Aeroelastic Deformation: Adaptation of Wind Tunnel Measurement Concepts to Full-Scale Vehicle Flight Testing


Contract(s)/Grant(s): 23-064-50-22
Report No.(s): RTO-MP-A VT-124; No Copyright; Avail: CASI; A03, Hardcopy

The adaptation of a proven wind tunnel test technique, known as Videogrammetry, to flight testing of full-scale vehicles is presented. A description is presented of the technique used at NASA’s Dryden Flight Research Center for the measurement of the change in wing twist and deflection of an F/A-18 research aircraft as a function of both time and aerodynamic load. Requirements for in-flight measurements are compared and contrasted with those for wind tunnel testing. The methodology for the flight-testing technique and differences compared to wind tunnel testing are given. Measurement and operational comparisons to an older in-flight system known as the Flight Deflection Measurement System (FDMS) are presented.

Author
Aeroelasticity; Flight Tests; Wind Tunnel Tests; F-18 Aircraft; In-Flight Monitoring; Photogrammetry

Actively Controlling Buffet-Induced Excitations


Contract(s)/Grant(s): 23-745-45-43
Report No.(s): RTO-MP-AVT-123; No Copyright; Avail: CASI; A03, Hardcopy

High performance aircraft, especially those with twin vertical tails, encounter unsteady buffet loads when flying at high angles of attack. These loads result in significant random stresses, which may cause fatigue damage leading to restricted capabilities and availability of the aircraft. An international collaborative research activity among Australia, Canada and the USA, conducted under the auspices of The Technical Cooperation Program (TTCP) contributed resources toward a program that coalesced a broad range of technical knowledge and expertise into a single investigation to demonstrate the enhanced performance and capability of the advanced active BLA control system in preparation for a flight test demonstration. The research team investigated the use of active structural control to alleviate the damaging structural response to these loads by applying advanced directional piezoelectric actuators, the aircraft rudder, switch
mode amplifiers, and advanced control strategies on an F/A-18 aircraft empennage. Some results of the full-scale investigation are presented herein.

Author

Active Control; Buffeting; Excitation; F-18 Aircraft; Control Systems Design

20050192588 Research and Technology Organization, Neuilly-sur-Seine, France

Modelling and Simulation to Address NATO’s New and Existing Military Requirements

October 2004; 272 pp.; In English; NATO RTO Modelling and Simulation Conference, 7-8 Oct. 2004, Koblenz, Germany; See also 20050192589 - 20050192610

Report No.(s): RTO-MP-MSG-028; AC/323(MSG-028)TP/15; Copyright; Avail: CASI; CD-ROM; A12 Hardcopy

NATO is in the process of radical change through the NATO Transformation process and the development of new military requirements without neglecting the existing ones. From a broad NATO perspective, the emphasis is on collaborative efforts to improve joint, combined capabilities. Two strategic commands, one operational (Allied Command Operations, ACO, located in Brussels, Belgium), and one functional (Allied Command Transformation, ACT, located in Norfolk, Virginia, USA) have been recently established. The second, functional strategic command ACT is responsible for the continuing transformation of military capabilities and for promoting interoperability of proposed implementations. Modelling and Simulation (M&S) has been recognized within NATO as a key element in addressing these new requirements and challenges of the NATO Transformation process. This year’s conference was planned to focus on the ways in which Modelling and Simulation can address these new requirements and challenges and assist in the NATO Transformation process without neglecting the existing military requirements. To this end, the conference was designed to provide attendees a forum to advance M&S in the Alliance. The combination of M&S users and developers concentrated in this one forum educated attendees, and also provided fresh ideas for the furtherance of NATO M&S in addressing NATO’s New and Existing Military Requirements.

