

# **AIAA Atmospheric Flight Mechanics Conference 2011**

**Portland, Oregon, USA  
8-11 August 2011**

**Volume 1 of 2**

**ISBN: 978-1-61839-456-9**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

The contents of this work are copyrighted and additional reproduction in whole or in part are expressly prohibited without the prior written permission of the Publisher or copyright holder. The resale of the entire proceeding as received from CURRAN is permitted.

For reprint permission, please contact AIAA's Business Manager, Technical Papers. Contact by phone at 703-264-7500; fax at 703-264-7551 or by mail at 1801 Alexander Bell Drive, Reston, VA 20191, USA.

# TABLE OF CONTENTS

## VOLUME 1

<b>Integration of Aeroservoelastic Properties into the NASA Dryden F/A-18 Simulator Using Flight Data from the Active Aeroelastic Wing Program .....</b>	1
<i>A. Chin, M. Brenner, M. Pickett</i>	
<b>A Covariance-Based Realization Algorithm for the Identification of Aeroelastic Dynamics from In-Flight Data.....</b>	20
<i>D. Miller, R. De Callafon, M. Brenner</i>	
<b>Suppression of Bending-Torsion Flutter in Accelerated Flight with Aero-Servo-Viscoelastic Controls.....</b>	38
<i>Craig Merrett, Harry Hilton, Sahithi Kalidindi, Elliot Schwartz</i>	
<b>High-Fidelity Aeroviscoelastic Predictive Analysis Capability Incorporating Rigid Body Dynamics .....</b>	73
<i>Peter Thompson, Brian Danowsky, Charbel Farhat, Thuan Lieu, Jason Lechniak, Chuck Harris</i>	
<b>Adaptive Lateral Flight Control with Active Flutter Suppression for Aeroviscoelastic Aircraft Systems .....</b>	88
<i>Z. Wilcox, M. Brenner</i>	
<b>Numerical Simulation of Hose Whip Phenomenon in Aerial Refueling.....</b>	95
<i>A. Styuart, H. Yamashiro, R. Stirling, R. Gaston</i>	
<b>Approach Trajectory Optimization including a Tunnel Track Constraint .....</b>	105
<i>Florian Fisch, Fabian Sewerin, Florian Holzapfel</i>	
<b>Envelopes for Flight Through Stochastic Gusts.....</b>	125
<i>J. Richardson, E. Atkins, P. Kabamba, A. Girard</i>	
<b>Polynomial Chaos Analysis of MAV's in Turbulence.....</b>	135
<i>B. Roberts, R. Lind, M. Kumar</i>	
