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AERONAUTICAL ENGINEERING

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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05 Aircraft Design, Testing and Performance **4**

Includes aircraft simulation technology.

06 Aircraft Instrumentation **N.A.**

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07 Aircraft Propulsion and Power **7**

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

08 Aircraft Stability and Control **9**

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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8. Abstract Author
9. Subject Terms

AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 339)

JANUARY 10, 1997

01
AERONAUTICS

19970000045 Battelle Memorial Inst., Columbus, OH USA
Development of Repair Processes and Sources for B-52 Aircraft Windows/Windshields ***Progress Report, Sep. 1991 - 31 Dec. 1995***
Olson, Richard J., Battelle Memorial Inst., USA; Feb. 1996; 247p; In English
Contract(s)/Grant(s): FO9603-90-D-2217
Report No.(s): AD-A307204; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

To assess the viability of using repaired W/WS, some used B-52 W/WS were procured, repaired, and then tested. The repair costs provide the data for the cost benefit analysis. The test results provide the technical evaluation data . The test results indicate that repaired W/WS are not equal to new WIWS. Many of the repaired W/WS still contain defects that would not pass an OEM quality assurance inspection. The bird impact test results are quite clear the new W/WS outperform either repaired or unrepaired W/WS, with one repaired W/WS failing catastrophically. The direct cost of repaired W/WS is less than half the cost of new W/WS. Thus, money can be saved by using repaired W/WS. Poor performance of the repaired W/WS in the bird impact tests makes it difficult to recommend the use of repaired B-52 W/WS. Because the WJWS that were tested came off of retired aircraft and were not removed for cause, there is a concern for active B-52 W/WS.
DTIC
B-52 Aircraft; Windshields; Windows; Aircraft Maintenance

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

19970001032 Aerotech Engineering and Research, Lawrence, KS USA
Stochastic Modeling of Antisymmetric Buffet Loads on Horizontal Stabilizers in Massively Separated Flows ***Final Report***
Farokhi, Saeed, Aerotech Engineering and Research, USA; Mauk, Clay S., Aerotech Engineering and Research, USA; Locke, James E., Aerotech Engineering and Research, USA; Mar. 1996; 78p; In English; Limited Reproducibility: More than 20% of this document may be affected by poor print
Contract(s)/Grant(s): DTRS57-94-C-00059
Report No.(s): AD-A307698; DOT/FAA/AR-95/7; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Federal Aviation Regulation (FAR) 25 has been revised to clearly identify buffet loading as a structural design load. A modem method was developed to model antisymmetric buffet design loads on horizontal stabilizers with a known probability, utilizing a rigid wind tunnel model. The surface pressure was measured for a large number of test conditions, including the most severe buffeting environment for this type of aircraft: the tail immersed in the massively separated wake of the wing. Modifications to the Beech King Air 200 one-sixth scale wind tunnel model included the construction of a new horizontal stabilizer instrumented with 12 miniature pressure transducers. Structural characteristics of the full-scale aircraft were estimated using the Automated STRuctural Optimization System (ASTROS) program. ASTROS, while not directly supporting buffet calculations, is written in a flexible high-level language and thus easily adaptable. Motion-dependent aerodynamics (stiffness and damping) were computed using the proven doublet lattice method, which is incorporated into ASTROS. Due to difficulties with the data acquisition system, the current approach was validated with buffet pressure power spectral densities from an existing reference. Based on the results,

the methodology is sound. Future work would include more detailed investigations of the buffet phenomenon and integration of software programs to build a multidisciplinary design tool. This would allow aircraft manufacturers to predict the horizontal stabilizer antisymmetric buffet loads early in the certification program.
DTIC
Certification; Pressure Sensors; Stochastic Processes; Buffeting; Horizontal Tail Surfaces; Control Surfaces; Separated Flow; Aircraft Design

19970001048 National Renewable Energy Lab., Golden, CO USA
Effects of grit roughness and pitch oscillations on the S814 airfoil
Janiszewska, J. M., Ohio State Univ., USA; Ramsay, R. R., Ohio State Univ., USA; Hoffmann, M. J., Ohio State Univ., USA; Gregorek, G. M., Ohio State Univ., USA; Jul. 1996; 153p; In English
Contract(s)/Grant(s): DE-AC36-83CH-10093
Report No.(s): NREL/TP-442-8161; DE96-007946; No Copyright; Avail: Issuing Activity (Department of Energy (DOE)), Microfiche

Horizontal-axis wind turbine rotors experience unsteady aerodynamics when the rotor is yawed, when rotor blades pass through the support tower wake, and when the wind is gusting. An understanding of this unsteady behavior is necessary to assist in the design of new rotor airfoils. The rotors also experience performance degradation due to surface roughness. These surface irregularities are due to the accumulation of insect debris, ice, and/or the aging process. Wind tunnel studies that examine both the steady and unsteady behavior of airfoils can help define pertinent flow phenomena, and the resultant data can also be used to validate analytical computer codes. An S814 airfoil model was tested in The Ohio State University Aeronautical and Astronautical Research Laboratory (OSU/AARL) 3 X 5 subsonic wind tunnel (3 X 5) under steady flow with both stationary model conditions and pitch oscillations. to study the extent of performance loss due to surface roughness, a leading edge grit roughness pattern (LEGR) was used to simulate leading edge contamination. After baseline cases were completed, the LEGR was applied for both steady state and model pitch oscillation cases. The Reynolds numbers for steady state conditions were 0.75, 1, 1.25 and 1.5 million, while the angle of attack ranged from -20 degrees to +40 degrees. While the model underwent pitch oscillations, data were acquired at Reynolds numbers of 0.75, 1, 1.25, and 1.5 million, at frequencies of 0.6, 1.2, and 1.8 Hz. Two sine wave forcing functions (+/-)5.5 degrees and (+/-)10 degrees, were used; at mean angles of attack of 8 degrees, 14 degrees, and 20 degrees. For purposes herein, any reference to unsteady conditions means the model was in pitch oscillation.
DOE
Airfoils; Performance Tests; Wind Turbines; Reynolds Number

19970001126 NASA Langley Research Center, Hampton, VA USA
Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes
Gatlin, Gregory M., NASA Langley Research Center, USA; Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA; Mar. 1996; 130p; In English
Contract(s)/Grant(s): RTOP 505-68-70-04
Report No.(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
Author
Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations

19970001280 Swedish National Board for Industrial and Technical Development, Stockholm, Sweden
Near wake behaviour of wind turbines
Magnusson, Mikael, Uppsala Univ., Sweden; Mar. 1996; 27p; In English
Contract(s)/Grant(s): NUTEK-P506226-9
Report No.(s): NUTEK-VIND-96-3; MIUU-WE-95-3; DE97-700161; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

If wind turbines are to be large contributors for energy production, a large amount of turbines have to be erected. As the areas suitable for wind energy production are limited, an optimum use of these areas are needed. For that reason wind turbines have to be localised in larger or smaller wind farms. Localizing wind turbines in cluster will lead to interference between them, reducing the wind speed and generating heightened loads on downstream sited turbines. In order to build suitable wind turbines, the loads have to be investigated properly. For that reason it is important to get as good understanding of the wake behaviour as possible. In this report a simple numerical model is used to calculate the near wake of a turbine. The purpose is to study the initial structure of the wake. A major part of the turbulence in the wake is generated from the shear originated from the difference in air velocity inside and outside the wake. As the velocity deficit determines the shear generated turbulence, the structure and magnitude of the deficit at the rotor is of importance for the development of the wake. Full-scale measurements in a wind farm consisting of four turbines have been performed on the island Gotland, Sweden. For one wind direction the wake at a down wind distance of one diameter can be measured. Comparisons between model and full-scale measurements are presented in this paper, which consists of four parts. First is a section describing the theory for the numerical model. Next section presents the site for the full-scale measurements. In section 3 the numerical results are presented. Finally in section 4 results from full-scale measurements are presented.
DOE
Wind Turbines; Windpower Utilization; Windpowered Generators; Mathematical Models; Turbulence; Wind Velocity

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

19970001034 Wright Lab., Plans and Programs Directorate, Wright-Patterson AFB, OH USA
Wright Laboratory Success Stories: A Review of 1994 ***Final Report***
Apr. 1996; 163p; In English; Limited Reproducibility: More than 20% of this document may be affected by poor print
Report No.(s): AD-A307798; WL-TR-96-6006; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Success stories from 1994/95 that recognize the accomplishments and combined effort of Wright Laboratory scientists and engineers. Stories have been selected from the following categories: TECHNOLOGY TRANSITION -- Technology that has achieved application on a Department of Defense system in development or operation or that has provided 'quick-reaction' response to problems or needs of field organizations; TECHNOLOGY TRANSFER -- Technology that has transferred from the laboratory to the private sector, to include: industry, academia, and state and local governments; TECHNICAL ACHIEVEMENT -- Major innovative technological advancements that offer significant potential for existing and future Air Force systems; and, PEER RECOGNITION -- External awards or recognition by the scientific community at large.
DTIC
Defense Program; Technology Transfer; Government/Industry Relations; Military Technology; Systems Engineering; Research Facilities; Research Management

19970001142 Naval War Coll., Newport, RI USA
GPS Capabilities for the Warfighter ***Final Report***
Dale, Jon C., Naval War Coll., USA; Feb. 12, 1996; 31p; In English; Limited Reproducibility: More than 20% of this document may be affected by microfiche quality
Report No.(s): AD-A307457; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The Global Positioning System (GPS) is a space-based worldwide navigation system that has a wide range of military and civil applications. The vastly increased situational awareness and accurate positioning capabilities provided by this system act as a force multipliers for today's smaller military. Increased situational awareness, as well as navigation and reconnaissance capabilities will support decisions regarding maneuver and application of forces. GPS will be used to guide weapons and vehicles, support combat identification and search and rescue missions, track troops and supplies, and much more. There are limitations to the system, such as potential signal jamming or enemy use, that must be controlled in order to maintain this valuable asset. GPS

is an extremely useful tool which has the capability to greatly enhance the military's warfighting ability. The successful commander must understand the capabilities and limitations of GPS technology to effectively utilize it's many applications on the battlefield.
DTIC
Global Positioning System; Reconnaissance; Navigation

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

19970000331 Advisory Committee on the Civil Tiltrotor Development, Washington, DC USA
Civil Tiltrotor Development Advisory Committee. Report to Congress, Volume 2, Technical Supplement ***Final Report***
Dec. 1995; 252p; In English
Report No.(s): AD-A306655; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

