

AHS Aeromechanics Specialists Conference 2010

**San Francisco, California, USA
20-22 January 2010**

ISBN: 978-1-61567-989-8

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.

Copyright© (2010) by the American Helicopter Society International
All rights reserved.

Printed by Curran Associates, Inc. (2010)

For permission requests, please contact the American Helicopter Society International
at the address below.

American Helicopter Society International
217 N. Washington Street
Alexandria, VA 22314-2538

Phone (703) 684-6777
Fax: (703) 739-9279

staff@vtol.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

ACTIVE CONTROL

An Examination of Rotor Loads due to On-Blade Active Controls for Performance Enhancement using CFD/CSD Analysis	1
<i>Rohit Jain, Hyeonsoo Yeo, Inderjit Chopra</i>	
Active Rotor Controls for Vibration Reduction and Performance Enhancement	23
<i>Kumar Ravichandran, Shreyas Ananthan, Inderjit Chopra, Benjamin Hein</i>	
Low-Speed and High-Speed Correlation of Smart Active Flap Rotor Loads	45
<i>Sesi Kottapalli</i>	
Exploitation of Active Controls and Morphing Technologies to Enhance Rotor Aerodynamic Performance in Hover Conditions.....	82
<i>Cristina Garcia-Duffy, Andrea D'Andrea, Stefano Melone</i>	

DESIGN I

Multibody Dynamics Model of a VTOL Teetering Rotor	103
<i>Jinwei Shen, Pierangelo Masarati, Jeremy Bain, Todd Hodges</i>	
A Promising New Vertical Take-Off and Landing (VTOL) Aircraft Concept.....	111
<i>John M. Lawrence</i>	
Experimental Performance Optimization of a MAV-Scale Cycloidal Rotor	119
<i>Moble Benedict, Tejaswi Jarugumilli, Inderjit Chopra</i>	
Experimental Investigation of an Insect-based Flapping Wing Hovering Micro Air Vehicle.....	136
<i>Pranay Seshadri, Moble Benedict, Inderjit Chopra</i>	

ACOUSTICS/AERO

Validation of HART II Structural Dynamics Predictions Based on Prescribed Airloads	157
<i>Sung Nam Jung, Jae-Sang Park, Soo Hyung Park, Yung Hoon Yu</i>	
Aerodynamic and Acoustic Design of a Low Noise Dual Rotor Tail-sitter	169
<i>Jeremy Bain, Kyle Collins</i>	
A Study of Acoustic Reflections in Full-Scale Rotor Low Frequency Noise Measurements Acquired Wind Tunnels	180
<i>Natasha L. Barbely, Ben W. Sim, Cahit Kitaplioglu, Pat Goupling II</i>	

DYNAMICS/LOADS

Transient Loads Control of a Variable Speed Rotor During Lagwise Resonance Crossing	188
<i>Dong Han, Joseph Wang, Edward C. Smith, George A. Lesieutre</i>	
Analytical, First Principles Modeling of Elastomeric Dampers.....	197
<i>Sesi Kottapalli, Olivier A. Bauchau, Changkuan Ju, Serkan Ozbay, Yogesh Mehrotra</i>	
Pitch Link Loads Reduction using Fluidelastic Isolators.....	212
<i>Dong Han, Christopher D. Rahn, Edward C. Smith</i>	

TILTROTOR

Improving Blade-Element Design Methods for High Speed Proprotors.....	221
<i>Daniel Patt, Harold Youngren</i>	
Integration of Rotor Aerodynamic Optimization with the Conceptual Design of a Large Civil Tiltrotor	236
<i>C. W. Acree Jr.</i>	
Influence of Pitch Attitude on Tiltrotor Autorotation Characteristics	248
<i>John Vorwald</i>	

