Acoustics

Acoustics I
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
The Development of a Coaxial Acoustics Test System for Rotor Noise (Paper 59)
Raja Akif Raja Zahirudin,* Eric Greenwood, Jose Palacios, Daniel Weitsman, Pennsylvania State University;

9:30 AM - 10:00 AM
Aeroacoustic Characterization of Optimum Hovering Rotors using Artificial Neural Networks (Paper 37)
Christopher Thurman,* Nikolas Zawodny, NASA Langley Research Center;

10:00 AM - 10:30 AM
eVTOL Rotor Noise in Ground Effect (Paper 224)
Brendan Smith,* Farhan Gandhi, Richard Healy, Rensselaer Polytechnic Institute; Anastasios Lyrintzis, Embry-Riddle Aeronautical University;

11:00 AM - 11:30 AM
Experimental and Computational Investigation of Stacked Rotor Broadband Noise in Hover (Paper 270)
Chloe Johnson,* Jayant Sirohi, University of Texas Austin; George Jacobellis,* Rajneesh Singh, US Army Research Lab;

11:30 AM - 12:00 PM
Aerodynamic Measurements from the Aerodynamic and Acoustic Rotorprop Test (AART) in the National Full-Scale Aerodynamics Complex (NFAC) 40- by 80-Foot Wind Tunnel (Paper 38)
James Stephenson,* Ben Sim, US Army; Benny Cheung, Natasha Schatzman, NASA Ames Research Center; Nikolas Zawodny, NASA Langley Research Center; D. Caleb Sargent, Sikorsky, a Lockheed Martin Co.;

12:00 PM - 12:30 PM
Aerodynamic and Acoustic Design of the Joby Aviation eVTOL Propeller (Paper 294)
Jeremy Bain,* Alex Stoll, Gregor Veble Mikic, Joby Aviation;

12:30 PM - 1:00 PM
eVTOL Rotor Noise Study Using Combined Comprehensive Modeling with Acoustic Analysis (Paper 68)
Chengjian He, Jeewoong Kim, Chris Ware, Seungjoon Yang,* Advanced Rotorcraft Technology, Inc.; James Baeder, Yong Su Jung, University of Maryland;

Acoustics II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Prediction of RACER's Lateral Rotor Noise Using the CONCERTO Chain (Paper 60)
Gabriel Rehoux,* Joëlle Bailly, ONERA; Frédéric Guntzer, Airbus Helicopters; Philip Bekemeyer, Gunnar Einarsson, Lukas Rottmann, German Aerospace Center (DLR);

9:30 AM - 10:00 AM
Aeroacoustic Analysis of Asymmetric Lift-Offset Helicopter in Forward Flight (Paper 226)
Paulo Arias,* James Baeder, Yong Su Jung, University of Maryland;

10:00 AM - 10:30 AM
An Assessment of Multi-copter Noise in Edgewise Flight (Paper 227)
Brendan Smith,* Farhan Gandhi, Rensselaer Polytechnic Institute; Anastasios Lyrintzis, Embry-Riddle Aeronautical University;

11:00 AM - 11:30 AM
Investigation of Empirical Rotor Broadband Prediction using CFD Boundary Layer Parameters Extraction (Paper 115)
Yong Su Jung,* James Baeder, University of Maryland; Chengjian He, Advanced Rotorcraft Technology, Inc.;
11:30 AM - 12:00 PM
A New Distributed Electric Propulsion Aircraft Simulation Tool for Coupled Flight Dynamics, Free Wake, and Acoustic Predictions (Paper 113)
Ze Feng Gan,* Kenneth Brentner, Eric Greenwood, Joseph Horn, Bhaskar Mukherjee, Jean-Pierre Theron, Pennsylvania State University; Mrunali Botre, Continuum Dynamics Inc;

12:00 PM - 12:30 PM
Acoustics Analysis of a Quiet Helicopter for Air Taxi Operations (Paper 110)
Sicheng Li,* Seongkyu Lee, University of California Davis;

12:30 PM - 1:00 PM
Acoustic Predictions for the Side-by-Side Air Taxi Rotor in Hover (Paper 171)
Jared Sagaga,* Seongkyu Lee, University of California Davis;
Advanced Vertical Flight

Advanced Vertical Flight I
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Structural Design and Aeromechanical Analysis of a Next-Generation Mars Hexacopter Rotor (Paper 33)
Cheng Chi,* Anubhav Datta, Ravi Lumba, University of Maryland;

9:30 AM - 10:00 AM
Axial Descent of Variable-Pitch Multirotor Configurations: An Experimental and Computational Study for Mars Deployment Applications (Paper 193)
Marcel Veismann,* Joel Burdick, Morteza Gharib, Skylar Wei, California Institute of Technology; Sarah Conley, Larry Young, NASA Ames Research Center; Jeff Delaune, Jacob Izraelevitz, NASA JPL, California Institute of Technology;