Under public law (PL102-581), the U.S. Congress directed the Secretary of Transportation to establish a Civil Tiltrotor Development Advisory Committee (CTRDAC). The committee was directed to examine the costs, technical feasibility, and economic viability of developing civil tiltrotor (CTR) aircraft. The CTRDAC found that the CTR is technically feasible, that it could be economically viable and operate profitable without government subsidies in heavily traveled corridors, and that it could provide significant societal benefits. The CTRDAC recommended that a public/private partnership be created to address CTR institutional, infrastructure, and coordination issues; that an integrated aircraft and infrastructure research, development, and demonstration program be conducted over 10 years with $600 million in Government/industry cost sharing; and that work be accelerated on regulatory and certification issues, including safety and environmental standards and changes in the air traffic control system.
DTIC
Congressional Reports; Economics; Tilt Rotor Aircraft; Civil Aviation; Air Traffic Control; Technology Assessment; Costs

19970000332 Advisory Committee on the Civil Tiltrotor Development, Washington, DC USA
Civil Tiltrotor Development Advisory Committee. Report to Congress, Volume 1 ***Final Report***
Dec. 1995; 120p; In English
Report No.(s): AD-A306654; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Under public law (PL102-58l), the U.S. Congress directed the Secretary of Transportation to establish a Civil Tiltrotor Development Advisory Committee (CTRDAC). The committee was directed to examine the costs, technical feasibility, and economic viability of developing civil tiltrotor (CTR) aircraft. The CTRDAC found that the CTR is technically feasible, that it could be economically viable and operate profitable without government subsidies in heavily traveled corridors, and that it could provide significant societal benefits. The CTRDAC recommended that a public/private partnership be created to address CTR institutional, infrastructure, and coordination issues; that an integrated aircraft and infrastructure research, development, and demonstration program be conducted over 10 years with $600 million in Government/industry cost sharing; and that work be accelerated on regulatory and certification issues, including safety and environmental standards and changes in the air traffic control system.
DTIC
Congressional Reports; Air Traffic Control; Civil Aviation; Technology Assessment; Transportation; Economics; Costs

19970000608 Defence Research Agency, Flight Dynamics and Simulation Dept., Bedford, UK
UK Attack Helicopter Flying Qualities: The Role of Piloted Simulation Evaluation in Supporting the Procurement Decision Making Process
Charlton, M. T., Defence Research Agency, UK; Padfield, G. D., Defence Research Agency, UK; Green, J. T., Ministry of Defence, UK; Apr. 1996; 20p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Contenders for the UK Army's Attack Helicopter (AH) competition, were subjected to a Technical Assessment during the period November 1993 to December 1994. The Defence Research Agency's Flight Dynamics and Simulation Department were Lead Assessors for the flight control system and handling qualities aspects of the assessments. FDS carried out a program of off-line and piloted simulation activities in support of the handling qualities assessments, using the DRA's HELISIM simulation model. A piloted simulation evaluation was completed using the DRA's Advanced Flight Simulator, where the objective was to evaluate the contenders handling qualities and agility in the context of the AH mission. The paper describes the test techniques and procedures used in the tests and discusses the background details of the handling qualities assessment methodology. Some

conclusions are also drawn regarding the effectiveness of simulation in supporting defence procurement objectives, and potential future developments.
Author
Helicopters; Competition; Decision Making

19970000609 NASA Ames Research Center, Moffett Field, CA USA
The Use of Piloted Simulation for Civil Tiltrotor Integrated Cockpit Design
Decker, William A., NASA Ames Research Center, USA; Simmons, Rickey C., NASA Ames Research Center, USA; Tucker, George E., NASA Ames Research Center, USA; Apr. 1996; 24p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Ground-based flight simulators are receiving increased use in the design of civil aircraft. In addition to traditional simulation roles in support of cockpit control and display design, simulators are now used to develop new flight procedures and to assist in airport design. This is particularly true for the concept of a civil tiltrotor transport. This presentation summarizes recent simulation activity at NASA's Ames Research Center focused on the design requirements for the introduction of tiltrotor aircraft as economic vertical flight transports.
Author
Vertical Flight; Flight Simulators; Economics; Display Devices; Cockpits; Tilt Wing Aircraft

19970000610 Boeing Defense and Space Group, Helicopters Div., Philadelphia, PA USA
Simulation Applications in V-22 and RAH-66 Design and Development
Sheffield, R. E., Boeing Defense and Space Group, USA; Lalicker, L. E., Boeing Defense and Space Group, USA; Apr. 1996; 6p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Boeing Company Defense & Space Group, Helicopters Division, has increasingly applied constructive and virtual simulation in support of its aircraft developmental programs which include the V-22 Osprey and the RAH-66 Comanche. From their conceptual phases to present, methodologies and mission simulation capabilities have evolved rapidly due to tremendous advances in computing power. by interacting directly with the systems engineering process, simulation has proven to be extremely valuable in optimizing rotorcraft survivability and mission effectiveness. At the same time, simulation has proven to be an effective means of reducing risk and costly flight testing. Recent focus has been on evolving our simulation capabilities for participation in Distributive Interactive Simulation (DIS). These capabilities and their acquired techniques provide potential opportunities to (1) better apply simulation to increase operational effectiveness of future rotorcraft, and (2) facilitate customer involvement in the developmental process.
Author
V-22 Aircraft; Computerized Simulation; Rotary Wing Aircraft; System Effectiveness

19970000611 Eurocopter France, Marignane, France
Piloted Simulation in Rotorcraft Design and Development: Eurocopter Experience and Future Trends ***La Simulation Pilotee pour la Conception et le Developpement des Appareils a Voilure Tournantes: L'Experience d'Eurocopter et les Tendances pour le Futur***
Rollet, Philippe, Eurocopter France, France; Apr. 1996; 10p; In French; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Piloted simulation has largely been used in EUROCOPTER's developments for the last 10 years. For the TIGER attack helicopter, piloted simulation was extensively used from the very beginning of the development to the prototypes' nights. Today, the development of the NH-90 helicopter requires a lot of experimentations on the SPHERE simulator. Piloted simulation is also used for research related to handling qualities, such as the ACT European program, or to Man-Machine-Interfaces (MMI's). The implementation of demonstrators, such as the FBW DAUPHIN, as well as the study of the EUROFAR Tilt-Rotor have also largely involved piloted simulations. A significant experience in testing procedures has been acquired. Environmental and human factors appear to be of the greatest importance. In the future, evolutions are planned to further enhance the representativity of SPHERE simulator. The emergence of new design standards, such as ADS-33C, leads to envisage new applications of piloted simulation.
Author
Tilt Rotor Aircraft; Rotary Wing Aircraft; Man Machine Systems; Human Factors Engineering; Military Helicopters

19970000621 NASA Ames Research Center, Moffett Field, CA USA

Research Applications and Capabilities of the NASA/Army Rotorcraft Aircrew Systems Concepts Airborne Laboratory (RASCAL)

Aiken, Edwin W., NASA Ames Research Center, USA; Jacobsen, Robert A., NASA Ames Research Center, USA; Hindson, William S., NASA Ames Research Center, USA; Apr. 1996; 14p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Rotorcraft Aircrew Systems Concepts Airborne Laboratory (RASCAL) is a UH-60 Black Hawk helicopter that is being modified by NASA and the US Army for flight systems research. The principal systems that are being installed in the aircraft are a Helmet-Mounted Display (HMD) and associated imaging systems, and a programmable full-authority Research Flight Control System (RFCS). In addition, comprehensive instrumentation of both the rigid body of the helicopter and the rotor system is provided. This paper describes the design features of this modern rotorcraft in-flight simulation facility and their current state of development. A brief description of initial research applications is included.

Author

Rotary Wing Aircraft; Flight Control; Flight Crews; Helicopter Design; Helmet Mounted Displays; Flight Simulation

19970000805 Research Inst. for Advanced Computer Science, Moffett Field, CA USA

Aerodynamic Shape Optimization of Supersonic Aircraft Configurations via an Adjoint Formulation on Parallel Computers

Reuther, James, Research Inst. for Advanced Computer Science, USA; Alonso, Juan Jose, Princeton Univ., USA; Rimlinger, Mark J., NASA Ames Research Center, USA; Jameson, Antony, Princeton Univ., USA; 1996; 22p; In English; 6th; Multidisciplinary Analysis and Optimization Symposium, Sep. 1996, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS2-13721; N00014-92-J-1976; AF-AFOSR-0391-91

Report No.(s): NASA-CR-202390; NAS 1.26:202390; RIACS-TR-96.17; AIAA Paper 96-4045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This work describes the application of a control theory-based aerodynamic shape optimization method to the problem of supersonic aircraft design. The design process is greatly accelerated through the use of both control theory and a parallel implementation on distributed memory computers. Control theory is employed to derive the adjoint differential equations whose solution allows for the evaluation of design gradient information at a fraction of the computational cost required by previous design methods. The resulting problem is then implemented on parallel distributed memory architectures using a domain decomposition approach, an optimized communication schedule, and the MPI (Message Passing Interface) Standard for portability and efficiency. The final result achieves very rapid aerodynamic design based on higher order computational fluid dynamics methods (CFD). In our earlier studies, the serial implementation of this design method was shown to be effective for the optimization of airfoils, wings, wing-bodies, and complex aircraft configurations using both the potential equation and the Euler equations. In our most recent paper, the Euler method was extended to treat complete aircraft configurations via a new multiblock implementation. Furthermore, during the same conference, we also presented preliminary results demonstrating that this basic methodology could be ported to distributed memory parallel computing architectures. In this paper, our concern will be to demonstrate that the combined power of these new technologies can be used routinely in an industrial design environment by applying it to the case study of the design of typical supersonic transport configurations. A particular difficulty of this test case is posed by the propulsion/airframe integration.

