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Linear stability analysis of cylindrical Rayleigh-Benard convection

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摘要: The instabilities and transitions of flow in a vertical cylindrical cavity with heated bottom, cooled top and insulated sidewall are investigated by linear stability analysis. The stability boundaries for the axisymmetric flow are derived for Prandtl numbers from 0.02 to 1, for aspect ratio A (A = H/R = height/radius) equal to 1, 0.9, 0.8, 0.7, respectively. We found that there still exists stable non-trivial axisymmetric flow beyond the second bifurcation in certain ranges of Prandtl number for A D 1, 0 : 9 and 0.8, excluding the A = 0.7 case. The finding for A = 0.7 is that very frequent changes of critical mode (azimuthal Fourier mode) of the second bifurcation occur when the Prandtl number is changed, where five kinds of steady modes m = 1, 2, 8, 9, 10 and three kinds of oscillatory modes m = 3, 4, 6 are presented. These multiple modes indicate different flow structures triggered at the transitions. The instability mechanism of the flow is explained by kinetic energy transfer analysis, which shows that the radial or axial shear of base flow combined with buoyancy mechanism leads to the instability results.
作者关键词: bifurcation; buoyancy-driven instability; convection in cavities
KeyWords Plus: VERTICAL CYLINDERS; NATURAL-CONVECTION; THERMOCONVECTIVE INSTABILITY; CIRCULAR-CYLINDER; PATTERN-FORMATION; FLUID LAYER; SCHEME; FLOWS
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Numerical study of the thunniform mode of fish swimming with different Reynolds number and caudal fin shape

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摘要: The hydrodynamics of a model-fish swimming in thunniform mode was studied numerically in this paper. A 'tuna'-like configuration and the undulating manner (the kinetics of swimming) were adopted from some references. The unsteady incompressible RANS equations were solved by an unsteady flow solver based on dynamic hybrid grids, which was developed by the authors in previous work. During the simulations, two typical turbulence models (SA-model and SST-model) were employed to investigate the turbulence effect, and compared with the 'laminar' case (switch off the turbulence models). The influence of Reynolds number was studied also. Numerical results demonstrate that the propulsion performance is better when considering turbulence models at higher Reynolds number, because the flow separation is relatively weaker than the 'laminar' cases. Furthermore, three types of caudal fin models were considered emphatically, including the popular crescent-shaped fin, a semicircle-shaped fin and a fan-shaped fin. Numerical results show that the crescent-shaped caudal fin is the most efficient when cruising, although the 'thrust' is relatively less. The main reason is that the energy loss in the lateral direction is less than those of the other two caudal fin models.
作者关键词: Dynamic hybrid mesh; Unsteady incompressible flow; Bio-fluid; Thunniform mode swimming; Caudal fin shape
KeyWords Plus: COMPUTATIONAL FLUID-DYNAMICS; LOCOMOTION; MECHANISMS; MESHES
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A Nonlinear Adaptive Beamforming Algorithm Based on Least Squares Support Vector Regression

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摘要: To overcome the performance degradation in the presence of steering vector mismatches, strict restrictions on the number of available snapshots, and numerous interferences, a novel beamforming approach based on nonlinear least-square support vector regression machine (LS-SVR) is derived in this paper. In this approach, the conventional linearly constrained minimum variance cost function used by minimum variance distortionless response (MVDR) beamformer is replaced by a squared-loss function to increase robustness in complex scenarios and provide additional control over the sidelobe level. Gaussian kernels are also used to obtain better generalization capacity. This novel approach has two highlights, one is a recursive regression procedure to estimate the weight vectors on real-time, the other is a sparse model with novelty criterion to reduce the final size of the beamformer. The analysis and simulation tests show that the proposed approach offers better noise suppression capability and achieve near optimal signal-to-interference-and-noise ratio (SINR) with a low computational burden, as compared to other recently proposed robust beamforming techniques.