<b>Method for Rapid Modelling of Missile Aerodynamics.....</b>	158
<i>A. Pankonen</i>	
<b>Projectile Monte-Carlo Trajectory Analysis Using a Graphics Processing Unit.....</b>	167
<i>M. Ilg, J. Rogers, M. Costello</i>	
<b>Affordable State Estimation Using Inertial Navigation Sensor Arrays .....</b>	185
<i>L. Fairfax, F. Fresconi</i>	
<b>Aerodynamic Characterizations of Asymmetric and Maneuvering 105mm, 120mm, and 155mm Fin-Stabilized Projectiles Derived from Telemetry Experiments .....</b>	193
<i>F. Fresconi, T. Harkins</i>	
<b>Modelling and Stability Analysis for a Class of 155 mm Spin-stabilized Projectiles with Course Correction Fuse (CCF).....</b>	223
<i>P. Werner, S. Theodoulis</i>	
<b>Multi-Axis Identifiability Using Single-Surface Parameter Estimation Maneuvers on the X-48B Blended Wing Body .....</b>	237
<i>N. Ratnayake, E. Koshimoto, B. Taylor</i>	
<b>Aerodynamic Coefficients Estimation of a Flight Vehicle From Different Flight Trials Under Limited Measurements .....</b>	256
<i>P. Kar, A. Sarkar, J. Umakan, R. Padhi</i>	
<b>Near Real-time Parameter Estimation in the C-12C .....</b>	287
<i>T. Spaulding, C. Naddy, J. Hines, G. Knowlan, D. Riley, Z. Schaffer, T. Jorris</i>	
<b>Flight Test of Orthogonal Square Wave Inputs for Hybrid-Wing-Body Parameter Estimation.....</b>	298
<i>Brian Taylor, Nalin Ratnayake</i>	
<b>Application of Structural Load Feedback in Flight Control.....</b>	312
<i>S. Frost, K. Trinh, B. Taylor, C. Jutte, J. Burken, M. Bodson</i>	
<b>Stability Enhancement of a Transonic Wing Using a Simple Passive Attachment .....</b>	323
<i>S. Hubbard, D. McFarland, A. Vakakis, L. Bergman, R. Fontenot, R. Brown, P. Cizmas, T. Strganac</i>	
<b>Linear Parameter Varying Control for the X-53 Active Aeroelastic Wing .....</b>	333
<i>P. Seiler, G. Balas, A. Packard</i>	
<b>Longitudinal Dynamics and Adaptive Control Application for an Aeroelastic Generic Transport Model .....</b>	344
<i>N. Nguyen, I. Tuzcu, T. Yucelen, A. Calise</i>	
<b>Assessment of Helicopter Model Fidelity through Inverse Simulation .....</b>	366
<i>G. Avanzini, G. De Matteis, A. Torasso</i>	

