which is a significant point in a practical large scale multi-agent system. It is important to note that in a moving frame with limited communication, agents cannot even recognize the forward direction. Every agent monitors the relative position of its neighbors; network configuration in its neighborhood is the only information available. Recognition of the forward direction depends on the distance and relative position of neighbors. According to the method, if an agent can define one of its neighbors as a leader, it will then show directional movements towards it. It means that the number of other agents and their attraction cannot prevent it from moving towards its leader. In order to prevent total disconnection, an additional algorithm prevents the agent from getting too far away from its following members. Note that every node does not necessarily show directional movement.

Key Words: Multi-agent, distributed control, passing through obstacles, squeezing maneuver, directed graph.

EXPERIMENTAL INVESTIGATION ON THE SOFTENING BEHAVIOR OF POLYACETAL UNDER CYCLIC AXIAL STRAIN-CONTROLLED LOADING

M. Shariati(corresponding author)
mshariati44@um.ac.ir
Dept. of Mechanical Engineering
Ferdowsi University of Mashhad
H. Yarahmadi
hossein128@gmail.com
Dept. of Mechanical Engineering
Shahrood University of Technology
K. Kolasangiani
kamal.kolasangiani@stu.um.ac.ir
Dept. of Mechanical Engineering
Ferdowsi University of Mashhad

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 117-125, Research Note

- Received 12 June 2013; received in revised form 6 October 2013; accepted 10 November 2013.

Abstract

In this paper, the softening behavior of polyacetal (POM) under strain-controlled cyclic axial loading is studied. All experimental tests were performed in four groups with different ratios of minimum to maximum strains by a servo-hydraulic INSTRON 8802 machine, to a specified number of cycles. The system was attached to a computer for test control, as well as for data acquisition. For each selected loading cycle, the computer acquired 100 data points per cycle, and those data can be used for further analysis. In these tests, quantitative parameters of mean stress, stress range, slope of stress-strain hysteresis loops, dissipated strain energy density, and elastic strain energy density amplitude have been investigated. The mechanical properties of specimens were determined according to simple ten sion and compression tests. It is observed that there is different behavior in compression and tension for polyacetal. Under displacement control loading, softening behavior is observed. The results showed that relaxation of mean stress was negligible under cyclic loading with zero mean strain, and due to positive mean strain, the rate of relaxation of mean stress increased. Minimum compressive strain caused the stress range to be steady, and the rate of stress range became zero. Dissipated strain energy density and elastic strain energy density amplitudes have been stabilized with an increasing number of cycles for all types of loading. Also, dissipated strain energy density under tension-compression cyclic loading is higher than that under tension cyclic loading. The hysteresis loop slope is the gradient of the line that connects the extreme points of the hysteresis loop together. At the same ratio of minimum to maximum strain, the hysteresis loop slope is lower at any cycle for higher strain amplitude and higher mean strain. Also, it is observed that the maximum rate of hysteresis loop slope occurs under symmetric displacement control loading, with the ratio of minimum to maximum strain equal to -1.

Key Words: Polyacetal, softening behavior, cyclic axial loading, dissipated strain energy.

PASSING THROUGH NARROW GATES FOR A MULTI-AGENT SYSTEM

S. Etemadi
setemadi@srbiau.ac.ir
Dept. of Mechanical and Aerospace Engineering
Science and Research Branch
Islamic Azad University
A. Alasty(corresponding author)
aalasti@sharif.edu
Department of Mechanical Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 127-135, Research Note

- Received 23 June 2013; received in revised form 6 January 2014; accepted 26 January 2014.