作者关键词: adaptive beamforming; least-squares support vector regression (LS-SVR); sparsification; kernel function
KeyWords Plus: ROBUST CAPON BEAMFORMER; SPARSE APPROXIMATION; SIDELOBE CONTROL; MISMATCH PROBLEM; MACHINES; CONSTRAINT

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Global Stability Analysis of Flow Past Two Side-by-Side Circular Cylinders at Low Reynolds Numbers by a POD-Galerkin Spectral Method

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摘要: A proper orthogonal decomposition (POD) method is applied to the problem of a two-dimensional flow past two side-by-side circular cylinders. Based on the POD bases, which are constructed by a snapshot method, a low-dimensional model is established for representing two-dimensional incompressible Navier-Stokes equations. Coupled with the low-dimensional model, the Chiba method is used to analyze the global stability of the basic flow. Different bifurcation paths at three major regions are revealed, in good agreement with the available results by other methods. However, the computation amount in the POD method is low, which shows the availability and advantage of the POD method.
KeyWords Plus: LOW-DIMENSIONAL MODELS; WAKE
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A Class of Hybrid DG/FV Methods for Conservation Laws III: Two-Dimensional Euler Equations

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摘要: A concept of "static reconstruction" and "dynamic reconstruction" was introduced for higher-order (third-order or more) numerical methods in our previous work. Based on this concept, a class of hybrid DG/FV methods had been developed for one-dimensional conservation law using a "hybrid reconstruction" approach, and extended to two-dimensional scalar equations on triangular and Cartesian/triangular hybrid grids. In the hybrid DG/FV schemes, the lower-order derivatives of the piece-wise polynomial are computed locally in a cell by the traditional DG method (called as "dynamic reconstruction"), while the higher-order derivatives are re-constructed by the "static reconstruction" of the FV method, using the known lower-order derivatives in the cell itself and in its adjacent neighboring cells. In this paper, the hybrid DG/FV schemes are extended to two-dimensional Euler equations on triangular and Cartesian/triangular hybrid grids. Some typical test cases are presented to demonstrate the performance of the hybrid DG/FV methods, including the standard vortex evolution problem with exact solution, isentropic vortex/weak shock wave interaction, subsonic flows past a circular cylinder and a three-element airfoil (30P30N), transonic flow past a NACA0012 airfoil. The accuracy study shows that the hybrid DG/FV method achieves the desired third-order accuracy, and the applications demonstrate that they can capture the flow structure accurately, and can reduce the CPU time and memory requirement greatly than the traditional DG method with the same order of accuracy.
KeyWords Plus: DISCONTINUOUS GALERKIN METHOD; FINITE VOLUME METHOD; ESSENTIALLY NONOSCILLATORY SCHEMES; NAVIER-STOKES EQUATIONS; HIGH-ORDER ACCURATE; ONE-DIMENSIONAL SYSTEMS; HERMITE WENO SCHEMES; UNSTRUCTURED GRIDS; ELEMENT-METHOD; HYPERBOLIC SYSTEMS
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研究方向: Physics

Applications of dynamic hybrid grid method forthree-dimensional moving/deforming boundary problems

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摘要: In the previous work, the authors had developed a dynamic hybrid grid generation method and an unsteady flow solver for two-dimensional incompressible and compressible unsteady flows with moving or morphing boundary. In this paper, the dynamic hybrid grid generation method and the unsteady flow solver are extended to three-dimensional complex geometries with moving and/or deforming boundaries, and coupled with force and moment calculation, and the integration of the rigid body, six degrees-of-freedom (6DOF) equations of motion. In order to enhance the flexibility and efficiency of moving grid generation, the dynamic hybrid grid method combines the 'Delaunay graph' mapping approach, node relaxation based on 'spring' analogy and local re-meshing strategy. Firstly, the prism/tetrahedral/Cartesian hybrid grids are adopted to discrete the initial computational domain over complex configurations. Once the bodies move or deform, the grid points in the boundary layer of the moving/morphing bodies are moved firstly with a modified advancing-layer method, the grid points in the outer far-field keep stationary, while the grid points between the last layer of body-fitted grids and the internal boundary of the specified far-field are mapped by the 'Delaunay graph' mapping method. But the background grids (the Delaunay graph) themselves are deformed by the simple node relaxation based on 'spring' analogy to improve the efficiency. Then the quality of the deformed grids is checked with some criteria. If the deformed grids do not pass the checking step, a local re-meshing procedure is carried out. Based on the dynamic hybrid grids, a parallel implicit finite-volume flow solver for 3D unsteady Navier-Stokes equations is developed also. In order to deal with the problems of multi-body separation, the integration of the rigid body, 6DOF equations of motion is coupled in the same framework of the flow solver. The applications for complex 3D morphing configurations demonstrate the robustness and efficiency of present method. (C) 2012 Elsevier Ltd. All rights reserved.
KeyWords Plus: UNSTRUCTURED GRIDS; FLOW COMPUTATIONS; EULER EQUATIONS; SIMULATION; GENERATION; ALGORITHM; MESHES; SOLVER
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Aerodynamic Modeling and Parameter Estimation from QAR Data of an Airplane Approaching a High-altitude Airport