<b>Turn Performance of an Air-Breathing Hypersonic Vehicle .....</b>	380
<i>D. Dalle, S. Torrez, J. Driscoll</i>	
<b>Mixed Newtonian-Lagrangian Approach for the Analysis of Flexible Aircraft Dynamics .....</b>	399
<i>G. Avanzini, E. Capello, I. Piacenza</i>	
<b>Determination of Sweet Spot for Trailing Aircraft in Formation Flight.....</b>	419
<i>W. Okolo, A. Dogan, W. Blake</i>	
<b>Modeling, Stability Analysis and Simulation of a Stratosphere Hybrid Tethered Platform.....</b>	432
<i>Z. Zuo, M. Zhu, Y. Wu, Y. Ma</i>	
<b>On Dynamical Assembly of Nonlinear Uniaxial Atmospheric Flight Mechanics-Revisited in Frequency Domain .....</b>	441
<i>A. Omran, B. Newman</i>	
<b>Estimation of Aircraft States and Wind Exposure .....</b>	470
<i>J. Lee, A. Dogan, D. Hullender</i>	
<b>Unsteady Aeroelasticity of Generic Transport Model .....</b>	493
<i>I. Tuzcu, N. Nguyen</i>	
<b>Obtaining the Aerodynamic and Flight Dynamic Characteristics of an Asymmetric Projectile Through Experimental Spark Range Firings.....</b>	504
<i>F. Fresconi, I. Celmins, B. Howell</i>	
<b>CFD Simulations and Wind Tunnel Experiments of a Generic Split-Canard Air-to-Air Missile at High Angles of Attack in Turbulent Subsonic Flow .....</b>	512
<i>T. Honkanen, T. Tuisku, A. Pankkonen</i>	
<b>Unsteady Aerodynamic Simulations of a Canard-Controlled Projectile at Low Transonic Speeds.....</b>	532
<i>J. Sahu</i>	
<b>Smart Projectile State Estimation Using Evidence Theory .....</b>	546
<i>J. Rogers, M. Costello</i>	
<b>Fin Mixing Optimization to Minimize Control Coupling Effects .....</b>	579
<i>U. Kuttay</i>	
<b>Range Extension Of An Air-to-air Engagement By Offline Trajectory Optimization.....</b>	588
<i>P. Kar, A. Mukherjee, A. Sarkar, R. Padhi</i>	
<b>Data Gathering and Preliminary Results of the System Identification of a Flexible Aircraft Model.....</b>	600
<i>B. Silva</i>	
<b>Validating the Multidimensional Spline Based Global Aerodynamic Model for the Cessna Citation II.....</b>	624
<i>C. De Visser, J. Mulder, Q. Chu</i>	
<b>Aerodynamic and Thrust Force Modeling for a Propulsion Assisted Control Aircraft Test Bed.....</b>	640
<i>Z. Merceruio, K. Phillips, Y. Gu, S. Gururajan, M. Napolitano</i>	
<b>Real-Time Frequency Response Estimation from Flight Data .....</b>	656
<i>M. Holzel, E. Morelli</i>	
<b>Aerodynamic Parameter Identification for Symmetric Projectiles: Comparing Gradient Based and Evolutionary Algorithms.....</b>	682
<i>B. Burchett, Terre Haute</i>	
<b>High-fidelity Modeling and Simulation of Flutter/LCO for All-movable Horizontal Tail with Free-play.....</b>	695
<i>P. Hu, H. Zhao, L. Xue, K. Ni, H. Liu</i>	
<b>Integrated and Multi-fidelity Software Package for Aero- Servo-Thermo-Elasticity and Propulsion (ASTE-P) of Aerospace Vehicles from Subsonic to Hypersonic Flight .....</b>	708
<i>P. Hu, L. Xue, K. Ni, H. Zhao, H. Liu, M. Brenner</i>	
<b>Gust Load Alleviation Control for Very Flexible Aircraft.....</b>	724
<i>M. Dillsaver, C. Cesnik, I. Kolmanovsky</i>	
<b>Adaptive Flutter Suppression for Aircraft Upset and Damage Conditions .....</b>	742
<i>J. Juang, J. Lew, M. Roemer, J. Ge</i>	
<b>Experimental Model Based Robust Aeroservoelastic Control for the S4T Wind-Tunnel Model .....</b>	765
<i>J. Zeng, B. Moulin, S. Kukreja</i>	
<b>Modeling and Flight Testing of the Longitudinal Dynamics of an Inflatable Wing UAV .....</b>	786
<i>A. Brown, E. Johnson</i>	
<b>Effect of Control Surface-Fuselage Inertial Coupling on Hypersonic Vehicle Flight Dynamics .....</b>	807
<i>N. Falkiewicz, S. Fendreis, C. Cesnik</i>	
<b>Wind Tunnel Test Results and Performance Prediction for a Ducted Fan with Collective and Cyclic Pitch Actuation for VTOL with Efficient Cruise .....</b>	844
<i>M. Colman, S. Suzuki, D. Kubo</i>	
<b>Modeling Interactions Between Flexible Flapping Wing Spars, Mechanisms, and Drive Motors.....</b>	864
<i>D. Doman, C. Tang, S. Regisford</i>	