10:00 AM - 10:30 AM
Dragonfly - Aerodynamics during Transition to Powered Flight (Paper 264)
Jason Cornelius,* Jack Langelaan, Tomas Opazo, Sven Schmitz, Pennsylvania State University; Douglas Adams, Lev Rodovskiy, Benjamin Villac, Johns Hopkins University Applied Physics Lab; Larry Young, NASA Ames Research Center;

11:00 AM - 11:30 AM
The Future of Rotorcraft and other Aerial Vehicles for Mars Exploration (Paper 64)
Larry Young,* Haley Cummings, Shannah Withrow-Maser, NASA Ames Research Center; Gregory Pisanich, KBR Wyle Services, LLC; Pascal Lee, Mars Institute; Geoff Briggs, NASA (Ret.); Edwin Aiken, NASA Ames (Ret.);

11:30 AM - 12:00 PM
Conceptual Design of the Dragonfly Lander (Paper 301)
Jack Langelaan,* Sven Schmitz, Pennsylvania State University; Douglas Adams, Ralph Lorenz, Johns Hopkins University Applied Physics Lab;

Advanced Vertical Flight II
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Scaling Investigation of Feasibility and Hover Endurance for Electric Quasi-Quadrotor Configurations (Paper 190)
Budhyant Venepalli,* D. Stefan Dancila, University of Texas Arlington;

9:30 AM - 10:00 AM
Redistributed Allocation for Flight Control Failure on a Coaxial Helicopter (Paper 158)
Michael McKay,* Farhan Gandhi, Praneet Vayalali, Rensselaer Polytechnic Institute; Tom Berger, Mark J. Lopez, US Army Combat Capabilities Development Command Aviation & Missile Center;

10:00 AM - 10:30 AM
Flight Dynamics Model Identification of a Meso-Scale Twin-Cyclocopter in Hover (Paper 207)
Carl Runco,* Mobile Benedict, Texas A&M University;

11:00 AM - 11:30 AM
Lichten Runner-Up Paper: Experimental and Computational Investigation of a UAV-Scale Cycloidal Rotor in Forward Flight (Paper 222)
Joseph Heimerl,* Mobile Benedict, Atanu Halder, Texas A&M University;

11:30 AM - 12:00 PM
Experimental Evaluation of Coaxial Micro-UAS Propellers (Paper 175)
Matthew Floros,* Hao Kang, US Army;

12:00 PM - 12:30 PM
System Identification of a Thrust-vectoring, Coaxial-rotor-based Gun-launched Micro Air Vehicle in Hover (Paper 67)
Hunter Denton,* Mobile Benedict, Grant McCurdy, Texas A&M University; Hao Kang, US Army Research Lab;
9:00 AM - 9:30 AM
Machine Learning Based Approach to Improve Low-Fidelity Predictions for a Compound Helicopter (Paper 52)
Gaurav Makkar,* Farhan Gandhi, Fotis Kopsaftopoulos, Rensselaer Polytechnic Institute; Jean-Paul Reddinger, US Army Research Lab;

9:30 AM - 10:00 AM
Duct-Winged Inertial Bicopter: Theory, Design and Testing (Paper 138)
Gary Gress,* Athena Aero Corp.;

10:00 AM - 10:30 AM
Considerations for Enabling Extreme Unmanned Aerial Systems Through Advanced Technologies (Paper 166)
Rajneesh Singh,* Ashish Bagai, US Army Research Lab;

11:00 AM - 11:30 AM
Designing a High Speed Morphing Rotor Blade (Paper 174)
Andrzej Kuczek,* Zaffir Chaudhry, Wenping Zhao, Raytheon Technologies; Farhan Gandhi, Rensselaer Polytechnic Institute; Daniel Camp, US Army CCDC AvMC;
Aerodynamics

Aerodynamics I
Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Wake Unsteadiness and Tip Vortex System of Full-Scale Helicopters in Ground Effect (Paper 81)
C. Christian Wolf,* Johannes N. Braukmann, Stefan Koch, Markus Raffel, Clemens Schwarz, Armin Weiss, German Aerospace Center (DLR);

9:30 AM - 10:00 AM
Investigation of the Flow Fields of Coaxial Stacked and Counter-Rotating Rotors using PIV Measurements and URANS Simulations (Paper 278)
Stefan Platzer,* Manfred Hajek, Technical University of Munich; Juergen Rauleder, Georgia Institute of Technology; Patrick Mortimer, Jayant Sirohi, University of Texas at Austin;

