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Numerical Stability and Control Analysis Towards Falling Leaf Prediction Capabilities of Splitflow for Two Generic High-Performance Aircraft Models

Aerodynamic Design with Computational Software Stability in Aviation: An Introduction to Dynamical Stability as Applied to the Motions of Aeroplanes NASA Technical Note

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Cable Supported Bridges

Currently, the use of computational fluid dynamics (CFD) solutions is considered as the state-of-the-art in the modeling of unsteady nonlinear flow physics and offers an early and improved understanding of air vehicle aerodynamics and stability and control characteristics. This Special Issue covers recent computational efforts on simulation of aerospace vehicles including fighter aircraft, rotorcraft, propeller driven vehicles, unmanned vehicle, projectiles, and air drop configurations. The complex flow physics of these configurations pose significant challenges in CFD modeling. Some of these challenges include prediction of vortical flows and shock waves, rapid maneuvering aircraft with fast moving control surfaces, and interactions between propellers and wing, fluid and structure, boundary layer and shock waves. A additional topic of interest in this Special Issue is the use of CFD tools in aircraft design and flight mechanics. The problem with these applications is the computational cost involved, particularly if this is viewed as a brute-force calculation of vehicle’s aerodynamics through its flight envelope. To make progress in routinely using of CFD in aircraft design, methods based on sampling, model updating and system identification should be considered.

Application of Three Aeroservoelastic Stability Analysis Techniques

Results of a Parametric Aeroelastic Stability Analysis of a Generic X-wing Aircraft

Aerodynamic analysis are performed using the Lockheed-Martin Tactical Aircraft Systems (LMTAS) Splitflow computational fluid dynamics code to investigate the computational prediction capabilities for vortex-dominated flow fields of two different tailless aircraft models at large angles of attack and sideslip. These computations are performed with the goal of providing useful stability and control data to designers of high performance aircraft. Appropriate metrics for accuracy, time, and ease of use are determined in consultations with both the LMTAS Advanced Design and Stability and
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Control groups. Results are obtained and compared to wind-tunnel data for all six components of forces and moments. Moment data is combined to form a "falling leaf" stability analysis. Finally, a handful of viscous simulations were also performed to further investigate nonlinearities and possible viscous effects in the differences between the accumulated inviscid computational and experimental data. Charlton, Eric F. Langley Research Center

Modeling and Analysis of Large Amplitude Flight Maneuvers

Wind Turbine Airfoils and Blades

Aerodynamic design of aircraft presented with realistic applications, using CFD software. Tutorials, exercises, and mini-projects provided involve design of real aircraft. Using online resources and supplements, this text prepares last-year undergraduates and first-year graduate students for industrial aerospace design and analysis tasks.

Stability Analysis of the RFD-2 Flight Test Vehicle

Analytical methods for stability analysis of large amplitude aircraft motion have been slow to develop because many nonlinear system stability assessment methods are restricted to a state-space dimension of less than three. The proffered approach is to create regional cell-to-cell maps for strategically located two-dimensional subspaces within the higher-dimensional model statespace. These regional solutions capture nonlinear behavior better than linearized point solutions. They also avoid the computational difficulties that emerge when attempting to create a cell map for the entire state-space. Example stability results are presented for a general aviation aircraft and a micro-aerial vehicle configuration. The analytical results are consistent with characteristics that were discovered during previous flight-testing. Anderson, Mark R. Langley Research Center