Derived from text

Interoperability; Simulation; Military Operations; User Requirements

20050192646 NASA Langley Research Center, Hampton, VA, USA

Latency in Visionic Systems: Test Methods and Requirements

Bailey, Randall E.; Arthur, J. J., III; Williams, Steven P.; Kramer, Lynda J.; [2005]; 14 pp.; In English; Workshop on Toward Recommended Methods for Testing and Evaluation of EV and ESV Based Visionic Devices, 26-27 Apr. 2005, Williamsburg, VA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): 23-079-60-10; No Copyright; Avail: CASI; A03 Hardcopy

A visionics device creates a pictorial representation of the external scene for the pilot. The ultimate objective of these systems may be to electronically generate a form of Visual Meteorological Conditions (VMC) to eliminate weather or time-of-day as an operational constraint and provide enhancement over actual visual conditions where eye-limiting resolution may be a limiting factor. Empirical evidence has shown that the total system delays or latencies including the imaging sensors and display systems, can critically degrade their utility, usability, and acceptability. Definitions and measurement techniques are offered herein as common test and evaluation methods for latency testing in visionics device applications. Based upon available data, very different latency requirements are indicated based upon the piloting task, the role in which the visionics device is used in this task, and the characteristics of the visionics cockpit display device including its resolution, field-of-regard, and field-of-view. The least stringent latency requirements will involve Head-Up Display (HUD) applications, where the visionics imagery provides situational information as a supplement to symbology guidance and command information. Conversely, the visionics system latency requirement for a large field-of-view Head-Worn Display application, providing a Virtual-VMC capability from which the pilot will derive visual guidance, will be the most stringent, having a value as low as 20 msec.

Author

Weather; Imaging Techniques; Technology Utilization; Time Lag; Enhanced Vision; Avionics; Head-Up Displays

20050196647 Research and Technology Organization, Neuilly-sur-Seine, France

Personal Hearing Protection including Active Noise Reduction

June 2005; 114 pp.; In English; Personal Hearing Protection Including Active Noise Reduction, 25-26 Oct. 2004, Warsaw, Poland; See also 20050196648 - 20050196652

Report No.(s): RTO-EN-HFM-111; AC/323(HFM-111)TP/56; Copyright; Avail: CASI; CD-ROM; A06 Hardcopy
Personal hearing protection and speech communication facilities are essential for optimal performance in military operations. High noise levels increase the risk of noise induced hearing loss and deterioration of communications. These proceedings from a lecture series on hearing protection and speech communication discuss the state-of-the-art of these topics. This includes: 1) The physiological effects in the ear due to a high noise exposure and criteria for an adequate protection; 2) The construction and performance of passive hearing protectors (isolation of noise); 3) Active hearing protectors (electronic generation of anti noise); 4) Optimal design or selection of systems by various assessment methods; and 5) Realistic examples of military applications. The lecture series were held in Poland, Belgium, and the USA.

Author (revised)

Active Control; Ear; Ear Protectors; Noise Reduction; Human Factors Engineering

20050199511 NASA Langley Research Center, Hampton, VA, USA

Virtual Laboratory Enabling Collaborative Research in Applied Vehicle Technologies
Contract(s)/Grant(s): 23-090-50-70
Report No.(s): RTO-MP-AVT-123; No Copyright; Avail: CASI; A03 Hardcopy

The virtual laboratory is a new technology, based on the internet, that has had wide usage in a variety of technical fields because of its inherent ability to allow many users to participate simultaneously in instruction (education) or in the collaborative study of a common problem (real-world application). The leadership in the Applied Vehicle Technology panel has encouraged the utilization of this technology in its task groups for some time and its parent organization, the Research and Technology Agency, has done the same for its own administrative use. This paper outlines the application of the virtual laboratory to those fields important to applied vehicle technologies, gives the status of the effort, and identifies the benefit it can have on collaborative research. The latter is done, in part, through a specific example, i.e. the experience of one task group.

Author

Research Vehicles; Leadership; Management Systems

20050199656 NASA Langley Research Center, Hampton, VA, USA

A Method to Analyze Tail Buffet Loads of Aircraft
Contract(s)/Grant(s): 23-745-45-43
Report No.(s): RTO-MP-AVT-123; Paper 19-1; No Copyright; Avail: CASI; A03 Hardcopy

Aircraft designers commit significant resources to the design of aircraft in meeting performance goals. Despite fulfilling traditional design requirements, many fighter aircraft have encountered buffet loads when demonstrating their high angle-of-attack maneuver capabilities. As a result, during test or initial production phases of fighter development programs, many new designs are impacted, usually in a detrimental way, by resulting in reassessing designs or limiting full mission capability. These troublesome experiences usually stem from overlooking or completely ignoring the effects of buffet during the design phase of aircraft. Perhaps additional requirements are necessary that addresses effects of buffet in achieving best aircraft performance in fulfilling mission goals. This paper describes a reliable, fairly simple, but quite general buffet loads analysis method to use in the initial design phases of fighter-aircraft development. The method is very similar to the random gust load analysis that is now commonly available in a commercial code, which this analysis capability is based, with some key modifications. The paper describes the theory and the implementation of the methodology. The method is demonstrated on a JSF prototype example problem. The demonstration also serves as a validation of the method, since, in the paper, the analysis is shown to nearly match the flight data. In addition, the paper demonstrates how the analysis method can be used to assess candidate design concepts in determining a satisfactory final aircraft configuration.