10:00 AM - 10:30 AM
Development of Secondary Vortex Structures in Rotor Wakes (Paper 146)
Clemens Schwarz,* Robert Brinkema, Anthony D. Gardner, Christian Wolf, German Aerospace Center (DLR); Andrew Bodling,* Science and Technology Corporation; Mark Potsdam, US Army TDD;

11:00 AM - 11:30 AM
Aerodynamic Optimization of the Sizing and Blade Designs of Hovering Corotating Coaxial Rotors (Paper 45)
Keen Ian Chan,* ST Engineering;

11:30 AM - 12:00 PM
Hover Performance in Ground Effect Prediction Using a Dual Solver Computational Methodology (Paper 200)
Alex Moushegian,* Marilyn Smith, Georgia Institute of Technology; Daniel Wachspress, Glen Whitehouse, Continuum Dynamics Inc.;

12:00 PM - 12:30 PM
A Computational Investigation of Side-by-Side Rotors in Ground Effect (Paper 199)
Richard Healy,* Farhan Gandhi, Joseph McCauley, Onkar Sahni, Rensselaer Polytechnic Institute;

Aerodynamics II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Time-Resolved Stereo PIV Measurements of a Cyclorotor in Hover (Paper 257)
Anouk Van Rooij,* CycloTech GmbH;

9:30 AM - 10:00 AM
Boundary Layer Transition Measured by DIT on the PSP Rotor in Forward Flight (Paper 98)
Anthony Gardner,* Markus Raffel, Armin Weiss, Christian Wolf, German Aerospace Center (DLR); J.T. Heineck, Hannah Spooner, NASA Ames Research Center; Rohit Jain, Austin Overmeyer, US Army;

10:00 AM - 10:30 AM
Physics of BVI-Induced Dynamic Stall on Equivalent One-Bladed and Four-Bladed Rotors (Paper 55)
Amanda Grubb,* Marilyn Smith, Georgia Institute of Technology; Rohit Jain, US Army CCDC AvMC;

11:00 AM - 11:30 AM
Investigation of Three-Dimensional Flow Structures on a Rotating Wing Using a Novel Rotating Velocimetry Technique (Paper 143)
Abhishek Gururaj,* Mahyar Moaven, Sarah Morris, Vrishank Raghav, Brian Thurow, Auburn University;

11:30 AM - 12:00 PM
Does Scatter Matter? Improved Understanding of UH-60A Wind Tunnel Rotor Measurements Using Data-Driven Clustering and CREATE-AV Helios (Paper 296)
Manikandan Ramasamy,* Rohit Jain, US Army; Thomas Norman, NASA Ames Research Center;
12:00 PM - 12:30 PM
CFD Turbulence Transition Models Validation for Rotors in Unsteady Axial and Forward-flight Conditions using CREATE™-AV Helios (Paper 186)
Rohit Jain,* U.S. Army DEVCOM AvMC;

12:30 PM - 1:00 PM
RCAS, VVPM, and Panel Coupling Enhancements for Interference and Download Prediction (Paper 292)
Jeewoong Kim,* Matthew Hasbun, Chengjian He, Hossein Saberi, Advanced Rotorcraft Technology, Inc.; Mahendra Bhagwat, U.S. Army Combat Capabilities Development Command Aviation & Missile Center;

Aerodynamics III
Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
High-fidelity Simulation of the Volocopter-2X in Cruise Flight (Paper 194)
Sebastian Miesner,* Manuel KeLer, Ewald KrMer, University of Stuttgart; Ulrich SchFerlein, Volocopter GmbH;

9:30 AM - 10:00 AM
Solving the Ship-Rotorcraft Dynamic Interface Problem Using Lattice-Boltzmann Aerodynamics Two-Way Coupled with Blade Element Based Flight Dynamics (Paper 1317)
Jakob Bludau,* Manfred Hajek, Technical University of Munich; JRgen Rauleder, Georgia Institute of Technology;

10:00 AM - 10:30 AM
High-fidelity Numerical Investigation of Ducted Propeller Aerodynamics/Acoustics and Adjoint-based Design Optimisation (Paper 133)
Tao Zhang,* George Barakos, University of Glasgow;

11:00 AM - 11:30 AM
S-97 RAIDER® Wake-Empennage Interaction Fight Data and Correlation (Paper 46)
Peter Lorber,* Patrick Bowles, Hong Xin, Jinggen Zhao, Sikorsky, a Lockheed Martin Co.;

11:30 AM - 12:00 PM
Reconsidering the Theory and Application of Helicopter Maneuverability (Paper 84)

12:00 PM - 12:30 PM
Modeling of the Blade Crossover Interaction using Machine Learning (Paper 132)
Kalki Sharma,* Kenneth Brentner, Daning Huang, Vidullan Surendran, Yin Yu, Pennsylvania State University; Phuriwat Anusonti-Inthra, US Army Research Lab;
Aircraft Design

