

Aeromechanics for Advanced Vertical Flight Technical Meeting 2022

San Jose, California, USA
25-27 January 2022

ISBN: 978-1-7138-5925-3

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.
These proceedings were created from a scanned original document, and are the best quality available.**

Copyright© (2022) by Vertical Flight Society
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact Vertical Flight Society
at the address below.

Vertical Flight Society
2701 Prosperity Ave, Suite 210
Fairfax, VA 22031
USA

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

www.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: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Conceptual Design of a Tiltduct Reference Vehicle for Urban Air Mobility	1
<i>S. Whiteside, B. Pollard</i>	
Conceptual Design of Tiltrotor Aircraft for Urban Mobility	16
<i>M. Radotich</i>	
Aeroelastic Analysis of an Urban Air Mobility Rotor in Forward Edgewise Flight	46
<i>S. Wright</i>	
Optimum Speed Tiltrotor, Recent Testing and Applications.....	56
<i>T. Berger, P. Parcell, D. Weinstein</i>	
Variations in Thrust Sharing for Torque-Balanced Lift-Offset Coaxial Rotors	70
<i>J. Ho, H. Yeo</i>	
Detailed Structural Design for the Co-Axial Compound Rotorcraft Based on the Physics-Based Approach	86
<i>S. Park, B. Im, J. Yeom, T. Chun, S. Shin</i>	
Fabrication, Measurement, and Modeling of Lithium Sulfur and Li-ion Electrochemistry	96
<i>E. Fisler, A. Datta</i>	
Minimum of Electric Propulsion Units (EPUs) for Fail-Safe Air-Taxi Vehicles	124
<i>F. Chang</i>	
Comparison of the CHARM Predictions of the Multirotor Test Bed with Wind Tunnel Experimental Results	130
<i>D. Shirazi</i>	
RABBIT: A Rapid Low Fidelity BVI Prediction Tool – Comparison and Validation using the NASA RVL T Toolchain.....	151
<i>L. Weist, N. Schatzman</i>	
Exploring Airfoil Table Generation using XFOIL and OVERFLOW	165
<i>K. Kallstrom</i>	
Understanding Fluid Dynamic Forces on a Cycloidal Rotor in Forward Flight.....	185
<i>J. Heimerl, M. Benedict</i>	
Vacuum and Hover Test of a Double Anhedral Tip Composite Rotor.....	199
<i>C. Chi, A. Datta, B. Panda</i>	
Revolutionary Flight Vehicle Based on Leonardo da Vinci Aerial Screw: A Paradigm Shift in VTOL Technology	213
<i>A. Prete, V. Nagaraj, I. Chopra</i>	
Predictions and Validations of Small-Scale Rotor Noise Using UCD-QuietFly	230
<i>S. Li, S. Lee</i>	
Rotor-Rotor Interaction Effects on Noise from a Tandem Rotor Configuration	241
<i>A. Karon, M. Mayo</i>	

Aeroacoustic Analysis of Non-Periodic Propeller Motions.....	250
<i>D. Jayasundara, J. Baeder</i>	
Prediction of Quadrotor Acoustics using RVLT Toolchain	269
<i>S. Kottapalli, C. Silva</i>	
Overview and Introduction of the Rotor Optimization for the Advancement of Mars eXploration (ROAMX) Project	292
<i>H. Cummings, B. Perez, W. Koning, W. Johnson, L. Young, F. Haddad, E. Romander, J. Balaram, T. Tzanetos, J. Bowman, L. Wagner, S. Withrow-Maser, E. Isaacs, S. Toney, D. Shirazi, S. Conley, B. Pipenberg, A. Datta, R. Lumba, C. Chi, J. Smith, C. Cornelison, A. Perez, T. Nonomura, K. Asai</i>	
Structural Design and Aeromedical Analysis of Unconventional Blades for Future Mars Rotorcraft	305
<i>R. Lumba, C. Chi, A. Datta, W. Koning, N. Perez, H. Cummings</i>	
Hover and Forward Flight Performance Modeling of Ingenuity Mars Helicopter	319
<i>C. Dull, L. Wagner, L. Young, W. Johnson</i>	
Flutter Assessment of a Double-Swept Rotor Blade in Hover Based on Indicial Aerodynamics Considering Blade Profile, Rotor Inflow and Wake Periodicity	332
<i>J. Arnold</i>	
Individual Blade Control for Component Load Alleviation using Higher-Order Linear Time- Invariant Models.....	340
<i>C. Mballo, J. Prasad</i>	
An Assessment of XV-15 Tiltrotor Hover Download Predictions	353
<i>A. Wissink, S. Tran, J. Lim</i>	
Performance Predictions of a Small Folding Propeller Using Rotorcraft Comprehensive Analysis.....	361
<i>H. Kang, P. Anusonti-Inthra, R. Singh, L. Battey</i>	
RCAS-Helios Elastic Fuselage Coupling Demonstration for Rotorcraft.....	379
<i>M. Hasbun, H. Saberi, J. Kim, B. Roget</i>	
Pretest Comprehensive Analysis for the Urban Air Mobility Side-by-Side Test Stand	391
<i>S. Wright, H. Cummings</i>	
Evaluation of a Combined Momentum Theory and Simple Vortex Theory (CMTSVT) Inflow Model for UAM Applications	402
<i>J. Hariani, F. Guner, J. Prasad</i>	
Identification of High-Order Linear Time-Invariant Models From Periodic Nonlinear System Responses	412
<i>M. Hayajnh, U. Saetti, J. Prasad</i>	
Incorporation of Airfoil-Interactional Data to Improve the Accuracy of Stacked Rotor Performance Predictions in the Design Stage	425
<i>M. Costenoble, J. Baeder, G. Jacobellis</i>	
Development and Validation of Conceptual Design Level Rotorcraft Acoustics Prediction Tools	435
<i>M. Bodie, Y. Wenren, M. Muhlestein, M. Avera, G. Jacobellis, M. Floros, P. Anusonti-Inthra</i>	
Multi-objective Rotor Blade Optimization Framework Advancements	443
<i>L. Allen, J. lim, R. Haehnel, I. Dettwiller</i>	

