect of geometrical and physical characteristics of the porous baffles and flow parameters on the developing velocity profile and the local Nusselt number, it can be concluded that the developing length, as well as the value of fully developed Nusselt number, are affected by these parameters, while, in the case of conventional thermally developed duct flow, the Nusselt number is independent of these parameters.
The results indicate that the local heat transfer coefficient significantly depends on the formation and variation of the recirculation caused by the porous baffles, so that, in cases where use of porous baffles leads to a recirculation zone, the local Nusselt number in the entrance region is less than that of the fully developed region. It is also shown that the heat transfer performance ratio is significantly improved for high Prandtl number fluids.

Key Words: Fluid flow, heat transfer, porous baffle, local thermal equilibrium, Nusselt number.

NUMERICAL SIMULATION OF CHAOTIC BEHAVIOR IN DOUBLE PENDULUM WITH MOVING PIVOT

S.E. Razavi
razavi@tabrizu.ac.ir
F. Ghaderi(corresponding author)
ghaderi67@yahoo.com
Dept. of Mechanical Engineering
University of Tabriz

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 33-38, Original Article

- Received 23 August 2011; received in revised form 8 July 2012; accepted 6 August 2012.

Abstract
During recent decades, much attention has been paid to solving different kinds of dynamic systems, including pendulums, to observe their chaotic behavior. The governing equations of a double pendulum are investigated numerically in this paper. The pivot of the first pendulum is considered to be moving, following a certain mathematical template. Also, the pendulum, as a dynamic system, shows regular and chaotic behavior, under different conditions of its motion, such as initial angles and velocities (as the initial energy injected into the system), and the frequency of the pivot. The Lagrange equation governs this phenomenon. The proposed solution methods include the modified midpoint, along with fourth-order Runge-Kutta, to check the conditions for probable instability. The total value of the energy of the system is in the form of initial kinetic and potential energies. All numerical evaluations of the mathematical equations were coded. To investigate the chaotic behavior, a three dimensional phase space diagram for characteristic parameters of the system was constructed. The energy of chaos onset for each value of the pivot frequency was obtained utilizing three procedures: 1) The Poincare map, which is a special section in the three-dimensional diagram of phase space, in which one of the system parameters is constant (the angle of the first pendulum with a vertical line is zero). For a regular system (not chaotic), points in the Poincare map are located in an imaginary circle with limited radius, and they do not exceed this circle, even at very large times, 2) Lyapunov characteristic exponents, which are the average exponential separation between the nearby phase space trajectories of system motion. A system with one or more positive Lyapunov characteristic exponents is known as chaotic, and 3) The bifurcation diagram for characteristic parameters that shows the period doubling of chaos. It is a form of transition from periodicity to chaos. From this diagram, the onset of chaos is detected. The results are obtained using three methods, which depict good agreement with each other. They indicate that the more the frequency of the moving pivot, the less the initial energy required by that system to become chaotic. Initial energy decrease, which is due to frequency increase, follows a regular style, except for the natural frequency of the system. It was found that the moving pivot of the double pendulum has a dominant effect on chaos onset under certain circumstances.

Key Words: double pendulum, Runge-Kutta, Lyapunov characteristic exponents, bifurcation diagram, Poincare section.

DEVELOPING A NEW APPLICABLE CORRELATION TO ESTIMATE CONDENSATION RATE ON RADIANT CEILING COOLING PANELS

rotational speed have minimum vibrations. Also, for air pad shape, circular and rectangular air pads have minimum vibrations.

Key Words: Ultra precision machining, air spindle, nanomachining, air pad, vibrations.

SIMULATION OF GRAVITATIONAL EFFECTS IN ONE-DIMENSIONAL OIL RESERVOIRS USING BLACK OIL MODEL AND DOMINANT WAVE METHOD

M. Moshiri
moshiri@mech.sharif.edu
M. T. Manzari(corresponding author)
mtmanzari@sharif.edu
School of Mechanical Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 11-20, Original Article

- Received 6 June 2011; received in revised form 10 December 2012; accepted 25 December 2012.