Aircraft Design I
Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Lift Off of H160 with Blue Edge\textregistered Blade (Paper 149)
C\textsuperscript{\textregistered}Dric Lanouette,* Jean-Fran\textsuperscript{ois} Hirsch,* Airbus Helicopters;

9:30 AM - 10:00 AM
Optimisation of the AH-64A Blade Planform Based on High-Fidelity CFD Methods (Paper 189)
Thomas Fitzgibbon,* George Barakos, Mark Woodgate, University of Glasgow;

10:00 AM - 10:30 AM
A Comparison of High-Fidelity Simulation Approaches for eVTOL Rotor Flows in Descent Conditions (Paper 135)
Abhishek Chopra,* Farhan Gandhi, Richard Healy, Joseph McCauley, Onkar Sahni, Rensselaer Polytechnic Institute;

11:00 AM - 11:30 AM
Helicopter Rotor Blade Multiple-Section Optimization with Performance Considerations (Paper 161)

11:30 AM - 12:00 PM
Fault Tolerant Individual Blade Control Actuation System (Paper 173)
John Kopp,* Moog Inc;

12:00 PM - 12:30 PM
The Search for an Ideal Bearingless Main Rotor (BMR) Design (Paper 306)
Daniel Schrage,* Georgia Institute of Technology;

Aircraft Design II
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Preliminary Design of Several New Kinds of Martian Aircrafts (Paper 147)
Bin Lou,* Zhejiang Lab;

9:30 AM - 10:00 AM
Military Mission Suitability Assessment of eVTOL Aircraft Configurations (Paper 276)
Mark Scott,* Science and Technology Corporation;

10:00 AM - 10:30 AM
Multidisciplinary Trim Analysis Using Improved Optimization, Image Analysis, and Machine Learning Algorithms (Paper 178)
Thomas Herrmann,* James Baeder, Roberto Celi, University of Maryland;

11:00 AM - 11:30 AM
Practical Conceptual Design of Quieter Urban VTOL Aircraft (Paper 202)
Christopher Silva,* Wayne Johnson, NASA Ames Research Center;

11:30 AM - 12:00 PM
Multi-Fidelity Surrogate Model for Interactional Aerodynamics of a Multicopter (Paper 223)
Orazio Pinti,* Assad Oberai, University of Southern California; Farhan Gandhi, Richard Healy, Robert Niemiec, Rensselaer Polytechnic Institute;

12:00 PM - 12:30 PM
37th Student Design Competition Undergraduate Winner: SolidityOne - Leonardo's Aerial Screw 500-years Later (Paper 1335)
Sungi Han,* Nick Pauly,* Kenny Van Gaalen, Thijs Van Herwerden, Mark Van Den Ham, Delft University of Technology;
12:30 PM - 1:00 PM
37th Student Design Graduate Winner: Elico - Leonardo's Aerial Screw 500-years Later (Paper 1334)
James Sutherland,* Katie Krohmaly,* University of Maryland;
9:00 AM - 9:30 AM  
**Incremental Dynamic Inversion Flight Control for the ACT/FHS EC 135 Helicopter** (Paper 62)  
Jakob Bachler,* Technical University Munich; Philippe Petit, German Aerospace center (DLR);  

9:30 AM - 10:00 AM  
**Deep Learning Based Obstacle Awareness from Airborne Optical Sensors** (Paper 21)  
Manogna Ammalladene-Venkata, Omkar Halbe,* Christian Seidel, Airbus Helicopters Deutschland GmbH; Christine Groitl, Christoph Stahl, Airbus Defense and Space GmbH;  

10:00 AM - 10:30 AM  
**Model Predictive Approach for Short-Term Collision Avoidance** (Paper 145)  
Alexej Dikarew,* German Aerospace Center (DLR);  

11:00 AM - 11:30 AM  
**Rust for Safe and Secure Avionics and Mission System Software** (Paper 58)  
Max Taylor,* Josh Ehlinger, Jeff Imig, Collins Aerospace; Massimiliano De Otto,* Wind River;  

11:30 AM - 12:00 PM  
**Air Vehicle/Mission System Architecture (AV/MSA) Interface Definition** (Paper 1314)  
Stephen Simi,* Tucson Embedded Systems (TES); Bill Jacobs,* US Army;
Crash Safety

Crash Safety
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Contribution to Improvement of Helicopter Ditching Capability Achieved within SARAH European Research Project (Paper 99)
Séverin Halbout,* Airbus Helicopters; Angélique Jullien, Harish Kerekyathanahalli Prakash, ALTAIR; Yoann Jus, Bureau Veritas Solutions Marine and Offshore; Benjamin Bouscasse, Ecole Centrale Nantes;