<b>Design and Simulation of a Morphing-Wing Controller with Actuator Loading Penalization.....</b>	893
<i>B. Obradovic, K. Subbarao</i>	
<b>Aerodynamic Performance of Small Model of Ornithopter -Numerical Study for Experimental Model-.....</b>	917
<i>Masaru Takashi, Hironori Fujii, Katsuyoshi Nakazato</i>	
<b>The Applicability of Unsteady Vortex Panel Methods to the Design of Hovering Flapping-Wing Micro Air Vehicles.....</b>	929
<i>D. Prosser, A. Crassidis, A. Ghosh, M. Roemer</i>	
<b>Aero and Structural-dynamic Repeatability of a Novel MAV Wing Manufacturing Process .....</b>	948
<i>N. Sladek, M. Anderson, R. Cobb</i>	

## VOLUME 2

<b>Optimization of Flap-Bounding Flight.....</b>	960
<i>G. Sachs, J. Lenz, F. Holzapfel</i>	
<b>Modal Analysis of 1/3-Scale Yak-54 Aircraft Through Simulation and Flight Testing.....</b>	971
<i>R. Lykins, S. Keshmiri, R. Riley, G. Garcia</i>	
<b>Aircraft System Identification using Pseudospectral Parameter Optimization with Adaptive Nodes .....</b>	978
<i>T. Jorris, B. McCracken</i>	
<b>A New System Identification Method Using Short Duration Flight Test Inputs.....</b>	995
<i>E. Bachelder, P. Thompson, D. Kyde, D. Alvarez</i>	
<b>False Fault Detection in Airdata Sensor due to Nonuniform Wind in Aerial Refueling.....</b>	1018
<i>H. Sevil, A. Dogan</i>	
<b>Robust Longitudinal and Transverse Rate Gyro Bias Estimation for Precise Pitch and Roll Attitude Estimation in Highly Dynamic Operating Environments Utilizing a Two Dimensional Accelerometer Array.....</b>	1029
<i>W. Scorse, A. Crassidis</i>	
<b>Flight Dynamics Modeling for a Small-Scale Flybarless Helicopter UAV.....</b>	1057
<i>S. Taamallah</i>	
<b>Development of a Small UAV with Autopilot Capability .....</b>	1084
<i>Pu Xie, Angel Flores-Abad, Gerardo Martinez, Ou Ma</i>	
<b>UAV Flight Control Using Flow Control Actuators .....</b>	1097
<i>E. Johnson, G. Chowdhary, R. Chandramohan, A. Calise</i>	
<b>Rapid Solution and Variable-fidelity Modeling of Aeroelasticity(AE) /Aeroservoelasticity (ASE) Using ASTE-P Toolset.....</b>	1103
<i>P. Hu, H. Zhao, L. Xue, K. Ni, H. Liu, M. Brenner</i>	
<b>Suppression of the Aeroelastic/Aeroservoelastic Interaction Using Adaptive Feedback Control Instead of Notching Filters .....</b>	1123
<i>J. Zeng, J. Wang, R. De Callafon, M. Brenner</i>	
<b>Controller and Aeroelasticity Analysis for a Morphing Wing.....</b>	1143
<i>T. Grigorie, A. Popov, R. Botez, M. Mamou, Y. Mebarki</i>	
<b>Ares I-X Range Safety Trajectory Analyses and Independent Validation and Verification.....</b>	1157
<i>A. Tarpley, B. Starr, P. Tartabini, A. Craig, C. Merry, J. Brewer, J. Davis, M. Dulski, A. Gimenez, M. Barron</i>	
<b>Ares I-X Separation and Reentry Trajectory Analyses.....</b>	1180
<i>P. Tartabini, B. Starr</i>	
<b>Trajectory-Based Loads for the Ares I-X Test Flight Vehicle .....</b>	1194
<i>R. Vause, B. Starr</i>	
<b>Use of Smoothed Measured Winds to Predict and Assess Launch Environments .....</b>	1223
<i>H. Cordova, F. Leahy, S. Adelfang, B. Roberts, R. Barbre</i>	
<b>Use of Flexible Body Coupled Loads in Assessment of Day of Launch Flight Loads.....</b>	1230
<i>B. Starr, I. Yunis, A. Olds</i>	
<b>Ares I-X Best Estimated Trajectory and Comparison with Preflight Predictions .....</b>	1244
<i>C. Karlgaard, R. Beck, S. Derry, J. Brandon, B. Starr, P. Tartabini</i>	
<b>Estimation of Aerodynamic Angles in a Mini Aerial Vehicle under Turbulent Atmosphere.....</b>	1265
<i>C. Ramprasad</i>	
<b>Experimental and Analytical Pressure Characterization of a Rigid Flapping Wing for Ornithopter Development.....</b>	1278
<i>D. Yeo, E. Atkins, W. Shyy</i>	
<b>System Identification Applied to Dynamic CFD Simulation and Wind Tunnel Data.....</b>	1296
<i>Patrick Murphy, Vladislav Klein, Neal Frink, Dan Vicroy</i>	