Abstract

In practice, agents of a multi-agent system usually access local information. In a real world example, agents must be able to move through obstacles while the connectivity of the group is maintained. Moving through obstacles needs network flexibility, in which, in an undirected network graph, unnecessary inter-agent connections must be ignored; this needs consensus between agents. In order to reach such a consensus, every agent needs information regarding its neighbors, or, at least, the neighbors of neighbors. Assuming a large scale multi-agent system, the huge amount of information exchange in a network is a serious problem. In this paper, an undirected network graph is presented, which is capable of switching to a directed graph, if needed. Nodes in this graph can perform directional movements, while they only use very local data. Hence, for moving through narrow gates, the network shows considerable flexibility. Since, in this method, decisions are only made based on every agent's local data, data traffic will not occur,

Six different types of MLPG method were introduced on the basis of different test functions. The MLPG1 is one of the most common meshless methods used to solve different types of engineering problem. In 2012, a new unified MLPG method was also introduced to solve elastostatic problems. Using this new method, four common types of MLPG can be approached, and may unify the various kinds of MLPG.

In this paper, for the first time, the new unified MLPG method is used to analyze the FGM cracked plate. The stress intensity factor of Mode I and Mode II is determined under the influence of various non-homogeneity ratios, crack lengths and material gradation angles.

In this method, both the moving least square (MLS) and direct methods have been applied to estimate the shape function and to impose the essential boundary conditions. The enriched weight function method is used to simulate the displacement and stress field around the crack tip. Normalized stress intensity factors are calculated using the path independent integral, J*, which is formulated for the non-homogeneous material. The FGM edge-cracked plate is considered here and analyzed under uniform membrane and uniform fixed grip conditions with the new MLPG method, and the results compared with common MLPG1 and the exact solution.

With this new method, results show higher accuracy compared to MLPG1. The present method may thus be substituted for common MLPG approaches to solve such problems.

Key Words: Unified meshless local Petrov-Galerkin (UMLPG), functionally graded material (FGM), mixed-mode stress intensity factor.

NEW APPROACH FOR MULTIDISCIPLINARY DESIGN OPTIMIZATION OF ENGINEERING SYSTEMS IN DESIGN OFFICES BASED ON COLLABORATIVE OPTIMIZATION

J. Roshanian
roshanian@kntu.ac.ir
H. Darabi(corresponding author)
hdarabi@dena.kntu.ac.ir
Dept. of Aerospace Engineering
K. N. Toosi University of Technology
H. Zare
h_zare@ae.sharif.ir
Dept. of Aerospace Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 107-115, Research Note

- Received 2 July 2013; received in revised form 4 January 2014; accepted 22 January 2014.

Abstract

Multidisciplinary design optimization (MDO), and its application for optimizing engineering systems in the form of design offices based on collaborative optimization, is undertaken in this research. In recent decades, the Multidisciplinary Design Optimization method has been developed for complex systems as a new field of engineering dealing with optimization methods and modern design. This methodology was first introduced in 1991, when Subisky wrote an inspiring article on multidisciplinary design optimization as a new design method capable of meeting the needs of the designer. Thus, the Subisky article can be seen as the starting point in application of multidisciplinary design optimization to engineering problems. and is still referred to in the majority of scholarly articles, The variety of disciplines involved in engineering design, especially in the aerospace industry, along with intense competition in the international marketplace, has forced designers to employ multidisciplinary design methods, and to give more attention to optimization as an inevitable necessity in today's engineering design. Multidisciplinary design optimization is of vast scope, covering all design optimization methods, sensitivity analysis, approximate concepts, data processing and management methods, and strategies, addressing multiple disciplines and the interrelationships between them in an integrated design structure. One of the various multidisciplinary optimization methods is the collaborative optimization method. This is a multi-level optimization method which first separates the problems into two distinct levels, according to the disciplines involved, and then solves them. This method solves an engineering problem, called the optimum design of a Speed Reducer gear unit, and provides a problem analyzing method, a problem optimization procedure at discipline level, and problem optimization at the system level. Also, it is illustrated that this method is an appropriate technique for solving complicated problems with large design space. These include problems introduced in the aerospace industry in the form of design offices and their division into related disciplines. The purpose of this article is to elaborate on the method in question, including the way it is used in the work cycle of design offices, and demonstrate, via an actual problem solving procedure, how it can be employed to solve complicated engineering problems.