9:30 AM - 10:00 AM
Simulation of Lift Plus Cruise Vehicle Models to Define a Full-Scale Crash Test Campaign (Paper 77)
Justin Littell,* Jacob Putnam,* NASA Langley Research Center; Megan Cooper, Massachusetts Institute of Technology;

10:00 AM - 10:30 AM
Integrated Occupant Safety for Urban Air Mobility Applications (Paper 183)
Gerardo Olivares,* Luis Gomez,* Vincent Robinson, National Institute for Aviation Research; Domenic Barsotti, Michiel Unger, Siemens Digital Industries Software; Paul Van Hooijdonk, TASS International;

11:00 AM - 11:30 AM
Spinal Injury Risk Associated with Performance Requirements for Military Rotary-Wing Seats (Paper 162)
Elizabeth Lafferty,* Valeta Chancey, Nathan Flath, Barney McEntire, US Army Aeromedical Research Lab;

11:30 AM - 12:00 PM
Development of an Improved Gunner Seat Restraint (Paper 261)
Roger Podob,* US Navy; Charles Van Druff,* Soteria Mechatronics;
Crew Stations and Human Factors

Crew Stations I
Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Investigation and Evaluation of a Multimodal Pilot Assistance System for Helicopter Operations (Paper 151)
Tanja Martini,* Michael Jones, Philipp Mevenkamp, Niklas Peinecke, German Aerospace Center (DLR); Rgen Schmidt, Airbus Helicopters;

9:30 AM - 10:00 AM
Assessment of Augmented Operator's Mental Workload with Visual Assistive Technology in Simulated Rotorcraft Piloting Tasks (Paper 139)
Calvin Lu,* Roberto Celi, Rodolphe Gentili, Bradley Hatfield, Hyuk Oh,* University of Maryland; Justin Blanco, Jessica Mohlar, Ann Vanleer, US Naval Academy;

10:00 AM - 10:30 AM
Modelling the Influence of Autonomous Systems on Pilot Workload during Helicopter Operations (Paper 180)
Sion Jennings,* Perry Comeau, Derek Gowanlock, John Robazza, National Research Council of Canada;

11:00 AM - 11:30 AM
Designing Flight Scenarios to Elicit Physiological Response among Aviators during High Workload Environments (Paper 90)
Lance Randles,* Kathryn Feltman, Jason Gerstner, Christopher O'Brien, US Army Aeromedical Research Lab;

11:30 AM - 12:00 PM
Visual-Gravitoinertial Interactions for Altitude Perception during Manual and Supervisory Control (Paper 141)
Martine Godfroy-Cooper,* Edward Bachelder, Joel Miller, US Army DEVCOM AvMC; Benoit Bardy, Euromov/ University of Montpellier; Jean-Christophe Sarrazin, ONERA;

12:00 PM - 12:30 PM
The Design of Pilot Cueing for the Degraded Visual Environment Mitigation (DVE-M) System for Rotorcraft (Paper 89)
Zoltan Szoboslay,* Martine Godfroy-Cooper, Joel Miller, US Army DEVCOM AvMC;

12:30 PM - 1:00 PM
Joel Miller,* Martine Godfroy-Cooper, Zoltan Szoboszlay, US Army DEVCOM AvMC;

Crew Stations II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Prediction of Motion Sickness Onset for Vertical Lift Applications (Paper 102)
Philippe Petit,* German Aerospace Center (DLR);

9:30 AM - 10:00 AM
Anthropometric Accommodation and Ergonomics in the MH-60S NextGen Gunners Seat (Paper 1327)
Lori Brattin Basham,* Justin R. Blankenship, Andrew N. Koch, Naval Air Warfare Center;

10:00 AM - 10:30 AM
3D Conformal Pilot Cueing for Rotorcraft Shipboard Landings: A Time Horizon Parametric Study (Paper 127)
Robert Walters,* Vinodhini Comandur, Karen Feigh, Georgia Institute of Technology;

11:00 AM - 11:30 AM
Sustaining Performance and Vigilance during Extended Unmanned Aerial System Operations (Paper 88)
Amanda Kelley,* Amanda Hayes, Ryan Mackie, US Army Aeromedical Research Lab;
Do We Need Biomedical Interventions to Maintain Crew Performance under Sustained Attention? (Paper 79)
Kathryn Feltman,* Amanda Kelley, Colby Mathews, Lance Randles, US Army Aeromedical Research Lab;
Dynamics

Dynamics I
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Rotor-Body Coupled Vibration Analysis of a High-Speed Lift Offset Coaxial Rotor (Paper 236)
Sung Jung, Jae Bae, Seong Hong,* Konkuk University; Sung-Boo Hong, Jae-Sang Park, Chungnam National University;