Author

Aircraft Configurations; Supersonic Aircraft; Distributed Processing; Parallel Computers; Parallel Processing (Computers); Aircraft Design; Aerodynamic Configurations

19970000848 Boeing Commercial Airplane Co., Structural Damage Technology, Seattle, WA USA

Investigation of Fuselage Structure Subject to Widespread Fatigue Damage ***Final Report, Oct. 1994 - Oct 1995***

Gruber, M. L., Boeing Commercial Airplane Co., USA; Mazur, C. J., Boeing Commercial Airplane Co., USA; Wilkins, K. E., Boeing Commercial Airplane Co., USA; Worden, R. E., Boeing Commercial Airplane Co., USA; Feb. 1996; 244p; In English

Contract(s)/Grant(s): DTFA03-94-C-00065

Report No.(s): AD-A307595; D6-81738; DOT/FAA/AR-95/47; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report documents the results of the 'Investigation of Fuselage Structure Subject to Widespread Fatigue Damage' contract. The primary program objective was to obtain data on airplane fuselage structures subject to Multiple Site Damage (MSD) in an environment that reflects typical commercial jetliner manufacturing and operating conditions. The program involves three technical tasks which include flat panel material characterization testing (Task 1), Full-scale fuselage pressure panel testing (Task

2) and predictions of pressure panel behavior through finite element modeling (Task 3). In Task 1 six specimens were tested to characterize the lot of 2024-T3 clad material used to fabricate the skins for die Task 2 pressure test panels. Material static, crack growth and toughness (K and R-curves) data were generated. Task 2 two generic wide-body curved fuselage panels were fabricated and pressure tested. Frame centered cracks in the die lap joint outer skin upper fastener row were grown by pressure cycling to two frame bays. A panel residual strength test was taken conducted with die skin crack centered on a broken frame. Panel lap joints were fabricated with and without MSD sawcuts in the fasteners ahead of die lead crack to develop the head-to-head comparison. In Task 3, a detailed finite element model was constructed to analyze the pressure test panels. Predictions were made of the pressure test panel strain gage stresses, crack growth life and residual strength. General conclusions from the testing and analysis were drawn.
DTIC
Commercial Aircraft; Crack Propagation; Fatigue (Materials); Fuselages; Mathematical Models; Stress Analysis; Aluminum Alloys; Finite Element Method; Strain Gages

19970001272 Department of the Navy, Washington, DC USA
Liquid-Blocking Ring Assembly for Surface Drains
Salmond, Charles N., Inventor, Department of the Navy, USA; Long, Cabot R., Inventor, Department of the Navy, USA; Jun. 1996; 6p; In English; Supersedes US-Patent-Appl-SN-300241
Patent Info.: Filed 1 Sep. 1994; US-Patent-Appl-SN-300241; US-Patent-5,527,131
Report No.(s): AD-D018076; No Copyright; Avail: US Patent and Trademark Office, Microfiche
A light-weight, liquid-blocking ring assembly for a surface drain for preventing a harmful liquid spilled nearby from entering the drain, which can be quickly and easily installed by a single person, and includes positive verification that none of the undesired liquid has entered the drain. The assembly includes (1) a center portion having a latching mechanism for attaching and drawing the assembly towards the drain, (2) a peripheral band which surrounds and is spaced from the drain, and which carries at its bottom edge a resilient gasket conformable to the surface surrounding the drain, and (3) an intermediate structure connecting the center portion and the peripheral band without blocking a clear view of the entire surface surrounding the drain.
DTIC
Drainage; Spilling; Blocking; Rings; Connectors

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

19970000347 Department of Energy, Energy Technology Center, Morgantown, WV USA
Gas turbine combustion instability
Richards, George A., Department of Energy, USA; Lee, George T., Department of Energy, USA; [1996]; 11p; In English; 1996 Central States Section Technical Meeting of the Combustion Institute, 5-7 May 1996, Saint Louis, MO, USA
Report No.(s): DOE/METC/C-96/7239; CONF-9605160-4; DE96-014528; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Combustion oscillations are a common problem in development of LPM (lean premix) combustors. Unlike earlier, diffusion style combustors, LPM combustors are especially susceptible to oscillations because acoustic losses are smaller and operation near lean blowoff produces a greater combustion response to disturbances in reactant supply, mixing, etc. In ongoing tests at METC, five instability mechanisms have been identified in subscale and commercial scale nozzle tests. Changes to fuel nozzle geometry showed that it is possible to stabilize combustion by altering the timing of the feedback between acoustic waves and the variation in heat release.
DOE
Combustion Chambers; Combustion Stability; Gas Turbines; Nozzle Geometry

19970000870 Wright Lab., Aero Propulsion and Power Directorate; Wright Lab.; Air Force Materiel Command., Wright-Patterson AFB, OH USA
An Induction Motor Drive Using a Resonant DC Link Inverter ***Final Report, May 1995 - Dec. 1995***
Fronista, Gregory L., Wright Lab., USA; Feb. 1996; 73p; In English
Contract(s)/Grant(s): AF Proj.3145

Report No.(s): AD-A307324; WL-TR-96-2048; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

New initiatives to increase the use of electrical power, such as the electric vehicle and the More Electric Airplane, have created a need for improved motor drives. The use of adjustable speed drives has recently received more attention in these applications because new circuit topologies and power components have been developed that have enabled improvements in efficiency, power density and response times. This study reports the design and simulation of an actively clamped resonant dc link inverter that will drive an induction motor based blower. The objective of this study is to design, build and test a Resonant DC Link (RDCL) inverter and compare the performance of a six-step control strategy with a pulse dens ity modulation strategy in an adjustable speed drive. Comparisons are made between a hard switched pulse width modulation converter and an RDCL inverter. Theoretical and experimental power loss calculations of the RDCL inverter are compared and discussed. The performance of constant voltage/frequency adjustable speed control is presented.

DTIC

Aircraft Engines; Induction Motors; Topology; Inverters

19970001041 University of Western Michigan, Dept. of Mechanical and Aeronautical Engineering., Kalamazoo, MI USA

Reynolds-Averaged Navier-Stokes Studies of Low Reynolds Number Effects on the Losses in a Low Pressure Turbine ***Final Report***

Dorney, Daniel J., University of Western Michigan, USA; Sep. 1996; 110p; In English

Contract(s)/Grant(s): NAG3-1668; RTOP 505-62-52

Report No.(s): NASA-CR-198534; NAS 1.26:198534; E-10457; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Experimental data from jet-engine tests have indicated that unsteady blade-row interaction effects can have a significant impact on the efficiency of low-pressure turbine stages. Measured turbine efficiencies at takeoff can be as much as two points higher than those at cruise conditions. Preliminary studies indicate that Reynolds number effects may contribute to the lower efficiencies at cruise conditions. In the current study, numerical experiments have been performed to quantify the Reynolds number dependence of unsteady wake/separation bubble interaction on the performance of a low-pressure turbine.

Author

Turbines; Unsteady Flow; Navier-Stokes Equation; Wakes; Turbine Blades; Reynolds Number; Unsteady Aerodynamics; Blade-Vortex Interaction; Rotor Stator Interactions; Propulsive Efficiency

19970001125 Prairie View Agricultural and Mechanical Coll., Mechanical Engineering Dept., TX USA

CFD Study of Turbo-Ramjet Interactions in Hypersonic Airbreathing Propulsion System ***Final Report***

Chang, Ing, Prairie View Agricultural and Mechanical Coll., USA; Hunter, Louis G., Lockheed Martin Tactical Aircraft Systems, USA; Sep. 1996; 68p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG3-1500

Report No.(s): NASA-CR-202418; NAS 1.26:202418; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Advanced airbreathing propulsion systems used in Mach 4-6 mission scenarios, usually involve turbo-ramjet configurations. As the engines transition from turbojet to ramjet, there is an operational envelope where both engines operate simultaneously. In the first phase of our study, an over/under nozzle configuration was analyzed. The two plumes from the turbojet and ramjet interact at the end of a common 2-D cowl, where they both reach an approximate Mach 3.0 condition and then jointly expand to Mach 3.6 at the common nozzle exit plane. For the problem analyzed, the turbojet engine operates at a higher nozzle pressure ratio than the ramjet, causes the turbojet plume overpowers the ramjet plume, deflecting it approximately 12 degrees downward and in turn the turbojet plume is deflected 6 degrees upward. In the process, shocks were formed at the deflections and a shear layer formed at the confluence of the two jets. This particular case was experimentally tested and the data were used to compare with a computational fluid dynamics (CFD) study using the PARC2D code. The CFD results were in good agreement with both static pressure distributions on the cowl separator and on nozzle walls. The thrust coefficients were also in reasonable agreement. In addition, inviscid relationships were developed around the confluence point, where the two exhaust jets meet, and these results compared favorably with the CFD results. In the second phase of our study, a 3-D CFD solution was generated to compare with the 2-D solution. The major difference between the 2-D and 3-D solutions was the interaction of the shock waves, generated by the plume interactions, on the sidewall. When a shock wave interacts with a sidewall and sidewall boundary layer, it is called a glancing shock sidewall interaction. These interactions entrain boundary layer flow down the shockline into a vortical flow pattern. The 3-D plots show the streamlines being entrained down the shockline. The pressure of the flow also decreases slightly as the sidewall is approached. Other difference between the 2-D and 3-D solutions were a lowering of the nozzle thrust coefficient value from 0.9850 (2-D) to 0.9807 (3-D), where the experimental value was 0.9790. In the third phase of our study, a different turbo-ramjet configuration was analyzed. The confluence of a supersonic turbojet and a subsonic ramjet in the turbine based combined-cycle (TBCC) propulsion system was studied by a 2-D CFD code. In the analysis, Mach 1.4 primary turbojet was mixed with the sub-

sonic ramjet secondary flow in an ejector mode operation. Reasonable agreements were obtained with the supplied I-D TBCC solutions. For low downstream backpressure, the Fabri choke condition (Break-Point condition) was observed in the secondary flow within mixing zone. For sufficient high downstream backpressure, the Fabri choke no longer exist, the ramjet flow was reduced and the ejector flow became backpressure dependent. Highly non-uniform flow at ejector exit were observed, indicated that for smooth downstream combustion, the mixing of the two streams probably required some physical devices.
Author
Nozzle Thrust Coefficients; Ramjet Engines; Turbojet Engines; Flow Distribution; Hypersonic Flight; Inviscid Flow; Nozzle Walls; Nozzle Geometry; Engine Design; Computational Fluid Dynamics

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

19970000623 Air Force Flight Test Center, Edwards AFB, CA USA
Variable Stability In-Flight Simulator Test Aircraft (VISTA)
Buehler, Kurt, Air Force Flight Test Center, USA; Reynolds, Phil, Calspan Corp., USA; Markman, Steve, Wright Lab., USA; Hellmann, Gary, Wright Lab., USA; Apr. 1996; 10p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The VISTA is the USA (US) of America's next generation in-flight simulator, replacing the aging NT-33. The VISTA is an F-16D with the Israeli Peace Marble 2 configuration. The flight control system has been extensively modified to create a state of the art in-flight simulator. The VISTA Phase 2 Development, Test and Evaluation (DT&E) at the Air Force Flight Test Center (AFFTC) started in July 1994 and was completed in January 1995. The flight test team consisted of personnel from the USA Air Force (USAF). Lockheed Fort Worth Company, and Calspan Corporation. The VISTA flew 62 test sorties for a total of 138 flight test hours at the AFFTC meeting or exceeding all design specifications. The VISTA is owned by Wright Laboratory's (WL) Flight Dynamics Directorate. The Calspan Corporation maintains and operates the VISTA for WL. Using the aerodynamic, mass, inertia, and controller characteristics, and the flight control laws of other aircraft, the VISTA can simulate the aircraft 'in-flight' determining the flying qualities and handling characteristics. The USAF and Navy Test Pilot Schools utilize the VISTA in their curriculum. The VISTA is available to support the USAF, other branches of the US Department of Defense, commercial aircraft development. National Aeronautics and Space Administration (NASA), and foreign military aircraft development programs. This paper presents a brief summary of the development of the VISTA, the hardware and softuare modifications that were made to create the VISTA, the VISTA Phase 2 flight test plan and results, and discusses the future direction of in-flight simulation.
Author
Flight Simulators; Flight Tests; Flight Control; Flight Characteristics; Control Theory; Aircraft Design