Tool for Optimization of Rotorcraft Concepts Applied to eVTOL Rotor Design	460
<i>J. Sinsay, A. Sridharan</i>	
Initial Assessment of a Real-Time Vorticity Solver for Flight Mechanics of Rotary-Wing and e-VTOL Vehicles: A Heterogeneous-Computing Approach	477
<i>D. Hidalgo, J. Vargas</i>	
A Combined Low and High Fidelity Approach for eVTOL Rotor Modeling and Design	497
<i>L. Sankar, C. Tung</i>	
Rotor5: Rotor Design Under 5 hours using Ultra-Fast and High-Fidelity CFD Simulation and Automatic Meshing	510
<i>R. Ji, F. Jia, P. Spalart, Z. Yu, Q. Wang</i>	
A Data-Driven Reduced Order Model of an Isolated Rotor	526
<i>N. Peters, C. Silva, J. Ekaterinaris</i>	
Active Flow Control Simulations and Experiments for Drag Reduction of an External Stores Support System.....	544
<i>D. Schatzman, O. Drori, S. Alexandroni, A. Seifert</i>	
Further Investigation of Fan-In-Wing Aerodynamic Performance Using Active Flow Control	560
<i>C. Sheng, Q. Zhao</i>	
Rotor Performance Predications for UAM – Single vs Coaxial Rigid Rotors.....	569
<i>J. Cornelius, S. Schmitz</i>	
Weather Solutions for VTOL Aircrafts Urban Operations.....	583
<i>M. Chrit, D. Berchoff</i>	
NRC Research in Autonomy Flight Sciences: Experimentation in Rotorcraft Landing Methodology in Degraded Visual Environments.....	587
<i>M. Alexander, S. Carignan</i>	
Real-Time Simulation Modeling of Electrical Propulsion Systems	599
<i>S. Meredith, K. Wayne, A. Gidden, K. Denny, M. Smith, H. Schwartz</i>	
Thermal Modeling of Brushless DC Motors for Vehicle Conceptual Design	611
<i>F. Saemi, M. Benedict</i>	
Investigation of Certification Consideration for Distributed Electric Propulsion (DEP) Aircraft.....	621
<i>R. McKillip Jr., D. Wachspress, R. Hansman, D. Sizoo, D. Dellmyer</i>	
Feasibility Study of a Robotic Science Arm on Future Martian Rotorcraft	632
<i>C. Rutter, M. Lach</i>	
LILI (Long-term Ice-field Levitating Investigator): Mars Aerial and Ground Explorer for Martian Polar Regions	650
<i>N. Schatzman, M. Dominguez, P. Lee, L. Young</i>	
Pilot Workload Rating Predictions Using Image Data and Recurrent Neural Networks.....	668
<i>K. Nagami, C. Malpica, M. Schwager</i>	
Investigation of Stability and Disturbance Rejection Trade-Offs for an e-VTOL Controller	680
<i>J.-P. Theron, J. Horn, D. Wachspress, J. Keller, A. Sharma</i>	

Evaluation of Heave Disturbance Rejection & Control Response Criteria on Handling Qualities
Evaluation of Urban Air Mobility (UAM) eVTOL Quadrotors Using Vertical Motion Simulator..... 713
S. Withrow-Maser, J. Aires, A. Ruan, C. Malpica, S. Schuet

NRC Research in Autonomy Flight Sciences: Rotorcraft Unmanned Air Systems Detection via the
Infrared Spectrum Perception Modality 743
M. Alexander

Author Index