9:30 AM - 10:00 AM
Comparison of Wind Tunnel Tiltrotor Loads of Two Hub Types Under Different Pylon Angles with Multibody Dynamics Analyses (Paper 233)
Jennifer Baggett,* Jinwei Shen, University of Alabama; Andrew Kreshock, U.S. Army Combat Capabilities Development Command Army Research Laboratory;

10:00 AM - 10:30 AM
Fabrication, Testing, and 3-D Comprehensive Analysis of Swept Tip Tiltrotor Blades (Paper 260)
James Sutherland,* Anubhav Datta, University of Maryland;

11:00 AM - 11:30 AM
Individual Blade Control for Component Load Alleviation using a Model Predictive Control Formulation (Paper 1315)
Chams Eddine Mballo,* J.V.R Prasad, Georgia Institute of Technology;

11:30 AM - 12:00 PM
Aeroelastic Loads and Stability of Swept-Tip Hingeless Tiltrotors Toward 400 knots Flutter-Free Cruise (Paper 266)
Seyhan Gul,* Anubhav Datta, University of Maryland;

12:00 PM - 12:30 PM
In Search of Extreme Limits of a Compound Helicopter in High Speed Flight (Paper 53)
Shashank Maurya,* Inderjit Chopra, Anubhav Datta, University of Maryland;

12:30 PM - 1:00 PM
CFD-CSD Support for Rotor Design Improvement to Reduce Vibrations (Paper 49)
Jinggen Zhao,* Mikel Brigley, Stephen Makinen, Ramin Modarres, Michael Monica, Nick Tuozzo, Sikorsky, a Lockheed Martin Co.;

Dynamics II
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Improved Higher Harmonic Control Analysis for HART-II Rotor (Paper 112)
Byeonguk Im,* Seunghoon Kang, Geonhyuk Kong, Sunhoo Park, SangJoon Shin, Seoul National University; Haeseong Cho, Jeonbuk National University;

9:30 AM - 10:00 AM
AeroServoElastic Test Campaign of the AW609 Civil Tilt-Rotor (Paper 131)
Marco Favale, Nicola Donini, Cristian Lilliu,* Giovanni Tovo, Alberto Angelo Trezzini, Leonardo Helicopters; Ahmad Haidar, AgustaWestland Philadelphia Corporation;

10:00 AM - 10:30 AM
Analysis Methods for Ground Resonance in Partial Ground Contact (Paper 50)
Reinhard Lojewski,* Christoph Kessler, German Aerospace Center (DLR);

11:00 AM - 11:30 AM
Performance Advantages and Resonance Analysis of a Variable Speed Rotor Using Geometrically Exact Beam Formulations (Paper 76)
Ruthvik Chandrasekaran,* Dewey Hodges, Georgia Institute of Technology;
11:30 AM - 12:00 PM
**Vibration Reduction in Rotorcraft Using Closed-Loop Active Flow Control** (Paper 117)
Ryan Patterson,* Peretz Friedmann, University of Michigan;

12:00 PM - 12:30 PM
**An Examination of Aerodynamic and Structural Loads for a Rotor Blade Optimized with Multi-Objective Genetic Algorithm** (Paper 268)

12:30 PM - 1:00 PM
**Modeling and Analysis of Proprotor Whirl Flutter** (Paper 263)
Hyeonsoo Yeo,* US Army DEVCOM AvMC; Hao Kang, Andrew Kreshock, US Army Research Lab;

**Dynamics III**
Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
**AW609 Civil Tiltrotor Drive Train Torsional Stability Analysis and Certification Test Campaign** (Paper 251)
Ahmad Haidar,* Luca Belluomini, Alberto Trezzini, Leonardo Helicopters;

9:30 AM - 10:00 AM
**How Big is a Lock Number?** (Paper 18)
Cory Seidel, David Peters,* Washington University St. Louis;

10:00 AM - 10:30 AM
**A Look Back on Flap-Lag Stability after 50 Years** (Paper 3)
David Peters,* Andrew Bergantz, Washington University St. Louis;

11:00 AM - 11:30 AM
**UH-60A Airloads Workshop - Setting the Stage for the Rotorcraft CFD/CSD Revolution** (Paper 114)
Hyeonsoo Yeo,* Robert Ormiston,* US Army DEVCOM AvMC;
Electric Vertical Takeoff and Landing (eVTOL)

### eVTOL I

**Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM**

**9:00 AM - 9:30 AM**
**Panel-Method-Based Path Planning for eVTOL in Urban Environment** (Paper 250)
Zeynep Unal,* Ykay Yavrucuk, Middle East Technical University;  

**9:30 AM - 10:00 AM**
**Electromechanical Modeling and Testing of a Novel Electrically Driven Stacked Rotor System** (Paper 297)
Matthew Asper,* Jayant Sirohi, University of Texas Austin; Michael Ricci, George A. Uy De Ong II, LaunchPoint EPS;  