19970000839 Virginia Polytechnic Inst. and State Univ., Dept. of Aerospace and Ocean Engineering., Blacksburg, VA USA
Unified Pilot-Induced Oscillation Theory, Volume 3, PIO Analysis Using Multivariable Methods ***Final Report, Oct. 1994 - Sep. 1995***
Anderson, Mark R., Virginia Polytechnic Inst. and State Univ., USA; Page, Anthony B., Virginia Polytechnic Inst. and State Univ., USA; Dec. 1995; 110p; In English
Contract(s)/Grant(s): F33615-94-C-3611; AF Proj. 2403
Report No.(s): AD-A307476; WL-TR-96-3030-VOL-3; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This work was conducted as part of a USAF initiative to develop a comprehensive theory to predict pilot-induced oscillation (PIO) tendencies due to the combined effect of all influencing elements. A PIO is a very complicated phenomenon stemming from a dynamic interaction between the pilot and the aircraft. When tight control is required of the pilot, an undesired oscillation can result. However, the adaptive nature of the human pilot makes such oscillations difficult to predict. This report describes an analysis method capable of predicting PIO tendencies due to several simultaneous dynamic factors. A unified approach involving pilot modeling, stability robustness analysis, and multivariable describing function analysis is applied to the problem of identifying aircraft with PIO tendencies. The approach is shown to have ties to existing PIO criteria and is successfully applied to the prediction of PIO tendencies of the M2-F2 lifting body.
DTIC
Pilot Induced Oscillation; Aerodynamic Stability; Aircraft Control; Mathematical Models; Computer Programs

19970000845 Systems Technology, Inc., Hawthorne, CA USA

Unified Pilot-Induced Oscillation Theory, Volume 1, PIO Analysis with Linear and Nonlinear Effective Vehicle Characteristics, Including Rate Limiting ***Final Report, Oct. 1994 - Sep. 1995***

Klyde, David H., Systems Technology, Inc., USA; McCruer, Duane T., Systems Technology, Inc., USA; Myers, Thomas T., Systems Technology, Inc., USA; Dec. 1995; 300p; In English

Contract(s)/Grant(s): F33615-94-C-3613; AF Proj. 2403

Report No.(s): AD-A307580; TR-1313-1; WL-TR-96-3028; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

This work was conducted as part of a USAF initiative to develop a comprehensive theory to predict Pilot-Induced Oscillation (PIO) tendencies due to the combined effect of all influencing elements. A PIO is a very complicated phenomenon stemming from a dynamic interaction between the pilot and the aircraft. When tight control is required from the pilot, an undesired oscillation can result. However, the adaptive nature of the human pilot makes such oscillations difficult to predict. The independent research of Scientific and Technical Information (STI) included: compilation of available PIO time histories and references as an initial step toward a comprehensive PIO database; refinement of the proposed PIO categories defined in NASA CR-4683; development of PIO theories based on these categories; development of methods to handle the higher frequency and nonlinear aspects of PIO analysis with an emphasis on rate limiting; and a review of existing and proposed linear PIO criteria.

DTIC

Aerodynamic Stability; Human Factors Engineering; Data Bases; Aerodynamic Configurations; Mathematical Models; Computerized Simulation; Nonlinearity; Flight Tests; Fighter Aircraft

19970000875 Calspan Advanced Technology Center, Buffalo, NY USA

Unified Pilot-Induced Oscillation Theory, Volume 4, Time-Domain Neal-Smith Criterion ***Final Report, Oct. 1994 - Sep. 1995***

Bailey, Randall E., Calspan Advanced Technology Center, USA; Bidlack, Timothy J., Calspan Advanced Technology Center, USA; Dec. 1995; 211p; In English

Contract(s)/Grant(s): F33615-93-C-3608; AF Proj. 2403

Report No.(s): AD-A307581; CALSPAN-FR-8184-13-VOL-4; WL-TR-96-3031; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This work was conducted as part of a USAF initiative to develop a comprehensive theory to predict Pilot-Induced Oscillation (PIO) tendencies due to the combined effect of all influencing elements. A PIO is a very complicated phenomenon stemming from a dynamic interaction between the pilot and the aircraft. When tight control is required from the pilot, an undesired oscillation can result. However, the adaptive nature of the human pilot, makes such oscillations difficult to predict. This report presents the theory, fundamental principles, and analytical procedures of a quantitative criterion for the prediction of PIO tendencies in fixed-wing aircraft. The criterion is validated against three very reliable flying qualities data bases. At present, the criterion is intentionally limited to the evaluation of pitch control only. No fundamental limitations were discovered which preclude the evolution of this methodology and analytical procedures to PIO analysis of roll control or 'outer-loop' longitudinal control, such as control of aircraft flight path.

DTIC

Aerodynamic Stability; Human Factors Engineering; Data Bases; Aircraft Configurations; Mathematical Models; Computerized Simulation; Flight Tests

19970001151 NASA Dryden Flight Research Center, Edwards, CA USA

Flight Test of a Propulsion-Based Emergency Control System on the MD-11 Airplane with Emphasis on the Lateral Axis

Burken, John J., NASA Dryden Flight Research Center, USA; Burcham, Frank W., Jr., NASA Dryden Flight Research Center, USA; Maine, Trindel A., NASA Dryden Flight Research Center, USA; Feather, John, McDonnell-Douglas Aerospace, USA; Goldthorpe, Steven, McDonnell-Douglas Aerospace, USA; Kahler, Jeffrey A., Honeywell, Inc., USA; 19960701; 18p; In English; Guidance, Navigation, and Control Conference, 29-31 Jul. 1996, San Diego, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 505-64-10

Report No.(s): NASA-TM-4746; H-2110; NAS 1.15:4746; AIAA Paper 96-3919; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A large, civilian, multi-engine transport MD-11 airplane control system was recently modified to perform as an emergency backup controller using engine thrust only. The emergency backup system, referred to as the propulsion-controlled aircraft (PCA) system, would be used if a major primary flight control system fails. to allow for longitudinal and lateral-directional control, the PCA system requires at least two engines and is implemented through software modifications. A flight-test program was con-

ducted to evaluate the PCA system high-altitude flying characteristics and to demonstrate its capacity to perform safe landings. The cruise flight conditions, several low approaches and one landing without any aerodynamic flight control surface movement, were demonstrated. This paper presents results that show satisfactory performance of the PCA system in the longitudinal axis. Test results indicate that the lateral-directional axis of the system performed well at high attitude but was sluggish and prone to thermal upsets during landing approaches. Flight-test experiences and test techniques are also discussed with emphasis on the lateral-directional axis because of the difficulties encountered in flight test.
Author (revised)
Flight Control; Aircraft Control; MD 11 Aircraft; Controllers; Backups; Emergencies

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

19970000594 Advisory Group for Aerospace Research and Development, Flight Vehicle Integration Panel, Neuilly-Sur-Seine, France
Flight Simulation: Where are the Challenges? ***Simulation de Vol: Quels Sont les Defis?***
Apr. 1996; 398p; In English; In French; Flight Vehicle Integration Panel Symposium, 22-25 May 1995, Brunswick, Germany; Sponsored by Advisory Group for Aerospace Research and Development, France; Also announced as 19970000595 through 19970000628
Report No.(s): AGARD-CP-577; ISBN-92-836-0024-X; Copyright Waived; Avail: CASI; A17, Hardcopy; A04, Microfiche

Effective Flight Simulation is an important capability for NATO nations, and it will become even more important in the face of reductions in defence budgets. This symposium reviewed the state of the art in flight simulation, in order to identify weaknesses where additional research and development are needed. Presentations dealt with simulation used for engineering and for training, both on the ground and in-flight. Session topics were: Visual and Motion Cueing and Requirements; Advances in Modelling; Simulation in Design and Development - Rotorcraft; Simulation in Design and Development - Fixed Wing and Systems; Simulation in Training; In-Flight Simulation; and Future Applications.
Author
Flight Simulation; Rotary Wing Aircraft; Research Projects; Training Simulators; Display Devices; Pilot Training; Visual Perception; Military Aircraft

19970000595 NASA Ames Research Center, Moffett Field, CA USA
Historical Review of Piloted Simulation at NASA Ames
Anderson, Seth B., NASA Ames Research Center, USA; Apr. 1996; 14p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper traces the conception and development of in-flight and ground based simulators at NASA Ames Research Center, starting in 1947 and continuing to the early 1990's. Problems with their development and operation and how limitations were handled are recounted. Advances needed in simulator equipment to improve performance and fidelity to gain pilot acceptance are discussed. The uses of these simulators in various aircraft research and development programs and their importance to aircraft design and flight testing are reviewed. Challenges remaining include a better understanding of the tradeoff between motion cues and visual cues, the importance of simulation sophistication when examining aircraft with marginal handling qualities characteristics, and the continuing need for upgrading simulation technology as more complex problems are encountered. Additional research is needed to understand the human behavior aspect in the pilot/simulator system.
Author
Histories; Research and Development; Visual Stimuli; Tradeoffs; Flight Simulators; Flight Simulation

19970000600 Technische Univ., SIMONA International Research Centre, Delft, Netherlands
Achieving High-Fidelity Motion Cues in Flight Simulation
Advani, S. K., Technische Univ., Netherlands; Mulder, J. A., Technische Univ., Netherlands; Apr. 1996; 12p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The simulation of high-bandwidth manual flight control tasks dictate the use of simulator motion systems for the reproduction of motion cues on the vestibular and neuromuscular-mechanical arm manipulator system. The reproduction of these cues, with particular emphasis on the lowest possible time delay, is necessary in human perception research, experimental flight control sys-

tem development studies, as well as in routine flight training. Perfect reproduction of motion cues with ground-based flight simulators is principally impossible due to the kinematic limitations inherent to the motion system. Washout filters minimize these effects. The dynamic characteristics of the motion system however lead to two types of control errors: short-term, due to finite oil stiffness and line dynamics, as well as limited control valve bandwidth, and long-term, due to complexity of the non-linear motion system dynamics, making compensation of unwanted parasitic errors difficult. This paper will review techniques which increase the performance of six-degrees-of-freedom hydraulic motion systems for flight simulators. Application of pressure-feedback actuator control increases the robustness of the motion system dynamics, hence decreasing the short-term errors. The long-term control errors are addressed by a (separate) robust, multi-variable motion system controller which provides control signals to the platform with knowledge of the system state and its inherent properties. The total mass and the vertical location of the center of gravity of the platform influence the time delay (phase lag) and fidelity of the motion system. These properties also limit any such improvements due to design changes in software or hydraulic hardware. As a result of these studies, a fundamentally unique light-weight motion platform design is proposed, making extensive use of advanced composite materials. This is called the SIMONA Research Simulator. With the improvements made to motion cue quality, fundamental research into human perception processes in human perception research, and experimental flight control system development work, will not be influenced by parasitic motions.
Author
Cues; Accuracy; Degrees of Freedom; Dynamic Characteristics; Flight Simulation; Flight Simulators; Motion Simulation; Motion Simulators; Robustness (Mathematics)