NONLINEAR SYSTEMS; AERODYNAMIC STABILITY; SYSTEMS ENGINEERING; STABILITY TESTS; GENERAL AVIATION AIRCRAFT; FLIGHT TESTS

2018 AIAA IEEE Electric Aircraft Technologies Symposium (EATS)

The flow about the complete Hypersonic Applied Research Technology (HART) missile is simulated for inviscid, laminar, and turbulent conditions and Mach numbers from 2 to 6. An explicit, second-order-accurate, flux-difference-splitting algorithm is implemented and employed to solve the Navier-Stokes equations. The equations are solved using a finite-volume methodology. The aerodynamic and static-stability characteristics are investigated to determine if conventional supersonic missile configurations can be flown at Mach numbers higher than 5. The effects of nosetip blunting and boundary-layer condition are demonstrated. The structure of the flow near the fins is significantly affected by the turbulent transport of momentum in regions of blocked cross flow. Turbulence and the blockage phenomenon cause bleeding around the fin leading edges. Ultimately, this results in lower fin effectiveness and reduced static stability. The aerodynamic characteristics of the HART missile are predicted at Mach numbers beyond the experimental free-flight testing capabilities. The current predictions indicated that the pitching-moment
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coefficient decreases with increasing Mach number much less than previous numerical computations. The present results also suggest that the clipped-delta-fin configuration is stable beyond Mach 7.

Technical Abstract Bulletin

Distributed propulsion technology is one of the revolutionary candidates for future aircraft propulsion. In this book, which serves as the very first reference book on distributed propulsion technology, the potential role of distributed propulsion technology in future aviation is investigated. Following a historical journey that revisits distributed propulsion technology in unmanned air vehicles, commercial aircrafts, and military aircrafts, features of this specific technology are highlighted in synergy with an electric aircraft concept and a first-of-its-kind comparison between commercial and military aircrafts employing distributed propulsion arrangements. In light of propulsion-airframe integration and complementary technologies, such as boundary layer ingestion, thrust vectoring and circulation control, transpired opportunities and challenges are addressed in addition to a number of identified research directions proposed for future aircrafts. Moreover, a diverse set of distributed propulsion arrangements are considered. These include: small engines, gas-driven multi-fan architectures, turboelectric systems featuring superconductive and non-superconducting electrical machine technology, and electromagnetic fans. This book features contributions by the National Aeronautics and Space Administration (NASA) and the United States Air Force (USAF), and includes the first proposed official definition for distributed propulsion technology in subsonic fixed wing aircrafts.

Structural Engineering/earthquake Engineering

While performance ground vehicles run in a highly dynamic environment, aerodynamic evaluation through wind tunnel tests and the computer simulation analyses are mostly performed under static condition. Study of a coupling relationship between stability of the vehicles and influences of unsteady aerodynamics during the high-speed turns was conducted by the numerical analysis. Two vehicle models were subjected to study under simplified turn motions in the numerical domain by implementing with Eulerian based approach, and the unsteady aerodynamic forces and moments acting on the vehicles were predicted by transient flow solver utilizing Reynolds-Averaged Navier-Stokes equations and compared to the steady cases. A significant correlation between the cornering performance and effects of unsteady aerodynamics on the vehicle’s stability during the high-speed turns was suggested along with introducing Hypotheses. The unsteady feature of the aerodynamic forces is mainly proposed by altering the CP location due to flow separations and shedded vortices around the bodies. From this research, although no evidence was able to found for relative change in the CP location, the remarkable overshoots and phase lags were identified in the predicted unsteady aerodynamic forces, which were not observed in the steady cases. The external flow fields were examined in order to determine a correlation between the unsteady aerodynamic forces and the unsteady flow characteristics. Although some indications of the correlation were found near surface of the pressure recovery region around aft of the bodies, negative and low total pressures dominate the external flow field around the bodies due to bluff-body aerodynamics and high Reynolds numbers for the both time-
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averaged and transient cases. Under those circumstances, determination of the clear correlation has left the researcher huge challenge.

Wind-Excited Vibrations of Structures

Numerical Stability and Control Analysis Towards Falling-Leaf Prediction Capabilities of Splitflow for Two Generic High-Performance Aircraft Models

Slender structures, such as towers, masts, high-rise buildings and bridges, are especially prone to wind excited vibrations. The lectures show how the susceptibility of a structure to wind excited vibrations can be assessed in early stages of design and what measures are effective for control or avoidance of vibrations. The book will be a help for all dealing with dynamic response of structures.