Key Words: Optimization, multidisciplinary design optimization, collaborative optimization.

through a generic packed bed involving adsorbent particles of constant surface pressure which is a subject for further investigation.

Key Words: Lattice Boltzmann method, pressure boundary condition, extrapolation, equilibrium distribution function, non-equilibrium distribution function.

DESIGN AND ANALYSIS OF A WEARABLE REHABILITATION ROBOT FOR ANKLE JOINTS

H. Afshar(corresponding author)
homeiraa.afshar@gmail.com
F. Farahmand
farahmand@sharif.edu
S. Behzadipour
behzadipour@sharif.edu
Department of Mechanical Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 89-94, Research Note

- Received 16 April 2013; received in revised form 29 July 2013; accepted 18 August 2013.

Abstract

Stroke is the third leading cause of death worldwide, after cancer and cardiac diseases. Not only it can lead to death, but its secondary complications, such as paralysis, dysarthria, and cognitive disorders, are critical for the quality of life. It has been reported that more than 30 percent of stroke patients have trouble in walking, even 6 months after recovery. In order to restore the physical functionality of such patients, and in particular their capability for performing the activities of daily living, very tough rehabilitation procedures are often required. Rehabilitation robots can facilitate these procedures for both the patient and the physiotherapist.

The purpose of this research was to design a robot to facilitate the rehabilitation procedure of the ankle joint, in order to improve the efficacy of treatment, to lessen the time duration of the physiotherapy and to reduce the exhaustion level of the physiotherapist. In the design of the robot, two important ankle joint movements were considered; plantarflexion-dorsiflexion and eversion-inversion; also, the movement of the MTP joint was incorporated. Different mechanisms for performing these movements were analyzed and compared and, finally, the best was chosen as a cable driven mechanisms via electrical motors. Two active and passive functional modes, which have been suggested previously for rehabilitation robots, were defined as the working modes of the robot.

After performing the detailed design of the robot, its forward and inverse kinematics were analyzed. These analyses were required for different working modes of the robot, such as performing exercises or evaluating a patient. Simulation of the robot was conducted in MATLAB software, to predict how the desired motions would be performed in reality. In this simulation, both of lower limbs, with their muscles and joints, were included in the model. The results helped to predict the real working behavior of the robot. It was concluded that the robot has an acceptable level of efficacy and safety for being uses in different rehabilitation modes, e.g., active, and passive.

Key Words: Rehabilitation robots, ankle joint, gait cycle, plantarflexion-dorsiflexion, eversion-inversion.

NEW MLPG METHOD FOR STUDYING THE EFFECT OF MATERIAL GRADATION ANGLE ON MIXED-MODE SIF OF FG PLATES

A. Abdollahifar
abdollahifar@shirazu.ac.ir
M.R. Nami(corresponding author)
nami@shirazu.ac.ir
Dept. of Mechanical Engineering
Shiraz University

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 95-105, Research Note

- Received 11 may 2013; received in revised form 25 Septembaer 2013; accepted 23 November 2013.

Abstract

Functionally graded materials (FGMs) are a good solution for sharp interface problems between two dissimilar materials. These materials contain a continuous, or discontinuous, gradient in composition, which can be designed to meet specific needs while providing the best use of composite components. To solve FGM crack problems, the use of computational methods, such as FDM, FEM and MFree, is inevitable. The meshless local Petrov-Galerkin (MLPG) method is a truly meshfree method that has become of interest to many researchers in recent years.

Faculty of New Sciences and Technologies
University of Tehran

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 73-82, Original Article

- Received 3 September 2013; received in revised form 24 February 2014; accepted 8 April 2014.