19970000603 Woodfield Aviation Research, Bedford, UK
Ship Airwakes: A New Generic Model for Piloted Simulation
Woodfield, Alan A., Woodfield Aviation Research, UK; Tomlinson, B. N., Defence Research Agency, UK; Apr. 1996; 18p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The disturbed airwake in the lee of the superstructure of ships with an aft flight deck causes significant control problems for helicopters operating during strong winds. Providing adequate data to describe these airwakes for use in night simulators has been a difficult task from either wind tunnel tests or theoretical airflow estimates. In this report an empirical mathematical model is developed based on the main types of airflow pattern present in airwakes. The model uses a single set of modelling parameters to produce airwake data for any shape of ship with an aft flight deck and for any wind direction. Assessment of the model in a piloted flight simulator has been very favorable with the main criticism being the absence of turbulence which is available in the model but could not be used because of difficulties in simulating helicopter responses at that time. Comparison of airwake estimates with a set of boundary layer wind tunnel results shows good agreement in the complex flow with the wind from starboard at 30 deg. and suggests some areas where adjustments to the model could improve the comparison for other wind directions. The model has highlighted several interesting features of airwakes, including probable improvements in airwakes if hangar tops can have porous net fences around the edges. the effects of gradients in vertical airflow velocities on control of a helicopter's height, and the need to include response to flow gradients in helicopter aerodynamic models for simulation of operations in airwakes. It is recommended that the airwake model should be validated against full scale and wind tunnel data on other shapes of ship, and, after any necessary adjustments to the model, it should be used for a trial installation on a suitable existing helicopter training flight simulator, prior to introduction into general use for R & D in helicopter/ship research programs and for helicopter training simulators.
Author
Wind Direction; Ships; Helicopters; Flight Simulators; Edges; Boundary Layers; Aerodynamic Characteristics; Air Flow

19970000604 Defence Research Agency, Flight Dynamics and Simulation Dept., Bedford, UK
A Dynamic Challenge: Helicopter/Ship Interface Simulation: Development, Integration and Application
Tate, S. J., Defence Research Agency, UK; Apr. 1996; 16p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

Piloted simulation has a potentially major role to play in training, test and evaluation and research in support of the helicopter/ship dynamic interface. The combination of visual/motion cueing and vehicle/environment modeling problems makes the helicopter/ship dynamic interface one of the most challenging in the simulation of aerospace vehicles. The exacting fidelity requirements of this application have hindered the use of simulation in this area until recently. This paper reviews the major fidelity issues of helicopter/ship interface simulation and describes some of the findings of a survey carried out of current simulators to attempt to identify areas that require improvement. The cost and operational benefits of the use of high fidelity piloted simulation in this field are outlined. Current Defense Research Agency (DRA) research work directed at improving models of the natural environment is described, as well as the thrust that future work will take. The uses of the high fidelity helicopter/ship dynamic

interface simulation of the DRA Advanced Flight Simulator (AFS) in support of other research packages is described. This work covers the establishment of handling qualities criteria for maritime helicopters and the use of simulation to develop improved pilot visual cues for deck operations. Use of simulations has allowed rapid development at relatively low cost and at much reduced risk.
Author
Flight Simulation; Computerized Simulation; Visual Stimuli; Ships; Helicopters; Flight Simulators

19970000612 Alenia Aeronautica, Flight Simulation Center, Turin, Italy
Technological and Economical Limits Experienced for R/D Mission Simulation
Castoldi, P., Alenia Aeronautica, Italy; Allocca, M., Alenia Aeronautica, Italy; LoPresti, S., Alenia Aeronautica, Italy; Trifoglietti, M., Alenia Aeronautica, Italy; Apr. 1996; 10p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This paper illustrates some significant lessons learned through R&D activities performed at the Flight Simulation Center of Alenia Aeronautica in Turin, highlighting experiences in Data Base Generation, Graphics and Graphics Prototyping, Particular Simulated Tasks and Integration of Dedicated Devices such as Target Projector and g-Seat g-Suit System. For each specific mission task, the problems, solutions, alternatives and resulting system limitations involved in identifying the required system characteristics are discussed.
Author
Research and Development; Flight Simulation; Flight Simulators; Computerized Simulation

19970000613 Dassault Aviation, Dept. Simulation Validation, Saint-Cloud, France
Use of Simulation for Design of the Rafale Navigation and Armament System ***Utilisation de la Simulation pour la Conception du SNA du Rafale***
Goussault, R., Dassault Aviation, France; Leclere, M., Centre d'Essais en Vol, France; Apr. 1996; 8p; In French; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

In this presentation conducted jointly by Dassault Aviation and the Flight Test Center (FTC), we first indicate important innovations introduced into the design of the Navigation and Armament System of Rafale Airplane and in particular the fundamental role of simulation. We subsequently show the synergy that exists between Dassault Aviation and the Flight Test Center and definition of the needs for this simulation, in the choice of models and equipment that comprise it and in its use by the industrial architect of the state. A few comments are necessary before entering into the heart of the matter: in the Rafale program, Dassault Aviation is the industrial architect of the Navigation and Armament System; the Flight Test Center is, within the General Administration for Armament, the expert state organization for flight tests as well as applications of aviation equipment and military onboard systems; and simulation here designates pilot simulation.
Author
Navigation; Aircraft Design; Computer Aided Design; Computerized Simulation

19970000614 Daimler-Benz Aerospace A.G., Dept. LME, Friedrichshafen, Germany
Arc Segment Attitude Reference (ASAR): Simulator Application During the Development Process of a New Attitude Reference Symbology
Fuchs, W., Daimler-Benz Aerospace A.G., Germany; Fischer, G., Daimler-Benz Aerospace A.G., Germany; Flight Simulation: Where are the Challenges?; Apr. 1996; 6p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Pilots of modern fighter aircraft with high pitch and extremely high roll rates complain about fast moving and twisting pitch ladders on the head-up display (HUD) and the necessity to virtually concentrate their entire attention on the attitude references in order to maintain orientation in space when performing aggressive three-dimensional maneuvers. For this reason we were considering a more stationary flight attitude symbology to allow for attitude awareness, which requires less attention and concentration. The result was the introduction of the Arc Segment Attitude Reference (ASAR) Symbology. After a number of alternating simulator trials and flight tests for further development and refinement of the symbology, a final version was agreed and already implemented in experimental programs.
Author
Attitude (Inclination); Head-Up Displays; Roll; Twisting; Pilots (Personnel); Flight Altitude

19970000615 British Aerospace Defence Ltd., Systems Engineering Research and Development, Preston, UK
Issues in the Flight Clearance of Vehicle Management Systems
Diston, D. J., British Aerospace Defence Ltd., UK; Weller, B. R. C., British Aerospace Defence Ltd., UK; Apr. 1996; 14p; In

English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The adoption ot highly-integrated and complex aircraft systems will facilitate the development of optimum strategies for vehicle management. This will provide benefits in functional performance and operational effectiveness. The drive towards standardization implies the adoption of some form of modular avionic architecture, thereby adding the benefits of improved logistics. In this paper, it is argued that these developments force a fundamental review of existing approaches to flight clearance. A number of challenges are proposed in the areas of Operating Systems, Analytical Control Theory and 'Virtual Rig' Simulation. In conclusion, the paper anticipates the evolution of a 'modular' procedure which might provide a legal basis for the certification of aircraft systems.

Author

Certification; Standardization; Management Systems; Clearances; Aircraft Design; Aircraft Industry

19970000616 National Aerospace Lab., Flight Simulation Dept., Amsterdam, Netherlands

The Dutch National Simulation Facility: Advancements in Simulator Technology and Application

Offerman, H. A. J. M., National Aerospace Lab., Netherlands; Apr. 1996; 10p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Dutch National Aerospace Laboratory NLR has developed during the last three years an advanced Full Mission Simulation capability for fast jet fixed wing and rotary wing aircraft. This Full Mission simulator, named the National Simulation Facility NSF, is created for research in training methodologies, investigation of simulation and simulator requirements for specific training tasks and to support industrial development of cockpit and aircraft systems. The current capability of the simulator focuses on the F-16 Mid-Life Update configuration, but will be extended to accommodate manned helicopter simulation later this year. The latter will be directed towards the recently (by the Dutch Air Mobile Brigade) procured Boeing CH-47D Chinook medium-heavy transport helicopter, and the McDonnell Douglas AH-64D Apache attack helicopter. This paper will address the various technical aspects of the National Simulation Facility.

Author

CH-47 Helicopter; Cockpits; F-16 Aircraft; Rotary Wing Aircraft; Flight Simulation; Flight Simulators

19970000617 Centre d'Essais en Vol, Section Etudes et Simulation, Istres, France

Piloted Multiple-Target Simulator for Development of Air-to-Air Fire Control ***Simulateur Multicible Pilote pour le Developpement des Conduites de Tir Air/Air***

Chevillot, J.-E., Centre d'Essais en Vol, France; Apr. 1996; 12p; In French; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Studies and Simulation Section of the Flight Test Center (Ministry of Defense) is participating closely in development of navigation and armament systems for all aircraft carrier programs (Rafale, Tigre, Mirage 2000, ...). The simulation tests of these navigation and armament systems require implementation of targets or teams that would comprise the tactical environment of the pilot. But as a function of the state of advancement of the investigations, the need varies from an automatic tactical environment to implementation of a team or of piloted targets for a greater level of realism.

Author

Fire Control; Target Simulators; Simulation

19970000620 National Research Council of Canada, Flight Research Lab., Ottawa, Ontario Canada

ASRA: A New Tool for In-Flight Simulation. Current Status and Actuation Studies

Morgan, J. Murray, National Research Council of Canada, Canada; Baillie, Stewart W., National Research Council of Canada, Canada; Flight Simulation: Where are the Challenges?; Apr. 1996; 8p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Flight Research Laboratory (FRL) of the Institute for Aerospace Research (LXR) is in the process of developing an Advanced Systems Research Aircraft (ASRA) based on a Bell 412HP helicopter. This paper describes the current status of this facility, and discusses the approach being taken towards fly-by-wire actuation in this high control power host vehicle. The primary problem faced in designing a research fly-by-wire (FBW) actuation system for this aircraft is that of maintaining an adequate level of flight safety throughout the entire flight envelope, while limiting its simulation capabilities as little as possible, this is discussed. A scheme for compound actuation of the 'critical' axes is introduced. Initial off-line simulations of various failure modes are described and the results presented. The purpose of this paper is to present to the community a proposed approach to this problem and to describe some initial studies in support of the design concept used.