Aircraft Aerodynamic Design with Computational Software

Stability in Aviation: An Introduction to Dynamical Stability as Applied to the Motions of Airplanes

A stability analysis and trend study for a balloon tethered in a steady wind are presented. The linearized, stability-derivative type analysis includes balloon aerodynamics, buoyancy, mass (including apparent mass), and static forces resulting from the tether cable. The analysis has been applied to a balloon 7.64 m in length, and the results are compared with those from tow tests of this balloon. This comparison shows that the analysis gives reasonable predictions for the damping, frequencies, modes of motion, and stability boundaries exhibited by the balloon. A trend study for the 7.64-m balloon was made to illustrate how the stability boundaries are affected by changes in individual stability parameters. The trends indicated in this study may also be applicable to many other tethered-balloon systems.

NASA Technical Note

Technical Data Digest

Stability and Control of Airplanes and Helicopters deals with aircraft flying qualities that determine the stability and control of airplanes and helicopters. It includes problems based on real aircraft, selected to represent the gamut from simple to complicated, and from conventional utility designs to futuristic research types. Many of these problems involve comparison of theory and experiment to demonstrate their mutual relationship. Comprised of 25 chapters, this book begins with a discussion on the aerodynamics of the component parts related to the lift and moment characteristics of an airplane, including wings and associated accessories; bodies such as fuselages, nacelles, and tip tanks; and control surfaces. The reader is then introduced to some mathematical techniques for linear differential equations; steady
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flight at different speeds; and stick force and control-free stability. Subsequent chapters focus on flaps and high-lift devices; power and compressibility effects; and the manner in which the aircraft responds to the application of control. Aerelasticity and longitudinal equations of motion are also examined. This monograph is intended for undergraduate and graduate students taking modern engineering courses.

An Introduction to Aerodynamic Stability

This book develops a full theory for hinged beams and degenerate plates with multiple intermediate piers with the final purpose of understanding the stability of suspension bridges. New models are proposed and new tools are provided for the stability analysis. The book opens by deriving the PDE’s based on the physical models and by introducing the basic framework for the linear stationary problem. The linear analysis, in particular the behavior of the eigenvalues as the position of the piers varies, enables the authors to tackle the stability issue for some nonlinear evolution beam equations, with the aim of determining the “best position” of the piers within the beam in order to maximize its stability. The study continues with the analysis of a class of degenerate plate models. The torsional instability of the structure is investigated, and again, the optimal position of the piers in terms of stability is discussed. The stability analysis is carried out by means of both analytical tools and numerical experiments. Several open problems and possible future developments are presented. The qualitative analysis provided in the book should be seen as the starting point for a precise quantitative study of more complete models, taking into account the action of aerodynamic forces. This book is intended for a two-fold audience. It is addressed both to mathematicians working in the field of Differential Equations, Nonlinear Analysis and Mathematical Physics, due to the rich number of challenging mathematical questions which are discussed and left as open problems, and to Engineers interested in mechanical structures, since it provides the theoretical basis to deal with models for the dynamics of suspension bridges with intermediate piers. More generally, it may be enjoyable for readers who are interested in the application of Mathematics to real life problems.

Stability Analysis and Trend Study of a Balloon Tethered in a Wind, with Experimental Comparisons

ASTROP2-LE: A Mistuned Aeroelastic Analysis System Based on a Two Dimensional Linearized Euler Solver

Scientific and Technical Aerospace Reports

Bridge Maintenance, Safety, Management, Resilience and Sustainability contains the lectures and papers presented at The Sixth International Conference on Bridge Maintenance, Safety and Management (IABMAS 2012), held in Stresa, Lake Maggiore, Italy, 8-12 July, 2012. This volume consists of a book of extended abstracts (800 pp) and a DVD (4057 pp) co
Theoretical Investigation for Hydro-Quebec Into the Aerodynamic Stability of Bundled Power Line Conductors: Part II, Two-dimensional Stability Analysis for a Bundle of Four Conductors

This textbook is a collection of technical papers that were presented at the 10th International Symposium on Unsteady Aerodynamics, Aeroacoustics, and Aeroelasticity of Turbomachines held September 8-11, 2003 at Duke University in Durham, North Carolina. The papers represent the latest in state of the art research in the areas of aeroacoustics, aerothermodynamics, computational methods, experimental testing related to flow instabilities, flutter, forced response, multistage, and rotor-stator effects for turbomachinery.