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摘要: Aerodynamic modeling and parameter estimation from quick accesses recorder (QAR) data is an important technical way to analyze the effects of highland weather conditions upon aerodynamic characteristics of airplane. It is also an essential content of flight accident analysis. The related techniques are developed in the present paper, including the geometric method for angle of attack and sideslip angle estimation, the extended Kalman filter associated with modified Bryson-Frazier smoother (EKF-MBF) method for aerodynamic coefficient identification, the radial basis function (RBF) neural network method for aerodynamic modeling, and the Delta method for stability/control derivative estimation. As an application example, the QAR data of a civil airplane approaching a high-altitude airport are processed and the aerodynamic coefficient and derivative estimates are obtained. The estimation results are reasonable, which shows that the developed techniques are feasible. The causes for the distribution of aerodynamic derivative estimates are analyzed. Accordingly, several measures to improve estimation accuracy are put forward.

作者关键词: civil airplane; aerodynamics; QAR data; aerodynamic modeling; aerodynamic parameter estimation; flight safety; EKF-MBF method; neural network

KeyWords Plus: SYSTEM-IDENTIFICATION; NEURAL-NETWORKS; AIRCRAFT

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Thermodynamic analysis of a transcritical CO_2 power cycle driven by solar energy with liquified natural gas as its heat sink

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摘要: This paper proposes a transcritical CO_2 power cycle driven by solar energy while utilizing the cold heat rejection to an liquified natural gas (LNG) evaporation system. In order to ensure a continuous and stable operation for the system, a thermal storage system is introduced to store the collected solar energy and to provide stable power output when solar radiation is insufficient. A mathematical model is developed to simulate the solar-driven transcritical CO_2 power cycle under steady-state conditions, and a modified system efficiency is defined to better evaluate the cycle performance over a period of time. The thermodynamic analysis focuses on the effects of some key parameters, including the turbine inlet pressure, the turbine inlet temperature and the condensation temperature, on the system performance. Results indicate that the net power output mainly depends on the solar radiation over a day, yet the system is still capable of generating electricity long after sunset by virtue of the thermal storage tank. An optimum turbine inlet pressure exists under given conditions where the net power output and the system efficiency both reach maximum values. The net power output and the system efficiency are less sensitive to the change in the turbine inlet temperature, but the condensation temperature exerts a significant influence on the system performance. The surface area of heat exchangers increases with the rise in the turbine inlet temperature, while changes in the turbine inlet pressure have no significant impact on the heat exchanging area under the given conditions.

作者关键词: Carbon dioxide; Liquified natural gas; Solar energy; Thermodynamic cycle
KeyWords Plus: SUPERCRITICAL CARBON-DIOXIDE; ORGANIC RANKINE-CYCLE; PERFORMANCE; SYSTEM

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A class of hybrid DG/FV methods for conservation laws I:Basic formulation and one-dimensional systems