Abstract

In this paper, a multi- linear cohesive zone model has been proposed for simulation of mode I delamination in laminated composites. This model considers the fracture process zone (FPZ) effects in the simulation of initiation and propagation of delamination. This model takes the spring elements with variable spring constants, according to the traction- separation curve of the specimen along the crack growth, to show the residual strength of the material in the FPZ. As a result of the existence of several types of toughening mechanism with different strain energy release rates, it is required to present a procedure which covers all the fracture process zone toughening events. Therefore, in this model, unlike previous ones and commercial codes, all the possible softening behavior of the traction-separation curve is taken into account. For simulation of toughening mechanisms in the FPZ, a finite element method has been chosen as a numerical method. The material outside the FPZ has been modeled with linear elastic behavior. Since the delamination phenomenon takes place between the plies, the crack propagation path is usually known in advance. In order to find the induced loads and relative displacements, a unit load is applied, and the corresponding system of equations has been solved in a step by step procedure. In order to simulate the multi-linearity of the cohesive zone model, several springs have been considered in the crack path and the calculation followed until the last spring in the FPZ shows the final breaking point of the traction-separation curve. At the end of each step, the spring constants will be changed based on the traction-separation curve of the specimen. The results of simulation are presented in the form of load-displacement curves that are in excellent agreement with available experimental results, and correctly show the softening behavior of the material after the failure initiation.

Key Words: Delamination, virtual crack model, fracture process zone, R-curve, toughening mechanism.

A NEW METHOD FOR PRESSURE BOUNDARY CONDITIONS IN THE LATTICE BOLTZMANN METHOD FOR DOMAINS WITH CURVED BOUNDARIES

M. Rahmani(corresponding author)
m_rahmani56@me.iut.ac.ir
M. Ashrafizaadeh
mahmud@cc.iut.ac.ir
Dept. of Mechanical Engineering
Isfahan University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 83-88, Research Note

- Received 6 November 2012; received in revised form 30 December 2013; accepted 11 January 2014.

Abstract

The Lattice Boltzmann model is an alternative kinetic based method, capable of solving hydrodynamics for various systems. Major advantages of this model lend themselves to the fact that the solution for particle distribution functions is explicit, easy to implement, and natural to be parallelized. Because the method uses a regular Cartesian lattice in space, implementation of the Dirichlet pressure boundary condition has always been a challenge for curved entities in Lattice Boltzmann simulations. The difficulty comes from the fact that the unknown boundary velocity cannot be determined on curved surfaces using common assumptions in the popular Zou-He scheme. The lack of a certain solution for flows having non-straight, constant pressure boundaries encourages the need to develop exact boundary conditions for such flows. In this paper, a method has been developed for imposing a pressure boundary condition for curved entities in the Lattice Boltzmann method. The proposed formulation is based on the so-called superposition interpolation scheme, where the unknown distribution functions of the boundary are divided into equilibrium and non-equilibrium parts. The equilibrium part is calculated based on the known value for the boundary density and the extrapolated value of the velocity. The non-equilibrium part is determined employing the bounce-back scheme. Finally, the unknown populations are corrected in such a way that the desired pressure is achieved on the surface. Fully developed flows in a 2-D channel and in a 2-D inclined channel with pressure boundary conditions at inlet and outlet are used to illustrate the accuracy of the scheme. The numerical results for the benchmark flows prove the second order accuracy of the proposed scheme. While the method is preliminarily established for 2D problems, its extension to 3D flows is quite straight forward and turns it into an efficient tool for simulating flows dealing with complex constant pressure geometries. One important industrial application of this new boundary condition is for flows

respect to clearance. It is predicted that higher pressure drop across the valve, and, to a lesser extent, the larger nozzle outer diameter, will result in improved sensitivity, while optimum inner nozzle diameter and the design point clearance are dependent on the level of drop in valve pressure. So, along with more restrictive valves, these two parameters should be chosen smaller, if higher accuracies are to be met. Provisions are also made for inlet pressure fluctuations and the gas reservoir.
Experiments are conducted on a single path of the circuit and also on a constant-flow nozzle. Nozzle pressure vs. distance was recorded, showing the same trend as predicted by simulations. Experiments demonstrate that sensitivity is improved at closer distances and with more gas consumption rates. Magnification of 20mm per micron is achieved at a distance range of 50-100 microns. Results were stable and repeatable. Feasibility of the application of this low-flow device to working distance adjustment in lithography was proven.