Abstract

Black oil model is widely used in simulation of oil reservoirs. In this model flow in porous media consists of three chemical components (oil, gas and water). These components can form at most three phases (liquid, vapor and aqua) which are homogeneous mixtures of components separated by fluid interfaces. The black oil model considers compressibility of fluids and mass transfer between vapor and liquid hydrocarbon phases. The black oil formulation used here is based on the Trangenstein and Bell (TB) matrix formulation. This formulation is particularly useful because it remains the same in both saturated (three-phase) and under-saturated (two-phase) cases. This formulation consists of a parabolic pressure equation together with a set of hyperbolic mass conservation equations for components. The mentioned system of equations is linearly degenerate due to complexity of flux functions which leads to singularity of Jacobian matrix.
When gravity effect is included in the governing equations, the non-convexity of flux functions is increased, and as a result, at some points the wave speed of system vanishes. Most of explicit methods for solving hyperbolic conservation equations encounter difficulties in such situations and produce non-physical expansion shocks which contradict second law of thermodynamics. To deal with this kind of expansion shocks, numerical methods use additional artificial diffusion. In this sense, methods with inherent additional dissipation like Rusanov-based central schemes are less prone to expansion shocks. However, these methods usually produce too much dissipation and cannot provide acceptable accuracy, especially near shocks. On the other side of spectrum, upwind methods can capture shocks and discontinuities with proper accuracy. These methods can however lead to expansion shocks more frequently than central schemes. Besides, the upwind methods require characteristics decomposition that is usually computationally costly.
In this paper, an improved numerical method, the so-called Dominant Wave method, is used to simulate flow in porous media using the black oil model. The numerical method is characterized as a one-wave method for which there is no need for characteristics decomposition. Moreover, the numerical method uses a finite volume flux approximation and is formulated as a Rusanov-based central type scheme.
In order to prevent expansion shocks, Harten's entropy correction is used. This correction adds artificial dissipation just at the points with nearly zero wave speed. In this work, a homogeneous, one-dimensional reservoir is used to study the performance of the dominant wave method in simulating saturated and under-saturated flows with and without gravitational effects.

Key Words: black oil model, gravity, system of conservation equations, dominant wave method, non-convexity, entropy correction.

NUMERICAL ANALYSIS OF FLUID FLOW AND HEAT TRANSFER IN A CHANNEL WITH POROUS BAFFLES

A. Davari
amin_davari_me@yahoo.com
M. Maerefat(corresponding author)
maerefat@modares.ac.ir
Dept. of Mechanical Engineering
Tarbiat Modares University

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 21-31, Original Article

- Received 27 June 2011; received in revised form 12 March 2012; accepted 15 July 2012.

Abstract

In the present study, analysis of fluid flow and heat transfer in the entrance and the periodically fully developed region of a channel with porous baffles in a stag-

Abstracts of Papers in English

STUDYING EFFECTIVE FACTORS ON AIR SPINDLE VIBRATIONS USING AIR PAD BEARING IN NANOMACHINING

M. Akhondzadeh(corresponding author)
m_akhondzadeh@iauahvaz.ac.ir
Dept. of Engineering
Islamic Azad University,Ahvaz Branch
M. Vahdati
vahdati@kntu.ac.ir
Dept. of Mechanical Engineering
K. N. Toosi University of Technology

Sharif Mechanical Engineering Journal
Volume 29, Issue 2, Page 3-9, Original Article

- Received 10 May 2011; received in revised form 23 May 2012; accepted 15 July 2012.

Abstract

The increasing demand for precision manufacturing of components for computers, electronics, nuclear energy and defence applications has caused the appearance of ultra precision machining processes. Ultra precision machines are made in order to create very fine and accurate products. The main features of ultra precision machine tools can be classified as: High loop stiffness, high thermal and mechanical stability, low vibration, and high precision axis of motion. Guide ways, air spindles and drive systems are important parts of ultra precision machine tools. The air spindle is an important element of the ultra precision machine tool, whose vibrations directly affect the quality of the work surface. In order to achieve nanometer accuracy, the low vibration of the air spindle is vital. Pressurized air is injected into the gap of the spindle in order to make it operative. Some of the parameters affecting air spindle vibrations are rotational speed, the air compression method, input hole diameter, air pad conditions, and air gap pressure, etc. In this study, the air pad shape, size, depth and number, and rotational speed have been experimentally investigated. 3 levels are selected for each parameter in experiments. Totally, 243 experiments have been committed. For accomplishing these experiments, air spindles were made using various production processes. The VibroTest 60 was used for studying air spindle vibrations. Then, experiment results were analyzed by the design of experiment, DOE, method. The results show that the spindles with 2 air pads of 300 mm2 area and 3 mm depth at low