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摘要: By comparing the discontinuous Galerkin (DG) and the finite volume (FV) methods, a concept of 'static reconstruction' and 'dynamic reconstruction' is introduced for high-order numerical methods. Based on the new concept, a class of hybrid DG/FV schemes is presented for one-dimensional conservation law using a 'hybrid reconstruction' approach. In the hybrid DG/FV schemes, the lower-order derivatives of a piecewise polynomial solution are computed locally in a cell by the DG method based on Taylor basis functions (called as 'dynamic reconstruction'), while the higher-order derivatives are re-constructed by the 'static reconstruction' of the FV method, using the known lower-order derivatives in the cell itself and its adjacent neighboring cells. The hybrid DG/FV methods can greatly reduce CPU time and memory required by the traditional DG methods with the same order of accuracy on the same mesh, and they can be extended directly to unstructured and hybrid grids in two and three dimensions similar to the DG and/or FV methods. The hybrid DG/FV methods are applied to one-dimensional conservation law, including linear and non-linear scalar equation and Euler equations. In order to capture the strong shock waves without spurious oscillations, a simple shock detection approach is developed to mark 'trouble cells', and a moment limiter is adopted for higher-order schemes. The numerical results demonstrate the accuracy, and the super-convergence property is shown for the third-order hybrid DG/FV schemes. In addition, by analyzing the eigenvalues of the semi-discretized system in one dimension, we discuss the spectral properties of the hybrid DG/FV schemes to explain the super-convergence phenomenon.

作者关键词: Discontinuous Galerkin method; Finite volume method; Reconstruction; Hybrid method
KeyWords Plus: DISCONTINUOUS GALERKIN METHOD; FINITE VOLUME METHOD; NAVIER-STOKES EQUATIONS; ESSENTIALLY NONOSCILLATORY SCHEMES; HERMITE WENO SCHEMES; UNSTRUCTURED GRIDS; ELEMENT-METHOD; COMPRESSIBLE FLOWS; MESHES; LIMITERS

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A class of hybrid DG/FV methods for conservation laws II: Two-dimensional cases

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摘要: By comparing the discontinuous Galerkin (DG) methods, the k-exact finite volume (FV) methods and the lift collocation penalty (LCP) methods, a concept of 'static reconstruction' and 'dynamic reconstruction' was introduced for higher-order numerical methods in our previous work. Based on this concept, a class of hybrid DG/FV methods was presented for one-dimensional conservation law using a 'hybrid reconstruction' approach. In the hybrid DG/FV schemes, the lower-order derivatives of the piecewise polynomial are computed locally in a cell by the traditional DG method (called as 'dynamic reconstruction'), while the higher-order derivatives are re-constructed by the 'static reconstruction' of the FV method, using the known lower-order derivatives in the cell itself and in its adjacent face neighboring cells. In this follow-up paper, the hybrid DG/FV schemes are extended onto two-dimensional unstructured and hybrid grids. The two-dimensional linear and non-linear scalar conservation law and Euler equations are considered. Some typical cases are tested to demonstrate the performance of the hybrid DG/FV method, and the numerical results show that they can reduce the CPU time and memory requirement greatly than the traditional DG method with the same order of accuracy in the same mesh.

作者关键词: Discontinuous Galerkin method; Finite volume method; Reconstruction; Hybrid method
KeyWords Plus: DISCONTINUOUS GALERKIN METHOD; FINITE VOLUME METHOD; ESSENTIALLY NONOSCILLATORY SCHEMES; NAVIER-STOKES EQUATIONS; ONE-DIMENSIONAL SYSTEMS; HIGH-ORDER ACCURATE; UNSTRUCTURED GRIDS; ELEMENT-METHOD; COMPRESSIBLE FLOWS; BASIC FORMULATION

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Web of Science 类别: Computer Science, Interdisciplinary Applications; Physics, Mathematical
研究方向: Computer Science; Physics

Flight Characteristics Analysis Based on QAR Data of a Jet Transport During Landing at a High-altitude Airport

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摘要: Flight data of a twin-jet transport aircraft in revenue flight are analyzed for potential safety problems. Data from the quick access recorder (QAR) are first filtered through the kinematic compatibility analysis. The filtered data are then organized into longitudinal-and lateral-directional aerodynamic model data with dynamic ground effect. The dynamic ground effect requires the radio height and sink rate in the models. The model data are then refined into numerical models through a fuzzy logic algorithm without data smoothing in advance. These numerical models describe nonlinear and unsteady aerodynamics and are used in nonlinear flight dynamics simulation. For the jet transport under study, it is found that the effect of crosswind is significant enough to excite the Dutch roll motion. Through a linearized analysis in flight dynamics at every instant of time, the Dutch roll motion is found to be in nonlinear oscillation without clear damping of the amplitude. In the analysis, all stability derivatives vary with time and hence are nonlinear functions of state variables. Since the Dutch roll motion is not damped despite the fact that a full-time yaw damper is engaged, it is concluded that the design data for the yaw damper is not sufficiently realistic and the contribution of time derivative of sideslip angle to damping should be considered. As a result of nonlinear flight simulation, the vertical wind acting on the aircraft is estimated to be mostly updraft which varies along the flight path before touchdown. Varying updraft appears to make the descent rate more difficult to control to result in a higher g-load at touchdown.
作者关键词: jet transport; unsteady aerodynamics; nonlinear aerodynamics; flight dynamics; flight safety; quick access recorder data
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Assessment of Two Turbulence Models and Some Compressibility Corrections for Hypersonic Compression Corners by High-order Difference Schemes