Key Words: Pneumatic sensor, lithography, flat nozzle, differential circuit.

EXPERIMENTAL AND NUMERICAL EVALUATION OF HEAT TRANSFER ENHANCEMENT IN TUBES WITH OBSTACLES IN TURBULENCE REGIMES

S. Vahidifar(corresponding author)
s_vahidifar@yahoo.com
M. Kahrom
mohsen.kahrom@yahoo.co.uk
M. Mamourian
mamourian@um.ac.ir
Dept. of Mechanical Engineering
Ferdowsi University of Mashhad

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 65-71, Original Article

- Received 16 September 2013; received in revised form 4 January 2014; accepted 22 January 2014.

Abstract
In the subject of heat transfer enhancement, there has been considerable interest in developing heat exchangers that have high efficiency, low cost, light weight, and the smallest size possible. So, energy prices and environmental considerations are being undertaken to support attempts to create a better performance than that of existing designs. The air side heat transfer coefficient is low, so, by enhancement of the boundary layer, it must be increased. The role of inserts in internal forced convection has been widely acknowledged as a passive device in heat transfer enhancement. The study follows the heat transfer enhancement caused by insersian of an obstacle into a boundary layer inside a horizontal tube. The flow of air is heated by electrical current. The presence of an obstacle was found to increase heat transfer, sometimes without inducing turbulence, but also increases pressure drop. The results demonstrate that the model could be a useful tool for optimization of heat exchanger performance in the presence of obstacles. The use of obstacle inserts leads to a considerable increase in heat transfer and pressure drop over the smooth tube. In this study, experimental and numerical heat transfer coefficients and friction in turbulent pipe flow were carried out with different obstacles. To evaluate the effect of barriers, air as fluid, with a Reynolds number range of 5000 to 20000, has been investigated. The mainstream barrier was stimulated with four cones, discs, rings and an O-ring to prevent cross, with the same (40%) barriers for various steps. The results show that O-rings with P/D=2 have the most effect on stimulation of the main flow and the increase in heat transfer. It is also shown that by increasing the Nusselt and friction factor average ratio, respectively, 2.6-3.2 and 20-22, that the overall enhancement efficiency performance increased 16% for Reynolds numbers above 12000; enhanced by stimulation of the mainstream. The numerical results agree well with experimental results.

Key Words: Heat transfer enhancement, convection heat transfer, pressure drop, turbulence flow.

SIMULATION OF INITIATION AND PROPAGATION OF MODE I DELAMINATION IN LAMINATED COMPOSITES CONSIDERING FRACTURE PROCESS ZONE EFFECTS

M.M. Shokrieh(corresponding author)
shokrieh@iust.ac.ir
Z. Daneshjoo
zdaneshjoo@mecheng.iust.ac.ir
Dept. of Mechanical Engineering
Iran University of Science and Technology
M. Fakoor
mfakoor@ut.ac.ir

IMPROVEMENT OF ARTICULATED HEAVY VEHICLES

R. Kazemi
kazemi@kntu.ac.ir
S. Azadi
azadi@kntu.ac.ir
N. Esmaeili(corresponding author)
nesmaeili@mail.kntu.ac.ir
Dept. of Mechanical Engineering
K. N. Toosi University of Technology
S. H. Tabatabaei Oreh
hamedtaba@yahoo.com
Dept. of Mechanical Engineering
Islamic Azad University, South Tehran Branch

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 41-53, Original Article

- Received 20 April 2013; received in revised form 27 October 2013; accepted 18 November 2013.