UH-60 COMPUTATIONAL STUDIES

Icing Studies for the UH-60A Rotor in Forward Flight.....	261
<i>Nischint Rajmohan, Jeremy Bain, Michael Nucci, Lakshmi Sankar, Robert Flemming, T. Alan Egolf, Richard Kreeger</i>	
Air-loads Prediction of a UH-60A Rotor inside the 40- by 80-Foot Wind Tunnel.....	277
<i>I-Chung Chang, Ethan A. Romander, Mark Pottsdam, Hyeonsoo Yeo</i>	
Numerical Simulation of Free-Flight Rockets Air-Launched from a Helicopter	288
<i>Bum Seok Lee, Min Seung Jung, Oh Joon Kwon</i>	

COMPUTATIONAL AERODYNAMICS - I

Reduced Order Nonlinear Unsteady Aerodynamic Modeling Using a Surrogate Based Approach.....	299
<i>Bryan Glaz, Li Liu, Peretz P. Friedman</i>	
CFD/CSD Simulation of Baseline UH-60 and Swashplateless Rotors	314
<i>Arun I. Jose, Shreyas Ananthan, James D. Baeder</i>	
Loosely Coupled CFD/CSD Analysis for a Helicopter Rotor in Hover and Forward Flight.....	338
<i>Sung-Hwan Yoon, Jin Sung Kwak, Sangjoon Shin, Chongam Kim</i>	

TESTS & EVALUATION

Application of Out-of-Plane Warping to Control Rotor Blade Twist	348
<i>Yannick Van Wedingen, Olivier Bauchau, Sesi Kottapalli, Serkan Ozbay, Yogesh Mehrotra</i>	
Wind Tunnel Investigation of Flow Around a Rotor in Ground Effect	362
<i>N. D. Nathan, R. B. Green</i>	
An Experimental Study of Rotorcraft in Ground Effect.....	381
<i>Gregory J. McCauley, William Tsai, Omer Savas</i>	

COMPUTATIONAL METHODS - I

Addressing Today's Aeromechanic Questions by Industrial Answers.....	390
<i>Markus Dietz, Christoph Maucher, Dieter Schimke</i>	
Large-Scale Domain Decomposition for a Scalable, Three-Dimensional Brick Finite Element Based Rotor Dynamic Analysis.....	408
<i>Anubhav Datta, Wayne Johnson</i>	
Parallel Computing for Rotorcraft Analysis	422
<i>Hao Kang, Hossein Saberi</i>	
Rotor Loads Identification Methodologies at AgustaWestland	431
<i>Ermanno Fosco, Francesco Vincenzo, Attilio Colombo, Claudio Montegaglia, Pierre Abdel Nour, Nicholas Griffiths, Chris Hutchin</i>	

FLIGHT CONTROL

Preliminary Assessment of a Candidate Structure for Robust Rotorcraft Flight Control.....	450
<i>Ronald A. Hess</i>	
Simulation of Dynamic Interface Flight Control Concepts Using the Charm Toolbox for MATLAB.....	463
<i>Robert McKillip Jr., Jeffrey Keller, Dan Wachpress, Glen Whitehouse, Todd Quackenbush, Jason Colbourne</i>	
Development and Operation of an Automatic Rotor Trim Control System for the UH-60 Individual Blade Control Wind Tunnel Test	474
<i>Colin R. Theodore, Mark B. Tischler</i>	
Modeling Biodynamic Interference in Helicopter Piloting Tasks.....	496
<i>Ronald A. Hess</i>	

COMPUTATIONAL METHODS - II

CFD Method for Efficient Analysis of Flapped Rotors	505
<i>Rene Steijl, Mark Woodgate, George Barakos</i>	

A Hybrid CFD Method for Coaxial Rotor Performance Prediction in Forward Flight	518
<i>T. Alan Egolf, Nischint Rajmohan, Edward Reed, Lakshmi Sankar</i>	
A Comparision of Three Coaxial Aerodynamic Prediction Methods Including Validation with Model Test Data	528
<i>Ondrej Juhasz, Monica Syal, Roberto Celi</i>	