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摘要: The Spalart-Allmaras (S-A) turbulence model, the shear-stress transport (SST) turbulence model and their compressibility corrections are revaluated for hypersonic compression corner flows by using high-order difference schemes. The compressibility effect of density gradient, pressure dilatation and turbulent Mach number is accounted. In order to reduce confusions between model uncertainties and discretization errors, the formally fifth-order explicit weighted compact nonlinear scheme (WCNS-E-5) is adopted for convection terms, and a fourth-order staggered central difference scheme is applied for viscous terms. The 15 degrees and 34 degrees compression corners at Mach number 9.22 are investigated. Numerical results show that the original SST model is superior to the original S-A model in the resolution of separated regions and predictions of wall pressures and wall heat-flux rates. The capability of the S-A model can be largely improved by blending Catris' and Shur's compressibility corrections. Among the three corrections of the SST model listed in the present paper, Catris' modification brings the best results. However, the dissipation and pressure dilatation corrections result in much larger separated regions than that of the experiment, and are much worse than the original SST model as well as the other two corrections. The correction of turbulent Mach number makes the separated region slightly smaller than that of the original SST model. Some results of low-order schemes are also presented. When compared to the results of the high-order schemes, the separated regions are smaller, and the peak wall pressures and peak heat-flux rates are lower in the region of the reattachment points.
作者关键词: aerodynamics; high-order weighted compact nonlinear scheme; hypersonic compression corners; turbulence models; compressibility corrections; shock/boundary layer interactions; shock waves
KeyWords Plus: COMPACT NONLINEAR SCHEMES; FLOWS
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研究方向: Engineering

Unsteady aerodynamics modeling for flight dynamics application

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摘要: In view of engineering application, it is practicable to decompose the aerodynamics into three components: the static aerodynamics, the aerodynamic increment due to steady rotations, and the aerodynamic increment due to unsteady separated and vortical flow. The first and the second components can be presented in conventional forms, while the third is described using a one-order differential equation and a radial-basis-function (RBF) network. For an aircraft configuration, the mathematical models of 6-component aerodynamic coefficients are set up from the wind tunnel test data of pitch, yaw, roll, and coupled yaw-roll large-amplitude oscillations. The flight dynamics of an aircraft is studied by the bifurcation analysis technique in the case of quasi-steady aerodynamics and unsteady aerodynamics, respectively. The results show that: (1) unsteady aerodynamics has no effect upon the existence of trim points, but affects their stability; (2) unsteady aerodynamics has great effects upon the existence, stability, and amplitudes of periodic solutions; and (3) unsteady aerodynamics changes the stable regions of trim points obviously. Furthermore, the dynamic responses of the aircraft to elevator deflections are inspected. It is shown that the unsteady aerodynamics is beneficial to dynamic stability for the present aircraft. Finally, the effects of unsteady aerodynamics on the post-stall maneuverability are analyzed by numerical simulation.

作者关键词: Unsteady aerodynamics; High angle of attack; Mathematical model; Flight dynamics; Bifurcation analysis; Post-stall maneuver

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Web of Science 类别: Engineering, Mechanical; Mechanics

研究方向: Engineering; Mechanics

Large-scale wind turbine blade design and aerodynamic analysis

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摘要: Incorporating controlled elitism and dynamic distance crowding strategies, a modified NSGA-II algorithm based on a fast and genetic non-dominated sorting algorithm is developed with the aim of obtaining a novel multi-objective optimization design algorithm for wind turbine blades. As an example, a high-performance 1.5 MW wind turbine blade, taking maximum annual energy production and minimum blade mass as the optimization objectives, was designed. A 1/16-scale model of this blade was tested in a 12 m x 16 m wind tunnel and the experimental results validated the high performance. Moreover, both the computational fluid dynamics (CFD) method and a free-vortex method (FVM) were applied to calculating the aerodynamic performance, which was consistent with the experimental data. For completeness, the CFD and FVM were used to analyze the wake structure, and good and consistent results were obtained between them.