**10:00 AM - 10:30 AM**
**Development of Aria, a Compact, Ultra-Quiet Personal Electric Helicopter** (Paper 281)
David Coleman,* Moble Benedict, Hunter Denton, Atanu Halder, Bochan Lee, Carl Runco, Farid Saemi, Texas A&M University; Vishaal Subramanian, Crystal Instruments; Eric Greenwood, Pennsylvania State University; Vinod Lakshminarayan, Science and Technology Corporation;  

**11:00 AM - 11:30 AM**
**Integrated Multi-Physics Simulation for eVTOL In-flight Energy Regeneration using Piezoelectric Power Harvesters and 6DOF Control** (Paper 249)
Llorenc Foraste Gomez,* Zhenhua Huang, Gamma Technologies, LLC; Felix Brenner, Stuttgart University;  

**11:30 AM - 12:00 PM**
**Analysis of Bus Voltage Sag during High Battery Power Operations on Hybrid Electric Urban Air Mobility Vehicles** (Paper 204)
Kyle Collins,* Richard Anderson, Patrick Currier, Roydon Fernandes, Sohail Lahaji, Jayaprakash Shivakumar, Embry-Riddle Aeronautical University;  

**12:00 PM - 12:30 PM**
**Post-Motor-Failure Performance of a Robust Feedback Controller for a UAM-Scale Hexacopter** (Paper 164)
Matthew Bahr,* Farhan Gandhi, Michael McKay, Robert Niemiec, Rensselaer Polytechnic Institute;  

### eVTOL II

**Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM**

**9:00 AM - 9:30 AM**
**Modelling of a Hybrid-Electric System and Design of Load-Following Control Law on Hybrid-Electric Urban Air Mobility Power Plants** (Paper 214)
Sohail Lahaji,* Richard Anderson, Kyle Collins, Eagle Flight Research Center; Patrick Currier, Embry-Riddle Aeronautical University;  

**9:30 AM - 10:00 AM**
**Multi-rotor eVTOL Flight Simulation and Assessment under Atmospheric Turbulence** (Paper 185)
Matthew Bahr,* Etana Ferede, Farhan Gandhi, Ullhas Hebb, Rensselaer Polytechnic Institute;  

**10:00 AM - 10:30 AM**
**A CFD Based Method to Model Aerodynamic Interactions in Complex eVTOL Configurations for Realtime and Medium Fidelity Simulations** (Paper 283)
Gregor Veble Miki?,* Jeremy Bain, JoeBen Bevirt, Alex Stoll, Joby Aviation;  

**11:00 AM - 11:30 AM**
**Design and Simulation of a Novel E-VTOL Aircraft AM20 to Understand Challenges in Certification and Flight Testing** (Paper 300)
Nirmal Kumar Umapathy,* Nandini Gopalakrishnan, Tony Wiederkehr, AeroMech Inc.;
Handling Qualities

Handling Qualities I
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Evaluation of a Slung Load Control System for Piloted Winch Operations (Paper 96)
Tim Jusko,* Michael Jones, German Aerospace Center (DLR);

9:30 AM - 10:00 AM
Synthesis and Piloted Evaluation of Advanced Rotorcraft Response-Types Using Robust Sliding Mode Control (Paper 4)
Omkar Halbe,* Manfred Hajek, Tim Mehling, Technical University of Munich; Milan Vrdoljak, University of Zagreb;

10:00 AM - 10:30 AM
Effects of Disk Loading on Handling Qualities of Large-Scale, Variable-RPM Quadcopters (Paper 205)
Ariel Walter,* Farhan Gandhi, Robert Niemiec, Rensselaer Polytechnic Institute;

11:00 AM - 11:30 AM
Impact of Handling Qualities on Motor Sizing for Multirotor Aircraft with Urban Air Mobility Missions (Paper 215)
Shannah Withrow-Maser,* Carlos Malpica, Keiko Nagami, NASA Ames Research Center;

11:30 AM - 12:00 PM
Load Alleviation Control using Dynamic Inversion with Direct Load Feedback (Paper 275)
Mariano Scaramal,* Joseph Horn, Pennsylvania State University; Umberto Saetti, Georgia Institute of Technology;

Handling Qualities II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Robust Flight Control for a Validated XV-15 Model (Paper 116)
Hao Yang, Rafael Morales,* University of Leicester;

9:30 AM - 10:00 AM
Evaluation of the Phase-Aggression Criterion for PIO Detection in Real-time (Paper 123)
Simone Fasiello,* Mike Jump, University of Liverpool; Pierangelo Masarati, Politecnico di Milano;

10:00 AM - 10:30 AM
Development of UH-72A Simulator Model in Support of ADS-33 Training (Paper 91)
William Geyer,* Barbara Gordon, Christopher Mattei,* Dwight Robinson, US Naval Test Pilot School;