ROTOR PERFORMANCE

Experimental and Analytical Studies of Lifting Rotor Performance at High Advance Ratios	548
<i>T. R. Quackenbush, D. A. Wachspress, R. M. McKillip Jr., M. J. Sibilia</i>	
Performance and Trim Analysis of Lightly Loaded Rotors in High Advance Ratio Autorotation.....	565
<i>James Rigsby, J. V. R. Prasad</i>	
Applications of the Induced Power Model and Performance of Conventional and Advanced Rotorcraft.....	588
<i>Robert A. Ormiston</i>	

COMPUTATIONAL AERODYNAMICS - II

Computational Investigation of Micro-Scale Shrouded Rotor Aerodynamics in Hover	616
<i>Vinod K. Lakshminarayan, James D. Baeder</i>	
Predicting Hub Drag on Realistic Geometries	639
<i>John O. Bridgeman, Glenn T. Lancaster</i>	
Experimental and Numerical Studies of Rotor/Fuselage Interactions	657
<i>Yasutada Tanabe, Shigeru Saito</i>	

ROTOR FLOW FIELDS

Unsteady Numerical Simulations of Helicopters and Tiltrotors Operating in Sandy-desert Environments	667
<i>Andrea D'Andrea</i>	
Investigation of Hybrid Grid-Based CFD Methods for Rotorcraft Flow Analysis.....	691
<i>Glen R. Whitehouse, Hormoz Tadghighi</i>	
Optimization of Overset Solution Adaptive Grids for Hovering Rotorcraft Flows	704
<i>Terry L. Holst, Thomas H. Pulliam</i>	

EXPERIMENTAL METHODS

Retroreflective Background Oriented Schlieren (RBOS) as Applied to Full-Scale UH-60 Blade Tip Vortices.....	722
<i>James T. Heineck, Laura K. Kushner, Edward T. Schairer, Louise A. Walker</i>	
Non-Intrusive Measurements of a Four-Bladed Rotor in Hover - A First Look	727
<i>Oliver D. Wong, Kevin W. Noonan, A. Neal Watkins, Luther N. Jenkins, Chung-Sheng Yao</i>	
Blade Deflection Measurements of a Full-Scale UH-60A Rotor System	738
<i>Lawrence E. Olson, Anita I. Abrego, Danny A. Barrows, Alpheus W. Burner</i>	

CFD/CSD

Development of a CFD-CSD-Based Reduced Order Model for Coupled Aeroelastic Rotor Predictions.....	748
<i>Jennifer Abras</i>	
Wake-Coupling CFD-CSD Analysis of Helicopter Rotors in Steady and Maneuvering Flight Conditions	758
<i>Sebastian Thomas, Shreyas Ananthan, James D. Baeder</i>	

DESIGN II

NDARC - NASA Design and Analysis of Rotorcraft: Theoretical Basis and Architecture	778
<i>Wayne Johnson</i>	

NDARC - NASA Design and Analysis of Rotorcraft: Validation and Demonstration	804
<i>Wayne Johnson</i>	
Design of a Slowed-Rotor Compound Helicopter for Future Joint Service Missions	838
<i>Christopher Silva, Hyeonsoo Yeo, Wayne Johnson</i>	
Converting a C-130 Hercules into a Compound Helicopter: A Conceptual Design Study	854
<i>Anjaney P. Kottapalli, Franklin D. Harris</i>	

DYNAMIC STALL

Unified Airloads Model for Morphing Airfoils in Dynamic Stall	891
<i>Loren A. Ahaus, David A. Peters</i>	
Mitigation of Dynamic Stall Using Small Controllable Devices	915
<i>Tin-Chee Wong</i>	
An Exploration of the Physics of Dynamic Stall	933
<i>Vrishank Raghav, Phillip Richards, Narayanan Komerath, Marilyn J. Smith</i>	
Trailing Edge Flap Flow Control for Dynamic Stall	949
<i>E. A. Gillies, R. B. Green, Y. Wang, F. N. Coton</i>	
Author Index	