作者关键词: wind turbine; multi-objective optimization; wind tunnel test; CFD; free-vortex method
KeyWords Plus: PREDICTIONS; PERFORMANCE; AIRFOIL; MODEL

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Web of Science 类别: Multidisciplinary Sciences
研究方向: Science & Technology - Other Topics

Simulation of shock wave buffet and its suppression on an OAT15A supercritical airfoil by IDDES

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摘要: In the present paper, extremely unsteady shock wave buffet induced by strong shock wave/boundary-layer interactions (SWBLI) on the upper surface of an OAT15A supercritical airfoil at Mach number of 0.73 and angle of attack of 3.5 degrees is first numerically simulated by IDDES, one of the most advanced RANS/LES hybrid methods. The results imply that conventional URANS methods are unable to effectively predict the buffet phenomenon on the wing surface; IDDES, which involves more flow physics, predicted buffet phenomenon. Some complex flow phenomena are predicted and demonstrated, such as periodical oscillations of shock wave in the streamwise direction, strong shear layer detached from the shock wave due to SWBLI and plenty of small scale structures broken down by the shear layer instability and in the wake. The root mean square (RMS) of fluctuating pressure coefficients and streamwise range of shock wave oscillation reasonably agree with experimental data. Then, two vortex generators (VG) both with an inclination angle of 30 degrees to the main flow directions are mounted in front of the shock wave region on the upper surface to suppress shock wave buffet. The results show that shock wave buffet can be significantly suppressed by VGs, the RMS level of pressure in the buffet region is effectively reduced, and averaged shock wave position is obviously pushed downstream, resulting in increased total lift.
作者关键词: supercritical airfoil; vortex generator; shock wave buffet
KeyWords Plus: DETACHED-EDDY SIMULATION; TRANSONIC BUFFET; VORTEX GENERATORS; TURBULENCE MODELS; FLOWS; PREDICTION; SEPARATION; PROFILE
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Web of Science 类别: Physics, Multidisciplinary
研究方向: Physics

Multi-jack Single-drive Semi-flexible Nozzle Mechanism Design and Simulation

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摘要: In order to reduce the cost of wind tunnel construction, simplify the requirement of control, and increase the security in the operation of nozzle, the multi-jack single-drive semi-flexible nozzle is designed. Based on the planar linkage design theory, the movement of multi-jack semi-flexible nozzle with single drive organ was achieved by using the software of MATLAB. Furthermore, the rigid-flexible coupling kinematics simulation of multi-jack single-drive semi-flexible nozzle is done to testify the rationality of the mechanism design by using the software of ADAMS and PATRAN/NASTRAN. The comparisons of four Mach numbers show that the simulation surfaces have good agreements with the aerodynamics surfaces.
作者关键词: semi-flexible nozzle; planar linkage design; rigid-flexible coupling; mechanism design
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Web of Science 类别: Engineering, Manufacturing; Materials Science, Multidisciplinary
研究方向: Engineering; Materials Science

A Coupled Method of Laplace Transform and Legendre Wavelets for Lane-Emden-Type Differential Equations

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摘要: A coupled method of Laplace transform and Legendre wavelets is presented to obtain exact solutions of Lane-Emden-type equations. By employing properties of Laplace transform, a new operator is first introduced and then its Legendre wavelets operational matrix is derived to convert the Lane-Emden equations into a system of algebraic equations. Block pulse functions are used to calculate the Legendre wavelets coefficient matrices of the nonlinear terms. The results show that the proposed method is very effective and easy to implement.
KeyWords Plus: HOMOTOPY-PERTURBATION METHOD; VARIATIONAL ITERATION METHOD; SINGULAR IVPS; APPROXIMATE SOLUTION; ALGORITHM
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Web of Science 类别: Mathematics, Applied
研究方向: Mathematics