Abstract

An articulated heavy vehicle, in typical form, consists of two units that include a tractor and a semi-trailer. The tractor unit is controlled by the driver, and the trailer unit used to carry heavy freight is connected to the tractor unit through a mechanical coupling point called the fifth wheel. The commonly used performance measure that reflects the maneuverability capabilities of the articulated vehicle is called off tracking. It refers to the phenomenon where the rear end of the trailer unit does not closely follow the path of the tractor unit. It is important to note that the poor path-following ability increases safety concerns for the surrounding vehicle and destruction of road infrastructures. In this paper, a new method is presented to eliminate off-tracking, leading to the maneuverability improvement of the articulated heavy vehicle. A reference model generating a desired articulation angle is derived based on geometric and kinematic analysis. The tracking of the desired value ensures that the rear end of the semi-trailer unit follows the path of the fifth wheel. The inputs to the reference model are the yaw rate and the longitudinal and lateral velocity of the tractor unit, while the output is the desired articulation angle. A fuzzy controller is designed to adjust the articulation angle. The proposed controller makes the articulation angle follow the desired value by active semi-trailer steering. Furthermore, a controller is designed to adjust the tractor yaw rate through active steering of the tractor front wheels. A fourteen-degree of freedom vehicle model is developed in order to evaluate the proposed method. Computer simulations, including different maneuvers, show the significant effects of the proposed method on improving the maneuverability and stability of the articulated vehicle. Furthermore, the sensitivity of the method against errors in the input variables of the reference model is evaluated. The sensitivity analysis revealed that the proposed method is not so sensitive to errors in the variables. In low speed turning, the large error in tractor yaw rate has a major effect on system performance. However, yaw rate can be accurately measured by a typical sensor. Furthermore, the impact of different sizes of time increment on system performance is also evaluated.

Key Words: Articulated vehicle, off tracking, desired articulation angle,vehicle dynamics, semi trailer steering.

DESIGN AND FABRICATION OF A PNEUMATIC DISTANCE SENSOR FOR LASER AUTOFOCUS SYSTEMS

M. Behzadi(corresponding author)
behzadi_milad@yahoo.com
Dept. of Aerospace Engineering
Sharif University of Technology
R. Asadi
rasadi56@gmail.com
Dept. of Electrical and Electronic Engineering
Malek Ahtar University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 55-64, Original Article

- Received 10 June 2013; received in revised form 5 November 2013; accepted 2 December 2013.

Abstract

A distance sensing apparatus for use in autofocus systems of laser lithography is developed. A nozzle is placed a small distance away from the photo-resist and the inside gas pressure is used as a measure of clearance. A differential circuit is chosen which consists of a measurement path of gas and a bleed line, which is used as a reference. The flow pattern of the main part, i.e. the nozzle, is explored via computational fluid dynamics, and it is shown that pressure loss in the cylindrical space between the nozzle and the sheet dominates. Moreover, available empirical correlation is shown to be valid, even in the presence of an objective lens inside the nozzle.
The governing equations of all components of the circuit, including the nozzle and the valves, are solved simultaneously, to yield operating pressures and flowrates. This provides a mathematical design tool that helps examine the influence of design parameters, particularly on accuracy and finding optimum values. Sensitivity is estimated by the derivative of differential pressure, with

learning rules are some features that play key roles in the quality of neural network training and generalizability, in order to model nonlinear systems. Furthermore, this paper seeks to particularly focus on applying evolutionary methods to optimize the parameters of recurrent neural networks, in order to improve the identification and modeling of aircraft nonlinear dynamics. The proposed method in this study is to apply MGA. In original genetic algorithms, genetic operators are regular seeded selection, elitism, random selection, crossover, and mutation, and the appropriate fitness function is the inversed mean squared error between the network output and target. In MGA, a new operator called mutation 2 is used. This operator randomly nullifies some weights and rules them out with a very small probability. Moreover, a penalty on non-zero weights (C) must be included in the fitness function to encourage the algorithm to reach a structure with a minimum number of connections. MGA improves generalization through zeroing unnecessary weights (or connections). MGA can additionally be used to simultaneously train and optimize three different types of recurrent neural network. To further validate this study, the reported results were compared with the recorded experimentally obtained data from a fourth-generation fighter aircraft. In conclusion, the results of training with the two methods applied in this study (modified and original genetic algorithms) clearly show that the simultaneous optimization of network architecture improves neural network generalization. This, of course, imposes a cost of longer computation time and an increased number of required generations to reach the desired mean squared error for in-sample data. Thus, the optimal network has better performance in the identification and modeling of aircraft nonlinear dynamics.