Distributed Propulsion Technology

Wind Turbine Airfoils and Blades introduces new ideas in the design of wind turbine airfoils and blades based on functional integral theory and the finite element method, accompanied by results from wind tunnel testing. The authors also discuss the optimization of wind turbine blades as well as results from aerodynamic analysis. This book is suitable for researchers and engineers in aeronautics and can be used as a textbook for graduate students.

Unmanned Aircraft Design Techniques

Fourteen years on from its last edition, Cable Supported Bridges: Concept and Design, Third Edition, has been significantly updated with new material and brand new imagery throughout. Since the appearance of the second edition, the focus on the dynamic response of cable supported bridges has increased, and this development is recognised with two new chapters, covering bridge aerodynamics and other dynamic topics such as pedestrian-induced vibrations and bridge monitoring. This book concentrates on the synthesis of cable supported bridges, suspension as well as cable stayed, covering both design and construction aspects. The emphasis is on the conceptual design phase where the main features of the bridge will be determined. Based on comparative analyses with relatively simple mathematical expressions, the different structural forms are quantified and preliminary optimization demonstrated. This provides a first estimate on dimensions of the main load carrying elements to give in an initial input for mathematical computer models used in the detailed design phase. Key features: Describes evolution and trends within the design and construction of cable supported bridges Describes the response of structures to dynamic actions that have attracted growing attention in recent years Highlights features of the different structural components and their interaction in the entire structural system Presents simple mathematical expressions to give a first estimate on dimensions of the load carrying elements to be used in an initial computer input This comprehensive coverage of the design and construction of cable supported bridges provides an invaluable, tried and tested resource for academics and engineers.

Nonlinear Equations for Beams and Degenerate Plates with Piers
Computational Aerodynamic Modeling of Aerospace Vehicles

This report describes two types of instabilities encountered by the YF-16 airplane that were caused by a coupling between the active control system and structural dynamics. Three mathematical models of the airplane were evaluated to determine the degree of correlation between analysis and flight tests. These mathematical models are described as: (1) Truncated Mode Analysis Using GVT Modes; (2) Truncated Mode Analysis Using Computed Modes; and (3) Residual Flexibility Method Using Computed Modes. Stability was determined in the frequency domain by employing the Nyquist criteria and the determinant plot. A method is presented for computing indicial functions from oscillatory generalized aerodynamic terms obtained from any linearized aerodynamic theory. The equations for employing the indicial functions in a root locus stability analysis are presented. Stability was determined by the root locus method for the mathematical model described as the truncated mode analysis using computed modes. The degree of correlation between analysis and flight test is shown. Recommendations for analysis techniques, tests, and criteria are made.

NASA Scientific and Technical Publications

Numerical Investigation on Unsteady Aerodynamic Stability of Ground Vehicles During the Cornering Entry

The symposium will focus on electric aircraft technology across three programmatic tracks (1) electric power enabled aircraft configurations and system requirements, (2) enabling technologies for electric aircraft propulsion, and (3) electric aircraft system integration and controls.

Flight Dynamics Principles

In this edited book various novel approaches to problems of current interest in civil engineering are demonstrated. The topics range from dynamic band seismic problems to the analysis of long-span structures and ancient buildings. Experts associated within the Lagrange Laboratory present recent research results on functionally-graded or composite materials, granular materials, geotechnics, as well as frictional or adhesive contact problems.