Author

Research Aircraft; Fly by Wire Control; Flight Simulation; Helicopters

19970000622 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany

ATTAS and ATTHeS In-Flight Simulators

Buchholz, J. J., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Bauschat, J.-M., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hahn, K.-U., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Pausder, H. J., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Apr. 1996; 16p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper gives an overview of DLR's latest flight experiments, both with the fixed-wing in-flight simulator ATTAS and the helicopter in-flight simulator ATTHeS. After a detailed description of both testbeds and the corresponding ground based simulators, flight test results are presented. These include experiments on in-flight simulation, rate saturation, reconfiguration, flight control laws, handling qualities, and vision based hovering. The paper concludes with a discussion on certain aspects of simulation fidelity.

Author

Flight Control; Control Theory; Flight Simulation; Flight Simulators; In-Flight Monitoring

19970000624 Thomson Training and Simulation Ltd., Clergy Pontoise, France

Experience Acquired During Implementation of Interactive Distributed Simulation Protocols With Already Existing Simulations ***Experiences Acquises Lors de la Mise en Oeuvre des Protocoles SID Avec des Simulations Deja Existantes***

CrassousdeMedeuil, Claude, Thomson Training and Simulation Ltd., France; Apr. 1996; 10p; In French; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The need to combine simulators or simulations grows each day, and the diversity of these simulations is very great. Past experiments have demonstrated that it is nearly impossible to interconnect pre-existing simulations when necessary for this purpose to use common methods and structures that are imposed for all simulations. The availability of Interactive Distributed Simulations (SID) allows one to combine heterogeneous simulations without having to modify them in an important way. In addition, current simulators have certain particular features when one compares them to recent simulators. They are often limited in memory, calculation power, and only rarely have means to connect to communication networks.

Author

Flight Simulation; Computerized Simulation

19970000625 Naval Air Warfare Center, Flight Vehicle Simulation Branch, Patuxent River, MD USA

High Fidelity, Mobile, Net Workable Trainers: The Trainers of the Future?

Miller, Chad C., Naval Air Warfare Center, USA; Perdue, David, Naval Air Warfare Center, USA; Davis, Scott, Naval Air Warfare Center, USA; Apr. 1996; 8p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The U.S. Naval Air Warfare Center Aircraft Division Patuxent River personnel recently completed a high fidelity, low cost mobile prototype AH-1W Aircrew Procedures Trainer for the USA Marine Corps at Camp Pendleton, California. The use of recent technological breakthroughs in both super-micro computers and visual display technologies made this program possible. These breakthroughs pave the way for future OFT/APT developments. The AH-1W APT project demonstrated the application of evolving simulation technology in four areas. First, that new technologies reduce the physical size of room required to support computational requirements of WSTs. Second, newer technologically advanced COTS computers can be used in a rugged environment without any special expensive considerations. Third, existing full-size training systems could be supplemented or replaced by such small, mobile devices such as the AH-1W high fidelity trainer prototype constructed at NAWC AD. Fourth, fixed wing tactical aircraft training systems that do not require motion cueing devices are particularly attractive for this application.

Author

Flight Simulation; Training Devices; Flight Training; Display Devices; Computers; Aircraft Configurations

19970000626 Science Applications International Corp., McLean, VA USA

Simulation, Distributed Simulation, and Synthetic Environments. Future Applications and Challenges

Adolph, Charles E., Science Applications International Corp., USA; Thorpe, Jack, Science Applications International Corp., USA; Apr. 1996; 10p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

This survey paper reviews current practices in simulation technology with emphasis on aircraft development and testing, followed by a discussion of present and future applications of distributed simulation and synthetic environments. The aviation community has used a wide variety of simulation tools for over 35 years. The benefits of current generation standalone simulation tools, including system integration laboratories, are well understood. Distributed simulation is beginning to be used to support

training and requirements definition; test applications are also beginning to be explored. Advanced distributed simulation provides an unprecedented opportunity to explore new concepts as well as improve the efficiency of test and training activities.With the rapid increases in information processing technology, synthetic environments will be used increasingly to support test and training, both in standalone and interactive distributed modes. There are numerous challenges in developing and applying these technologies; including simulation fidelity and scalability, verification and validation. There is also a need to decrease simulation costs. The emergence of distributed simulation has been the catalyst for increased interaction between the simulation world and test and training systems. Next generation range and platform instrumentation architectures will be designed to facilitate interaction between live players and simulated entities.
Author
Flight Simulation; Computerized Simulation; Systems Integration; Systems Simulation; Procedures

19970000846 Federal Aviation Administration, Airport and Aircraft Safety, Atlantic City, NJ USA
Evaluation of L-8O4 Elevated Runway Guard Light Fixtures
Katz, Eric, Federal Aviation Administration, USA; Mar. 1996; 21p; In English
Report No.(s): AD-A307589; DOT/FAA/AR-TN96/18; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The number of inadvertent runway incursions has grown during recent years, increasing the importance of protective visual guidance systems for incursion prevention. One such visual system is the L-804 elevated runway guard light fixture. Also known as a wig-wag light, these fixtures contain two alternately flashing yellow lights and are used to help identify runway holding positions to pilots. Pilots, however, have indicated that the light intensity (600 candelas minimum average intensity) and flash rate (average of 35 flashes per minute per lamp) of the L-804s are inadequate. The L-804s were examined under day and night Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions from various distances and angles. Particular attention was paid to performance characteristics such as intensity, flash rate, vertical and horizontal aiming angle, lamp separation, and the usefulness of providing a hood over each lamp. As a result of the evaluation it was determined that the L-804 specifications needed to be modified. Flash rate should be increased to 45 to 50 flashes per minute per lamp. The light intensity of the Mode 1 (constant current) L-804 when energized at 6.6 amps and tested with one lamp in the steady burning mode and the other lamp masked out should be 4100 candelas. The light intensity of the Mode 2 (constant voltage) L-804 when energized at 120 volts and similarly tested should be 940 candelas.
DTIC
Light Sources; Steady State; Combustion; Luminous Intensity

19970000907 NASA Langley Research Center, Hampton, VA USA
NASA Boeing 737 Aircraft Test Results from 1996 Joint Winter Runway Friction Measurement Program
Yager, Thomas J., NASA Langley Research Center, USA; 1996; 10p; In English; 1st; International Meeting on Aircraft Performance on Contaminated Runways (IMAPCR '96), 22-23 Oct. 1996, Montreal, Quebec, Canada
Report No.(s): NASA-TM-110482; NAS 1.15:110482; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
A description of the joint test program objectives and scope is given together with the performance capability of the NASA Langley B-737 instrumented aircraft. The B-737 test run matrix conducted during the first 8 months of this 5-year program is discussed with a description of the different runway conditions evaluated. Some preliminary test results are discussed concerning the Electronic Recording Decelerometer (ERD) readings and a comparison of B-737 aircraft braking performance for different winter runway conditions. Detailed aircraft parameter time history records, analysis of ground vehicle friction measurements and harmonization with aircraft braking performance, assessment of induced aircraft contaminant drag, and evaluation of the effects of other factors on aircraft/ground vehicle friction performance will be documented in a NASA Technical Report which is being prepared for publication next year.
Author
Boeing 737 Aircraft; Aircraft Performance; Friction Measurement; Runway Conditions

19970001170 Institute for Human Factors TNO, Soesterberg, Netherlands
Specifications for Implementation of Performance Measurement and Feedback Systems for the Leopard 2 and YPR-765 Driving Simulators ***Final Report Specificaties voor de implementatie van prestatiemeting en feedback systemen voor de Leopard 2 en VPR-765 rijsimulatoren***
Korteling, J. E., Institute for Human Factors TNO, Netherlands; vanErp, J. B. F., Institute for Human Factors TNO, Netherlands; Padmos, P., Institute for Human Factors TNO, Netherlands; Jul. 30, 1996; 31p; In English
Contract(s)/Grant(s): A96/KL/345
Report No.(s): TNO-TM-96-A028; RP-96-0164; Copyright; Avail: Issuing Activity (TNO Human Factors Research Institute,

Kampweg 5, 3769 De Soesterberg, The Netherlands), Hardcopy, Microfiche

In a previous report, specifications and guidelines were given for the implementation of Performance Measurement and Feedback (PMF) systems for the Leopard 2 and YPR-765 driving simulators. In connection with an update program for both simulators, the Dutch Armed Forces have decided to implement both systems. Therefore, the above-mentioned report is revised, taking into consideration changes in the Learning trajectories, and comments of the, by now, experienced users of both simulators. Report IZF 1992 A-20 is herewith expired. The PMF systems objectively measure the critical task variables of a selection of the most relevant subtasks. Application of these systems is expected to improve the efficiency of the training of student drivers on these simulators. In order to enable system engineers to program and implement these systems on both simulators, the present report provides an exact and detailed description of scores, vehicle reference points for calculation of scores and for the trajectories over which scores will be measured, and weights for subtask variables and for clusters of subtasks. In addition, general requirements are provided with regard to the calculation and presentation of scores and marks, database management, and system operation. Author

Tanks (Combat Vehicles); Simulators; Education

19970001173 Institute for Human Factors TNO, Soesterberg, Netherlands

Visual and Auditive 3D Displays as Support for Locating Target Jets ***Interim Report Visuele en auditieve 3D displays als ondersteuning bij het opsporen van doelvliegtuigen***

Veltman, J. A., Institute for Human Factors TNO, Netherlands; vanErp, J. B. F., Institute for Human Factors TNO, Netherlands; vanBreda, L., Institute for Human Factors TNO, Netherlands; Bronkhorst, A. W., Institute for Human Factors TNO, Netherlands; Aug. 27, 1996; 31p; In Dutch

Contract(s)/Grant(s): A95/KLu/341

Report No.(s): TNO-TM-96-A036; RP-96-0173; Copyright; Avail: Issuing Activity (TNO Human Factors Research Institute, Kampweg 5, 3769 De Soesterberg, The Netherlands), Hardcopy, Microfiche

In order to determine the most effective information presentation to aid pilots in locating target jets, 12 pilots had to follow a target jet that suddenly disappeared and reappeared at a random spot somewhere around the own jet in a flight simulator. The pilot, supported by a 2D or 3D (perspective) radar display, was tasked with getting the target jet as fast as possible in front of his own jet. In half of the exercises, the position of the target jet was also presented by 3D sounds. to investigate the effects of high visual load upon task performance, the pilots had to perform a visual task together with the flight task under some conditions. to investigate the effects of 3D sound when two sounds are presented, two target jet could be heard in half of the trials. Results showed that performance was best when a 3D perspective radar display was used. 3D sound improved the performance when it was combined with the 2D but not with the 3D radar, probably because performance was already maximal with the 3D display. The performance on the visual task was improved with 3D sound, indicating that attention is available when a visual radar is supported by a 3D sound system. The sound of two target jets with the 3D presentation jets did not affect performance.