Key Words: Aircraft nonlinear dynamics, system identification, neural networks, optimization algorithm.

UPGRIDDING OF ABSOLUTE PERMEABILITY GEOLOGICAL MODELS USING THE QUADTREE DECOMPOSITION METHOD

S. Gholinezhad
s.gholinezhad@gmail.com
S. Jamshidi(corresponding author)
jamshidi.s@gmail.com
Dept. of Chemical and Petroleum Engineering
Sharif University of Technology
A. Hajizadeh
hajizadeh@gmail.com
University Technology Petronas, Malaysia

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 35-40, Original Article

- Received 6 April 2013; received in revised form 25 May 2013; accepted 8 June 2013.

Abstract
The process of upscaling is an active area of research, due to the advances made in geostatistical techniques, which allows reservoir properties, such as absolute permeability, to be described by more and more fine models. However, these detailed reservoir models cannot be used directly for numerical simulation because they require high amounts of time and memory storage capacity. As a consequence, it is necessary to coarsen detailed geological models to a scale more appropriate for reservoir simulation. The first step in upscaling is the upgridding of the original geological model. Once upgridding is completed, the reservoir properties are reassigned to the simulation grid using various property upscaling methods. An important issue in upscaling is that the upscaled model must maintain the essential heterogeneity details of the original geological model. Moreover, the flow characteristics of the upscaled and geological models must be the same.
In this study, a new and simple method for the upscaling of absolute permeability geological models is presented. This method, based on quadtree decomposition, upscales the geological model such that the grids of the upscaled model are unstructured. In other words, in the regions of the geological model where permeability variation is high, the grids of the upscaled model remain small, but, in regions where permeability is almost uniform, the grids of the upscaled model become large. So, this method reduces the total number of grids, and results in large savings of the time and memory required for flow simulations in the reservoir. The grids of the upscaled model have different sizes and each grid may be adjacent to several grids with several arrangements. Simulation of flow through such complex upscaled models is very hard. To solve this problem, we present a new method, in which, each side of all grids reduces the number of neighbors to a maximum of 2, and facilitates discretization of the flow equations.

Key Words: Upscaling, unstructured grids, quadtree decomposition, flow simulation.

A NEW METHOD FOR MANEUVERABILITY

rudder forces and moments relative to time consumption for boat simulation is negligible. The only problem when using this method is the accuracy of the rudder forces. The accuracy of equations used for rudder force calculations in the current research is investigated and the certainty of precision is gained.

Key Words: Rudder, lift, drag, pitch angle.

MULTI-OBJECTIVE OPTIMIZATION ON CONTROL PARAMETERS OF PARALLEL HYBRID VEHICLES EQUIPPED WITH FULL-TOROIDAL CVT USING PSO ALGORITHM

M. Delkhosh
m_delkhosh@mech.sharif.edu
M. Saadat Foumani(corresponding author)
m_saadat@sharif.ir
Dept. of Mechanical Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 15-21, Original Article

- Received 25 February 2013; received in revised form 5 October 2013; accepted 12 October 2013.