Study on the Similarity Criteria of Aircraft Structure Temperature/ Stress/Dynamic Response

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摘要: The performance parameters of thermal protection system are essential for the design and optimization of high-speed aircraft. The flight-ground conversion is a valid method to provide the effective support to the design of the thermal protection structure (TPS), because the performance data of TPS were generally obtained from wind tunnel test and should be conversed to the corresponding environment. In this paper, the similarity parameters of heat conduction and thermoelasticity equations are studied, the similarity criteria proposed, and the effectiveness of some of the similar parameters are calculated and analyzed. The research results indicated that wind tunnel test can be better designed using the proposed similarity criteria, and the data obtained from wind tunnel test can be modified more rational to accommodate the reality flight condition so as to improve the precision and the efficiency of wind tunnel experiment.
作者关键词: Wind Tunnel Test; Hypersonic Flow; Heat Transfer; Thermal Stress; Similarity Criteria
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Web of Science 类别: Thermodynamics
研究方向: Thermodynamics

KINEMATICS AND DYNAMICS ANALYSIS OF A HIGH-SPEED PARALLEL MECHANISM

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摘要: This paper introduced the design of a 6-DOF high-speed parallel mechanism for the wind tunnel tests, with the particular focus on analysis of the kinematic and dynamic factors. It starts with kinematics analysis to the mechanism to get the positive and inverse kinematics equation, followed by the use of Lagrange's equation combined with a simplified model of the dynamics modeling approach to build a rigid kinetic equation. The next step comes to a comprehensive analysis of the constraints to determine the structural parameters of the mechanism. Rod and the moving platform are given the discretized sampling to complete the flexible dynamics simulation, from which the rigid analysis results are compared to obtain the dynamic characteristics. Under such constraints as ball joints, the calculation is made on the attitude workspace. Finally, the parallel mechanism under the actual operation with the measurement results show that the mechanism is effective in achieving the single and multi degree oscillatory motions, which is featured in a large work space, high-precision and high-speed rate, also highlighted by higher kinematic performance.
作者关键词: Parallel mechanism; Kinematics; Flexible dynamic; High-speed; Wind tunnel test
KeyWords Plus: MANIPULATOR; ROBOT
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Web of Science 类别: Metallurgy & Metallurgical Engineering
研究方向: Metallurgy & Metallurgical Engineering

CATALYTIC COMBUSTION OF n-C4H10 AND DME IN SWISS-ROLL COMBUSTOR WITH POROUS CERAMICS

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摘要: An experimental study on combustion in Swiss-roll combustor with Pt-coated catalyst porous ceramics was conducted. For n-butane/air or dimethyl ether (DME)/air mixtures, both extinction limits and temperature distributions on an external surface of combustor were determined. The experimental results show that the lean limits of the fuels were actually in fuel rich conditions, and the flammable range of DME is larger than that of n-butane at low Reynolds numbers. The component analysis for the exhaust gas showed that only catalytic reactions occurred in the combustor. The surface temperature distributions indicate that a reaction zone is always in the center region where the catalyst is placed.
作者关键词: DME; Extinction limits; n-C4H10; Pt catalyst; Swiss-roll combustor
KeyWords Plus: ELECTROSPRAYED LIQUID HYDROCARBONS; HEAT-RECIRCULATING COMBUSTORS; MESOSCALE POWER-GENERATION; SYSTEMS; FUEL; MICROBURNERS; EXTINCTION; MIXTURES; PLATINUM; BURNERS
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研究方向: Thermodynamics; Energy & Fuels; Engineering

Multi-symplectic methods for the Ito-type coupled KdV equation

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摘要: In this paper, we find that the Ito-type coupled KdV equation can be written as a multisymplectic Hamiltonian partial differential equation (PDE). Then, multi-symplectic Fourier pseudospectral method and multi-symlpectic wavelet collocation method are constructed for this equation. In the numerical experiments, we show the effectiveness of the proposed methods. Some comparisons between the proposed methods are also made with respect to global conservation properties.
作者关键词: Ito-type coupled KdV equation; Multi-symplectic; Fourier pseudospectral method; Wavelet collocation method
KeyWords Plus: HAMILTONIAN PDES; RUNGE-KUTTA; INTEGRATORS; SCHEMES
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