Derived from text

Pilot Performance; Display Devices; Flight Simulators; Visual Tasks; Target Acquisition; Audio Signals

10
ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

19970000587 NASA Johnson Space Center, Houston, TX USA

STS-79 Flight Day 7

Sep. 22, 1996; In English; Videotape: 15 min. playing time, in color, with sound

Report No.(s): NASA-TM-111770; BRF-1399G; NONP-NASA-DK-96-1996093679; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this seventh day of the STS-79 mission, the flight crew, Cmdr. William F. Readdy, Pilot Terrence W. Wilcutt, Mission Specialists, Thomas D. Akers, Shannon Lucid, Jay Apt, and Carl E. Walz, share a brief video tour of the Mir Space Station with flight controllers, taking a break from the transfer activities that has occupied the astronauts' time during three days of docked operations. Readdy and Apt floated through several of Mir's modules and back into Atlantis' double Spacehab module during

the tour pointing out the numerous transfer items stowed on both spacecraft. Readdy, Wilcutt, Lucid and Blaha are seen discussing their mission in an interview with CNN's John Holliman.
CASI
Space Transportation System Flights; Mir Space Station; Flight Control; Space Flight; Space Missions

11
CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

19970001031 Naval Research Lab., Washington, DC USA
Experiences in Seeking Stabilizers for Zirconia Having Hot Corrosion-Resistance and High Temperature Tetragonal (t') Stability ***Interim Report***
Jones, Robert L., Naval Research Lab., USA; Apr. 16, 1996; 24p; In English; Limited Reproducibility: More than 20% of this document may be affected by poor print
Report No.(s): AD-A307697; NRL/MR/6170--96-7841; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This report summarizes the results of a research effort aimed at identifying hot corrosion-resistant stabilizers for zirconia (ZrO2) which could be used in zirconia-based thermal barrier coatings (TBCs) for engines operating on marine fuel under sea-going conditions. Among the oxides investigated were TiO2, CeO2, Y2O3, MgO, Sc2O3, In2O3, and SnO2. A brief overview of the hot corrosion of zirconia TBCs is given to illustrate the rationale used in evaluating the hot corrosion performance of the candidate oxides. The most promising stabilizer found for hot corrosion resistance was Sc2O3, or perhaps mixtures of Sc2O3 and small amounts of Y2O3. It was also discovered that Sc2Os, Y2O3-stabilized ZrO2 (SYSZ), of approx. 7 mol% of total stabilizer of which 5-20% is Y2O3, shows improved 1400 deg C stability of the tetragonal (t') phase as compared to present-day Y2O3-stabilized ZrO2 TBC compositions. This new material may have potential for TBC use in future high temperature, high efficiency gas turbine engines.
DTIC
Gas Turbine Engines; Yttria-Stabilized Zirconia; High Temperature Gases; Hot Corrosion; Thermal Control Coatings; Thermal Stability; Titanium Oxides; Corrosion Resistance

19970001047 Oak Ridge National Lab., High Temperature Materials Lab., TN USA
Isothermal and cyclic oxidation of an air plasma-sprayed thermal barrier coating system
Haynes, J. A., Oak Ridge National Lab., USA; Ferber, M. K., Oak Ridge National Lab., USA; Porter, W. D., Oak Ridge National Lab., USA; Rigney, E. D., Alabama Univ., USA; [1996]; 9p; In English; 41st; American Society of Mechanical Engineers (ASME) International Gas Turbine and Aeroengine Congress and Exposition, 10-13 Jun. 1996, Birmingham, UK
Contract(s)/Grant(s): DE-AC05-96OR-22464
Report No.(s): CONF-960608-7; DE96-011952; No Copyright; Avail: Issuing Activity (Department of Energy (DOE)), Microfiche

Thermogravimetric methods for evaluating bond coat oxidation in plasma-sprayed Thermal Barrier Coating (TBC) systems were assessed by high-temperature testing of TBC systems with Air Plasma-Sprayed (APS) Ni-22Cr-10Al-1Y bond coatings and yttria-stabilized zirconia top coatings. High-mass thermogravimetric analysis (at 1150 C was used to measure bond coat oxidation kinetics. Furnace cycling was used to evaluate APS TBC durability. This paper describes the experimental methods and relative oxidation kinetics of the various specimen types. Characterization of the APS TBCs and their reaction products is discussed.
DOE
Aluminum Alloys; Ceramics; Chromium Alloys; Gas Turbine Engines; Nickel Alloys; Sprayed Coatings

12
ENGINEERING

Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

19970000593 Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium
Computational Fluid Dynamics, Volume 1
1996; ISSN 0377-8312; 472p; In English, 25-29 Mar. 1996, Rhode-Saint-Genese, Belgium; Sponsored by Von Karman Inst. for Fluid Dynamics, Belgium
Report No.(s): VKI-LS-1996-06-Vol-1; Copyright; Avail: Issuing Activity (Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium), Hardcopy, Microfiche

At cruise flight conditions, a variety of approximate techniques are used in the design of a flight vehicle. Under the assumptions of inviscid and irrotational flow, versatile and reliable panel methods and nonlinear potential equation solvers are used. Recently, substantial progress has been made towards the goal of improving the mathematical models of the aerodynamic techniques used in aircraft design. Both the Euler and the time-averaged Navier Stokes equations are being introduced into the design process. This progress is being driven by: (1) the accuracy and efficiency of the numerical algorithms for solving these equations have been improved considerably, and (2) the significant advancements in the memory capacity and processing time for computers.
Derived from text
Computational Fluid Dynamics; Navier-Stokes Equation; Aircraft Design; Euler Equations of Motion; Computer Aided Design; Nonlinear Equations; Algorithms

14
LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and space biology.

19970000596 Thomson Training and Simulation Ltd., Crawley, UK
Simulated Visual Scenes: Which are the Critical Cues?
McIntyre, H. M., Thomson Training and Simulation Ltd., UK; Roberts, M. E. C., Thomson Training and Simulation Ltd., UK; Apr. 1996; 8p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Research has shown that pilots can extract information from relatively impoverished visual scenes. However, performance of a variety of simulated flight tasks improves with greater scene complexity. Simulator visual systems cannot replicate the real world. Further, it is not possible to optimize visual system performance in all areas simultaneously. Some improvements in flight simulator visual cueing will come inevitably, as technology advances. Others present a research challenge, particularly where the likely effects of missing, contradictory or distorted information are not fully understood. These include: The luminance dynamic range of the display; this is far less than that encountered in reality. Relative luminances between objects cannot be maintained. Luminance variations with range will therefore be distorted. Maintaining accurate colour ratios at low luminances is also difficult. By careful mapping, detection ranges could be adjusted to be nominally accurate under specific conditions but not continuously accurate. The implications need to be considered carefully. The simulation of night scenes, with some illuminated areas may require the simultaneous mixing of 2 or 3 models in the same scene, creating unusual data base management demands. This requires further investigation. Distance judgments may be observed to be inaccurate in the simulator. to prevent this leading to degraded simulator performance and deficiencies in training it may be possible to compensate for the absence of some cues by enhancing the effect of others. Further investigation is required to establish whether such compensation is truly possible, to what degree it enhances simulator effectiveness and to identify associated costs.
Author
Visual Discrimination; Visual Perception; Pilots (Personnel); Visual Stimuli; Cues; Flight Crews; Flight Simulators; Luminance; Flight Simulation

19970000597 Cranfield Univ., Dept. of Applied Psychology, Bedford, UK
Visual Scenes for Battlefield Helicopter Operations: Evaluation of Requirements and How to Specify Them
Deighton, C. D. B., Cranfield Univ., UK; Woodfield, Alan A., Woodfield Aviation Research, UK; Apr. 1996; 12p; In English;

Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

The structured specification and evaluation of simulated visual scenes for training pilots in tasks such as Battlefield Helicopter operations is required to ensure that cost-effective flight simulator training is being achieved. Historically this has been a difficult process because of a lack of consistent and prioritized descriptions of different visual flight activities within the intended training missions; limited evaluations of the contributions and relative importance of different scene features within appropriate operational scenes; and a lack of any structured way of collating and presenting such information to those who specify and design visual scene databases for flight training simulators. A research program funded by the UK Defence Research Agency was conducted in collaboration with Cranfield University, UK to address these challenges. Specific aims were to identify and prioritize visual flight activities in the context of a battlefield nap-of-the-earth (NoE) attack mission; to determine the relative importance of visual scene components (e.g. woods, farm buildings, roads, livestock) to the achievement of visual flight activities: and to assess the impact of removing or adding information to the scene upon the achievement of visual flight activities in a mission simulator. The purpose of the paper is twofold: firstly to describe the human factors procedures and techniques used to address these aims and secondly to describe the proposed structure of a computer based relational database to integrate the results of the program. Selected findings from the study are used to highlight the structure of the database.

Author

Visual Flight; Nap-Of-The-Earth Navigation; Helicopters; Flight Training; Flight Simulators; Combat; Visual Discrimination

19970000598 Aeronautical Systems Div., Training Systems Product Group, Wright-Patterson AFB, OH USA

Visual System Operational Evaluation

Brown, James E., Aeronautical Systems Div., USA; Poe, Don R., Aeronautical Systems Div., USA; Lincourt, Timothy J., Aeronautical Systems Div., USA; Leos, Melissa J., Aeronautical Systems Div., USA; Apr. 1996; 12p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the results of an operational evaluation of the training effectiveness of three different visual technologies. Purpose of the program was to determine (1) trainability of low altitude tasks on available visual display technology; (2) demonstrate current visual simulation technology to users; (3) get feedback from those users to help define future visual requirements; and (4) provide information and data to support future simulation acquisition decisions. Three visual simulation display technologies at three different sites were evaluated: (1) a dome display with head tracked area-of-interest, (2) a rear-projection display, and (3) a fiber optic helmet mounted display. A team of highly experienced F-16C and F-16E instructor pilots evaluated each of the three display technologies. Three evaluation missions were flown by each pilot. At the completion of each evaluation mission, extensive questionnaires were completed and de-briefings were conducted to rate the training capability of the visual system for each task. Results are presented for each of the three display systems evaluated. The results are expressed in terms of tasks that were rated trainable and those tasks that were not trainable in the system.