Abstract

In this paper, the objective is to optimize the control parameters of a parallel hybrid electric vehicle equipped with continuously variable transmissions (CVT) in SC03 driving cycle. At first, the impacts of using CVT instead of manual transmission on the fuel consumption (FC) of the vehicle are investigated, quantitatively. It is shown that by using CVT, the rotational speed of the engine is not limited by vehicle speed. Hence, the engine rpm can be determined to achieve minimum FC. Then, an algorithm is introduced to calculate the FC of the vehicle equipped with CVT, and the speed ratio of CVT is specified to minimize the vehicle FC. The model accuracy is investigated by comparing its results with manufacturer documents. An algorithm which is on the basis of a baseline static control strategy (BSC), is introduced to control the parallel hybrid electric vehicles. In this algorithm, the engine is the primary power generator, and the electric motor in conjunction with the battery, acts as an auxiliary power supply. By utilization of the introduced control algorithm, the FC of a vehicle equipped with a five-speed manual transmission is about 30% lower, compared to non-hybrid version of the vehicle. Finally, a multi-objective optimization is accomplished to minimize both FC and the battery capacity. To multi-objective optimize the control algorithm, a method similar to PSI was exploited. In this method, at each step, an upper bound for the battery capacity is defined as a constraint, and FC as the objective function is minimized. By gradually increasing the upper bound of the battery capacity and running the algorithm, the battery capacity of the optimized system and the vehicle FC, versus the upper bound of the battery capacity, is obtained. It is found that by using the optimized control algorithm, the FC of the vehicle equipped with CVT in the SC03 driving cycle is 35% lower, compared to the application of a five-speed manual transmission, and no optimized control algorithm.

Key Words: Parallel hybrid vehicle, power transmission, continuously variable transmission, control algorithm, driving cycle, multi-objective optimization.

SIMULTANEOUS OPTIMIZATION OF RECURRENT NEURAL NETWORK TO IMPROVE IDENTIFICATION AND MODELING OF AIRCRAFT NONLINEAR DYNAMICS

A. Roudbari(corresponding author)
alirezaroudbari@ae.sharif.edu
F.Saghafi
saghafi@sharif.edu
Dept. of Aerospace Engineering
Sharif University of Technolgy

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 23-34, Original Article

- Received 13 March 2013; received in revised form 11 December 2013; accepted 29 January 2014.

Abstract

In this paper, using the modified genetic algorithm (MGA) as an optimization method and combining it with neural networks, the nonlinear dynamics of a highly maneuverable aircraft has been modeled. Generalization has long been considered a dilemma in dynamic system identification, especially for dynamic systems with various possible inputs, like aerospace vehicles. Therefore, the focus of this paper is to obtain methods for improving generalization of neural network based aircraft models that are going to be used in aircraft simulators. Weighted connections, network architecture, and

Abstracts of Papers in English

RUDDER INFLUENCE MODELING IN NUMERICAL SIMULATION OF HIGH SPEED CRAFT

A. M. Hoseyni(corresponding author)
amin.mehdihoseyni@gmail.com
M. S. Seif
seif@sharif.edu
Dept. of Mechanical Engineering
Sharif University of Technology

Sharif Mechanical Engineering Journal
Volume 31, Issue 1, Page 3-13, Original Article

- Received 2 February 2013; received in revised form 14 July 2013; accepted 17 December 2013.

Abstract

Maneuvering capability is one of the most important aspects of a ship. The rudder is often used for maneuvering, and its dimensions, type and location must be designed correctly. In the first steps of design, similar boats can be used, but, in the final steps of design, exact dimensions must be assigned. A method for achieving this is a model test, which is precise but very costly. The use of numerical simulations, such as CFD, is another method. Its precision is high and it is not costly, but it does, however, have weaknesses in complicated geometries. Rudder simulation using meshing is a time consuming and more complex procedure. Consequently, we use meshing only for the hull, but rudder forces are added by experimental and numerical equations. Software created and developed by the CFD group of Sharif University of Technology Marine Laboratory, NUMELS, is used to solve the fluid domain. It is based on the finite volume method. After the solution process, cell velocity, body orientation and body linear velocity are used to compute rudder lift and drag. Finally, rudder forces and moments are added to the pressure, viscous forces and moments. After a six degree of freedom equation solution, angular and linear accelerations are achieved, and after computation of angular and linear velocities and body motions and orientations, simulation for the current time step finishes. This method of boat and rudder simulation is fast. Compared to simulation of boats without rudders, speed loss in the solution does not exist, because time consumption for computation of