<b>CFD Modeling for Trajectory Predictions of a Generic Fighter Configuration</b>	1310
<i>M. Ghoreyshi, A. Jirasek, R. Cummings</i>	
<b>Modeling of Unsteady Aerodynamic Loads</b>	1327
<i>A. Da Ronch, A. McCracken, K. Badcock, M. Ghoreyshi, R. Cummings</i>	
<b>On the Applicability of an Unsteady Aerodynamic ROM to the Transonic Flight Regime</b>	1343
<i>T. Skuijins, C. Cesnik</i>	
<b>Characterisation of wind tunnel observed, large-amplitude pitch limit-cycles</b>	1358
<i>J. Pattinson, M. Lowenberg, M. Goman</i>	
<b>Experiments on Free-to-Pivot Hover Motions of Multi-hinged Flat Plates</b>	1383
<i>K. Granlund, L. Bernal</i>	
<b>Mitigating Unfavorable Pilot Interactions with Adaptive Controllers in the Presence of Failures/Damage</b>	1401
<i>D. Klyde, C. Liang, D. Alvarez, N. Richards, R. Adams, B. Cogan</i>	
<b>Power Frequency - A New Metric for Analyzing Pilot-in-the-Loop Flying Tasks</b>	1418
<i>Amanda Lampton, David Klyde</i>	
<b>Verification of a Flying Wing Handling Qualities Analysis by means of In-Flight Simulation</b>	1439
<i>Jana Ehlers, Dominik Niedermeier, Dirk Leissling</i>	
<b>Criteria to Mitigate Rudder Overcontrol in Transport Aircraft</b>	1454
<i>Roger Hoh, Thomas Nicoll, Paul Desrochers</i>	
<b>Handling Qualities of a Blended Wing Body Aircraft</b>	1477
<i>T. Peterson, P. Grant</i>	
<b>Limited Handling Qualities Evaluation of Inter-axis Control Coupling</b>	1501
<i>D. Fields, D. Marten, G. Di Loreto, R. Koo, J. Lemery, K. Ryan</i>	
<b>A Flight Dynamics Model for a Multi-Actuated Flexible Rocket Vehicle</b>	1607
<i>J. Orr</i>	
<b>Production of Synthetic Winds for Launch Vehicle Loads and Trajectory Simulations Based on Principal Component Analysis</b>	1621
<i>R. Walterscheid, B. Sako</i>	
<b>First Stage Solid Propellant Multiply Debris Thermal Analysis</b>	1632
<i>B. Toleman</i>	
<b>A Method for Optimizing Launch Vehicle Aero-Assist Including Path Optimization</b>	1640
<i>R. Hartfield, V. Ahuja, K. Albarado, T. Walsh</i>	
<b>Continuous Aerodynamic Modelling of Entry Shapes</b>	1654
<i>D. Dirkx, E. Mooij</i>	
<b>Rapid Design Space Exploration for Conceptual Design of Hypersonic Missions</b>	1678
<i>M. Grant, I. Clark, R. Braun</i>	
<b>Derivation and Analysis of the Equations of Motion for a Ducted Fan UAV</b>	1694
<i>B. Stiltner, M. Cotting, O. Ohanian</i>	
<b>Evaluation of Multi-body Parafoil Dynamics Using Distributed Miniature Wireless Sensors</b>	1714
<i>C. Gorman, N. Slegers</i>	
<b>Aircraft Lateral Trim Using Internal Fuel Transfer &amp; Differential Thrust In Formation Flight</b>	1734
<i>W. Okolo, A. Dogan, W. Blake</i>	
<b>Development of a Simulation Environment to Support Aircraft Health Management Education</b>	1749
<i>Frederick Beamer, Mario Perhinschi, Matthew Cunningham, Jennifer Davis</i>	
<b>Entry Guidance for the 2011 Mars Science Laboratory Mission</b>	1765
<i>G. Mendeck, L. Craig</i>	
<b>Rapid Simultaneous Hypersonic Aerodynamic and Trajectory Optimization Using Variational Methods</b>	1787
<i>M. Grant, I. Clark, R. Braun</i>	
<b>Optimal Online Path Planning for Approach and Landing Guidance</b>	1802
<i>A. Heydari, S. Balakrishnan</i>	
<b>F-22 Raptor GBU-39 Separation Test Results</b>	1813
<i>G. Kummer, A. Gunnett, M. Besson, D. Javorsek, T. Keithley</i>	
<b>Flight Test Results Of A GPS-Based Pitot-Static Calibration Method Using Output-Error Optimization For a Light Twin-Engine Airplane</b>	1825
<i>B. Martos, P. Kiszely, J. Foster</i>	
<b>Investigation of a Flutter Exciter for Aircraft Flight Testing Using Unstructured Overset Grids</b>	1840
<i>Xu Heyong, Zhengyin Ye</i>	
<b>Concept of a Predictive Ship Helicopter Operational Limitations Analysis Tool</b>	1848
<i>A. Hoencamp</i>	
<b>Flight Test Maneuvers For Efficient Aerodynamic Modeling</b>	1860
<i>Eugene Morelli</i>	

<b>Model-Based Strategies for Modern Flight Test .....</b>	1878
<i>F. De Almeida</i>	
<b>Tensor Flight Dynamics .....</b>	1890
<i>P. Zipfel</i>	
<b>Author Index</b>	