Author

Display Devices; Training Evaluation; Helmet Mounted Displays; Flight Simulation; Visual Acuity; Visual Perception

19970000599 NASA Ames Research Center, Moffett Field, CA USA

Yaw Motion Cues in Helicopter Simulation

Schroeder, Jeffrey A., NASA Ames Research Center, USA; Johnson, Walter W., NASA Ames Research Center, USA; Apr. 1996; 16p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A piloted simulation that examined the effects of yaw motion cues on pilot-vehicle performance, pilot workload, and pilot motion perception was conducted on the NASA Ames Vertical Motion Simulator. The vehicle model that was used represented an AH-64 helicopter. Three tasks were performed in which only combinations of vehicle yaw and vertical displacement were allowed. The commands issued to the motion platform were modified to present the following four motion configurations for a pilot located forward of the center of rotation: (1) only the linear translations, (2) only the angular rotation, (3) both the linear translations and the angular rotation, and (4) no motion. The objective data indicated that pilot-vehicle performance was reduced and the necessary control activity increased when linear motion was removed; however, the lack of angular rotation did not result in a measured degradation for almost all cases. Also, pilots provided subjective assessments of their compensation required, the motion fidelity, and their judgment of whether or not linear or rotational cockpit motion was present. Ratings of compensation and fidelity were affected only by linear acceleration, and the rotational motion had no significant impact. Also, when only linear motion was present, pilots typically reported the presence of rotation. Thus, linear acceleration cues, not yaw rotational cues, appear necessary to simulate hovering flight.

Author

Yawing Moments; Cues; AH-64 Helicopter; Motion Perception; Motion Simulation; Vertical Motion Simulators; Flight Simulation

15
MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

19970000601 Sogitec Electronique, Electronique Div., Suresnes, France
Apogee: A Breakthrough in Synthetic Image Generation
Chauvin, Jean-Claude, Sogitec Electronique, France; Apr. 1996; 8p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

Though polygon and pixel capacity remain significant parameters of real time image generators, the visual aspect and the content's quality of the images take more and more importance with their utilization in NOE flight of helicopters, or combined arms simulation and interoperability context. In this field, APOGEE represents a breakthrough in real time image quality and complex scene content restitution. An improved management of the database guarantees the best restitution of the scene content accounting for the specific polygon and pixel capacity of one system. AZtec, the new algorithm developed by Sogitec for hidden part elimination and antialiasing, allows for processing of opaque, transparent, or lighting polygon participation, in any number and in any order. A nice rendering of complex scenes, regarding the lighting and shading aspect, is obtained without the sorting constraints encountered in similar systems, to process transparent faces at the end of the computation cycle. On the whole, the optimization and the integration of all stages of the APOGEE image computer, provide the best figures on all image generation criteria, and offer modularity in terms of performance and image definition.
Author
Image Resolution; Illuminating; Helicopters; Image Analysis; Image Converters; Image Enhancement; Imaging Techniques

19970000605 NASA Ames Research Center, Moffett Field, CA USA
Simulation of Rotor Blade Element Turbulence
McFarland, R. E., NASA Ames Research Center, USA; Duisenberg, Ken, Syscon Corp., USA; Apr. 1996; 12p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

A turbulence model has been developed for blade-element helicopter simulation. This model, called Simulation of Rotor Blade Element Turbulence (SORBET), uses an innovative temporal and geometrical distribution algorithm that preserves the statistical characteristics of the turbulence spectra over the rotor disc, while providing velocity components in real time to each of five blade-element stations along each of four blades. An initial investigation of SORBET has been performed using a piloted, motion-based simulation of the Sikorsky UH60A Black Hawk. Although only the vertical component of stochastic turbulence was used in this investigation, vertical turbulence components induce vehicle responses in all translational and rotational degrees of freedom of the helicopter. The single-degree-of-freedom configuration of SORBET was compared to a conventional full 6-degrees-of-freedom baseline configuration, where translational velocity inputs are superimposed at the vehicle center of gravity, and rotational velocity inputs are created from filters that approximate the immersion rate into the turbulent field. For high-speed flight the vehicle responses were satisfactory for both models. Test pilots could not distinguish differences between the baseline configuration and SORBET. In low-speed flight the baseline configuration received criticism for its high frequency content, whereas the SORBET model elicited favorable pilot opinion. For this helicopter, which has fully articulated blades, results from SORBET show that vehicle responses to turbulent blade-station disturbances are severely attenuated. This is corroborated by in-flight observation of the rotor tip path plane as compared to vehicle responses.
Author
Rotors; Blades; Motion Simulation; Helicopters; Degrees of Freedom; Center of Gravity; High Frequencies

19970000606 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany
C-160 Ground Handling Model Update Using Taxi Test Data
Fischenberg, D., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Moennich, W., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Apr. 1996; 8p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A02, Hardcopy; A04, Microfiche

The need for representative ground handling modelling for flight simulators according to modern approval standards is generally strong. A main problem is to find an adequate level of model accuracy for the complex physics of ground related maneuvers. In this paper some examples of the development process of a C-160 ground handling model are presented. The original analytically derived model is updated and validated with taxi test data using system identification methods. Not only the identification of model

parameters is discussed, but it is also demonstrated how to derive equivalent submodels in order to reduce the complexity of the data bases without hardly any loss of simulation fidelity.
Author
C-160 Aircraft; Ground Handling; Parameter Identification

19970000607 Sogitec Electronique, Electronique Div., Suresnes, France
Tactical Environment Servers
Heran, Francois D., Sogitec Electronique, France; Apr. 1996; 4p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A01, Hardcopy; A04, Microfiche

Mission training or evaluation on a manned military simulator requires the presence of friend and foe forces. These forces, either computer generated or man-controlled, must react in an intelligent manner, in real time. Due to restrictions in software tools and computing power (or manpower in the case of dedicated manned stations), as well as emphasis put on procedural and skill training more than on mission training, many existing simulators feature little or no tactical environment. This paper presents a concept, the tactical environment server, which has been developed to populate the battle space of real time combat simulators with various computer generated friends and foes. In the first part, tactical environment requirements for air combat and land battle simulators are discussed. Coherence between the server and its clients, one of the most problematic technical issues, is analysed. A second part addresses the algorithmic and technological trade-offs one has to consider to implement a real-time tactical environment server. The connection of the server to the client simulator(s), via a network using the DIS protocol or via other solutions, is also discussed. Implementation of a tactical environment servers for a Mirage 2000 and a combat helicopter simulator are presented and conclusions are drawn.
Author
Protocol (Computers); Training Evaluation; Real Time Operation; Simulators; Helicopters; Combat

19970000628 Armstrong Lab., Aircrew Training Research Div., Mesa, AZ USA
Estimating the Training Effectiveness of Interactive Air Combat Simulation
Wang, Wayne L., Armstrong Lab., USA; Bell, Herbert H., Armstrong Lab., USA; Apr. 1996; 12p; In English; Also announced as 19970000594; Copyright Waived; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper is concerned with the general problem of measuring the value of simulation for combat mission training. There are a number of engineering efforts currently attempting to develop multi-player, virtual simulations that will allow soldiers, sailors, and pilots to interact with one another in a synthetic battlefield for combat mission training. This paper will briefly discuss the continuation training environment that simulation must effectively complement and the various approaches for obtaining training effectiveness data for estimating the training payoff of these efforts. It will then summarize the results of recent efforts conducted by the Armstrong Laboratory to assess the value of combat mission simulation for continuation training of pilots. Although the results of these studies indicate high user acceptance for simulation and improved performance during the course of simulator-based training, transfer of training data has yet to be obtained.
Author
Flight Simulation; Transfer of Training; Training Simulators; Military Operations; Military Technology

19970000856 California Inst. of Tech., Control and Dyamical Systems, Pasadena, CA USA
Robust Control Theory and Applications ***Final Report, 1 Nov. 1991 - 30 Sep. 1995***
Doyle, John, California Inst. of Tech., USA; Sep. 30, 1995; 9p; In English
Contract(s)/Grant(s): F49620-92-J-0026; AF Proj. 2304
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This is the final report for AFOSR F49620-92-J-0026, which began in 1992 and ended in 1995. The research described here includes robust control, integrated modeling, identification, and analysis, nonlinear control implicit systems, and experimental testbeds for evaluating theoretical contributions. During the period of this program, Caltech established a new graduate department in Control and Dynamical Systems (CDS) which will also be briefly described.
DTIC
Control Theory; Mathematical Models; Algorithms; Computerized Simulation; Software Engineering; Flight Control; Computational Fluid Dynamics

16
PHYSICS

Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.

19970000906 Lockheed Martin Engineering and Sciences Co., Hampton, VA USA
ROTONET Primer
Prichard, Devon S., Lockheed Martin Engineering and Sciences Co., USA; Oct. 1996; 96p; In English
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This document provides a brief overview of use of the ROTONET rotorcraft system noise prediction capability within the Aircraft Noise Program (ANOPP). Reviews are given on rotorcraft noise, the state-of-the-art of system noise prediction, and methods for using the various ROTONET prediction modules.
Author
Aircraft Noise; Noise Prediction (Aircraft)

19970001270 National Aeronautics and Space Administration. Langley Research Center, Hampton, VA USA
Performance of Optimized Actuator and Sensor Arrays in an Active Noise Control System
Palumbo, D. L., National Aeronautics and Space Administration. Langley Research Center, USA; Padula, S. L., National Aeronautics and Space Administration. Langley Research Center, USA; Lyle, K. H., Army Research Lab., USA; Cline, J. H., Army Research Lab., USA; Cabell, R. H., Virginia Polytechnic Inst. and State Univ., USA; Sep. 1996; 14p; In English; 2nd; Aeroacoustics Conference, 6-8 May 1996, State College, PA, USA; Sponsored by National Oceanic and Atmospheric Administration, USA
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Experiments have been conducted in NASA Langley's Acoustics and Dynamics Laboratory to determine the effectiveness of optimized actuator/sensor architectures and controller algorithms for active control of harmonic interior noise. Tests were conducted in a large scale fuselage model - a composite cylinder which simulates a commuter class aircraft fuselage with three sections of trim panel and a floor. Using an optimization technique based on the component transfer functions, combinations of 4 out of 8 piezoceramic actuators and 8 out of 462 microphone locations were evaluated against predicted performance. A combinatorial optimization technique called tabu search was employed to select the optimum transducer arrays. Three test frequencies represent the cases of a strong acoustic and strong structural response, a weak acoustic and strong structural response and a strong acoustic and weak structural response. Noise reduction was obtained using a Time Averaged/Gradient Descent (TAGD) controller. Results indicate that the optimization technique successfully predicted best and worst case performance. An enhancement of the TAGD control algorithm was also evaluated. The principal components of the actuator/sensor transfer functions were used in the PC-TAGD controller. The principal components are shown to be independent of each other while providing control as effective as the standard TAGD.
Author
Active Control; Noise Reduction; Acoustics; Aircraft Noise; Noise Prediction; Optimization; Algorithms

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