Author

Gust Loads; Buffeting; Fighter Aircraft; Aircraft Design; Angle of Attack; Random Loads
Candidate passive flow control devices were chosen from a NASA flow visualization study to investigate their effectiveness at improving flow quality over a flat-top carrier model. Flow over the deck was analyzed using a particle image velocimeter and a 1/120th scaled carrier model in a low-speed wind tunnel. Baseline (no devices) flow quality was compared to flow quality from combinations of bow and deck-edge devices at both zero and 20 degrees yaw. Devices included plain flaps and spiral cross-section columnar vortex generators attached in various combinations to the front and sides of the deck. Centerline and cross plane measurements were made with velocity and average turbulence measurements reported. Results show that the bow/deck-edge flap and bow/deck-edge columnar vortex generator pairs reduce flight deck turbulence both at zero yaw and at 20 degrees yaw by a factor of approximately 20. Of the devices tested, the most effective bow-only device appears to be the plain flap.

Author

Particle Image Velocimetry; Vortex Generators; Computational Fluid Dynamics; Aircraft Carriers; Low Speed Wind Tunnels; Aircraft Compartments
types of reports and briefings that should take place and a discussion of some of the uses of the flight test data are covered. A brief forecast is presented of where present trends may be leading.

Author

Flight Tests; Data Processing; Ground Tests

20050215585  Research and Technology Organization, Neuilly-sur-Seine, France

Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation

August 2005; 86 pp.; In English; Pathological Aspects and Associated Biodynamics in Aircraft Accident Investigation, 28-29 Oct. 2004, Madrid, Spain; See also 20050215586 - 20050215594

Report No.(s): RTO-EN-HFM-113; AC/323(HFM-113)TP/57; Copyright; Avail: CASI; CD-ROM; Hardcopy

Associated Biodynamics in Aircraft Accident Investigation, to review the status and future directions related to effective crashworthiness design and design criteria of aircraft and how such new design interfaces with some critical aspects of the aircraft accident investigation preferably those related to forensic pathology, biodynamics of injury, injury mechanism, injury mitigation and their implications for flight safety in relation to any type air based platform. These Lecture Series (LS) will be focused on determining what injury and injury mechanism data are required from accident investigations and will make recommendations on effective techniques and methodologies to use in the conduct of an accident investigation. The purpose of this LS is to address the above mentioned critical aspects of the investigation and discuss specific issues such: 1) Determine service and country aircraft accident and ejection data requirements (injuries, equipment failure, etc...). Focus on determining what injury and injury mechanism data are required by service and by country and determine what data are not universally acquired, or not acquired at all, but deemed essential. 2) Acquire crash and survivability data on non aircraft accidents. Focus on general data, automobile crash data and correlation of measurements in anthropometric dummies to injury risk (predictive modelling of human tolerance levels), crashworthiness of vehicles and equipment and survivability of accidents, that may be useful in determination of injury mechanisms, survivability and development of crashworthiness design criteria. 3) Determine what appropriate injury criteria are available and how those criteria can be measured and analysed during testing of aircraft personnel. 4) Provide recommendations on effective accident investigation techniques and methodologies for obtaining accurate and sufficient injury data from aircraft crashes and ejection. Recommendations should enhance ability to determine injury mechanism from aircraft accidents and to prevent injuries. This LS, sponsored by the Human Factor and Medicine Panel has been implemented by the Consultant and Exchange Programme. Thanks for the collaboration and magnificent support given for the Spanish authorities in providing the necessary facilities in Madrid to conduct this Lecture Series, and LS speakers for providing the related academic technical and scientific information.

Author

Accident Investigation; Biodynamics; Crashworthiness; Data Processing Equipment; Flight Safety