An Aerodynamic Analysis of Saturn I, Block I Flight Test Vehicles

Provides a comprehensive introduction to the design and analysis of unmanned aircraft systems with a systems perspective. Written for students and engineers who are new to the field of unmanned aerial vehicle design, this book teaches the many UAV design techniques being used today and demonstrates how to apply aeronautical science concepts to their design. Design of Unmanned Aerial Systems covers the design of UAVs in three sections—vehicle design, autopilot design, and ground systems design—in a way that allows readers to fully comprehend the science behind the subject so that they can then demonstrate creativity in the application of these concepts on their own. It teaches students and engineers all about: UAV classifications, design groups, design requirements, mission planning, conceptual
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design, detail design, and design procedures. It provides them with in-depth knowledge of ground stations, power systems, propulsion systems, automatic flight control systems, guidance systems, navigation systems, and launch and recovery systems. Students will also learn about payloads, manufacturing considerations, design challenges, flight software, microcontroller, and design examples. In addition, the book places major emphasis on the automatic flight control systems and autopilots. Provides design steps and procedures for each major component Presents several fully solved, step-by-step examples at component level Includes numerous UAV figures/images to emphasize the application of the concepts Describes real stories that stress the significance of safety in UAV design Offers various UAV configurations, geometries, and weight data to demonstrate the real-world applications and examples Covers a variety of design techniques/processes such that the designer has freedom and flexibility to satisfy the design requirements in several ways Features many end-of-chapter problems for readers to practice Design of Unmanned Aerial Systems is an excellent text for courses in the design of unmanned aerial vehicles at both the upper division undergraduate and beginning graduate levels.

DYNAMICS OF FLIGHT

Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines

The theoretical and experimental determinations of the aerodynamic coefficients of the RFD-2 re-entry vehicle are presented. The resulting coefficients are incorporated into an aerodynamic analysis of the re-entry trajectory where the changes of configuration and the resultant changes in the physical and aerodynamic parameters of the vehicle are considered. Radar and camera-tracking data were obtained from the flight test which took place October 9, 1964. These experimental trajectory data correlated with the calculated trajectory within 400 feet of distance or 1 second of flight time throughout the re-entry flight.

Bridge Maintenance, Safety, Management, Resilience and Sustainability

The report presents the results of ballistics range and wind-tunnel measurements of the static force and moment and the pitch-damping, roll-damping and Magnus moments for a General Purpose 20-Millimeter Projectile. Data are presented for a Smooth and Basic configuration. These aerodynamic data are used in a special digital computer program to rapidly assess the stability of the projectiles over various mission profiles. The normal-force and pitching-moment derivatives are evaluated, theoretically, by Wood's method and compared with the measurements.

Pamětní list k 10. výročí práce Sboru skautů v Táboře 1919-1929

Computer Programs for Helicopter Aerodynamic Stability Evaluation
Aerodynamic and Static-Stability Analysis of the Hypersonic Applied Research Technology (HART) Missile

The study of flight dynamics requires a thorough understanding of the theory of the stability and control of aircraft, an appreciation of flight control systems and a grounding in the theory of automatic control. Flight Dynamics Principles is a student focused text and provides easy access to all three topics in an integrated modern systems context. Written for those coming to the subject for the first time, the book provides a secure foundation from which to move on to more advanced topics such as, non-linear flight dynamics, flight simulation, handling qualities and advanced flight control. About the author: After graduating Michael Cook joined Elliott Flight Automation as a Systems Engineer and contributed flight control systems design to several major projects. Later he joined the College of Aeronautics to research and teach flight dynamics, experimental flight mechanics and flight control. Previously leader of the Dynamics, Simulation and Control Research Group he is now retired and continues to provide part time support. In 2003 the Group was recognised as the Preferred Academic Capability Partner for Flight Dynamics by BAE SYSTEMS and in 2007 he received a Chairman's Bronze award for his contribution to a joint UAV research programme. New to this edition: Additional examples to illustrate the application of computational procedures using tools such as MATLAB®, MathCad® and Program CC®. Improved compatibility with, and more expansive coverage of the North American notational style. Expanded coverage of lateral-directional static stability, manoeuvrability, command augmentation and flight in turbulence. An additional coursework study on flight control design for an unmanned air vehicle (UAV).

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