11:00 AM - 11:30 AM
A Theoretical Framework Unifying Handling Qualities, Workload, Stability and Control (Paper 269)
Edward Bachelder,* San Jose State University; Bimal Aponso, NASA Ames Research Center;

11:30 AM - 12:00 PM
Probabilistic Techniques for Pilot-Vehicle Interaction and Handling Qualities Analysis (Paper 219)
Jared Cooper,* Michael DeVore, Adam Reed, Barron Associates, Inc.; David Klyde,* Chase Schulze, Systems Technology, Inc.;

12:00 PM - 12:30 PM
Pilot Workload and Performance Assessment for a Coaxial-Compound Helicopter and Tiltrotor During Aggressive Approach (Paper 225)
Edward Bachelder,* Martine Godfroy-Cooper, San Jose State University; Bimal Aponso, NASA Ames Research Center; Tom Berger, US Army DEVCOM AvMC;
Health and Usage Monitoring Systems (HUMS) - Condition Based Maintenance (CBM)

HUMS I
Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Model-based Failure Anticipation and Predictive Maintenance: a Landing Gear Application (Paper 87)
Antonin Rocher,* Roland Becquet, Airbus Helicopters; Jean-Charles Mar, INSA Toulouse;

9:30 AM - 10:00 AM
Direct Load Recognition and Damage Estimation using Supervised Learning (Paper 48)
Caroline Del Cistia Gallimard,* Sorbone Universiti; Frederic Beroul, Jeremy Jouve, Konstanca Nikolajevic, Airbus Helicopters;

10:00 AM - 10:30 AM
Probabilistic Damage Estimation for Rotorcraft Condition-Based Maintenance (Paper 209)
Dakota Musso,* Jonathan Rogers, Georgia Institute of Technology;

11:00 AM - 11:30 AM
Prognostics Framework to Enable a Maintenance Free Operating Period (Paper 156)
Eric DeWind,* Richard Sopko, Collins Aerospace;

11:30 AM - 12:00 PM
James Hunt,* TJ Martin, Thomas C. Samper, Avion Solutions;

12:00 PM - 12:30 PM
Predicting a Maximum Stress using Machine Learning and Parametric Flight Data (Paper 101)
Michael Sweet, Samuel Forgerson,* Chad DeMontfort, Mercer Engineering Research Center;

12:30 PM - 1:00 PM
A Model for Inferred Gross Weight using HUMS Data (Paper 92)
Eric Bechhoefer,* GPMS Inc; Thomas Wells, Purdue University;

HUMS II
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
On Leveraging Network-wide Information from Hotspot Sensor Networks using Multi-output Gaussian Process Regression Models (Paper 234)
Ahmad Amer,* Fotis Kopsaftopoulos, Rensselaer Polytechnic Institute;

9:30 AM - 10:00 AM
Unified Statistical Framework for Rotor Fault Diagnosis on a Hexacopter via Functionally Pooled Stochastic Models (Paper 182)
Airin Dutta,* Farhan Gandhi, Fotis Kopsaftopoulos, Robert Niemiec, Rensselaer Polytechnic Institute;

10:00 AM - 10:30 AM
Effect of load limiting control on rotorcraft maneuver performance and component damage growth (Paper 309)
Aarohi Shah,* Chams Mbalo, J. V. R. Prasad, Julian J. Rimoli, Georgia Institute of Technology;
History

Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Floyd Carlson: The Legacy and Contributions of One of America's Greatest Rotary Wing Test Pilots (Paper 17)
Paul Fardink,* US Army (Retired);

9:30 AM - 10:00 AM
History of the Vertol Aircraft Corporation, 1956 to 1960 (Paper 118)
Kenneth Bartie,* Boeing Vertical Lift (Ret.);

10:00 AM - 10:30 AM
A Brief History of VTOL In-Flight Aircrew Rescue Systems (Paper 142)
Jacques Virasak,* Kaman Corporation; Erasmo Pi Ero, Jr.,* Bell;

11:00 AM - 11:30 AM
Preserve, Educate & Inspire - Founding the American Helicopter Museum & Education Center (Paper 313)
Robert Beggs,* American Helicopter Museum;
9:00 AM - 9:30 AM
Development of Magnesium Laser Powder Bed Fusion to Manufacture Light-weight Components for Vertical Lift Applications (Paper 153)
Marc De Smit,* Ludmila 'T Hoen, Maria Montero-Sistiaga, Netherlands Aerospace Centre NLR; Antonio Paesano, The Boeing Company;

9:30 AM - 10:00 AM
Use of Uncertainty Quantification to Determine the Impact of Manufacturing Error on the Handling Qualities of Tiltrotor Aircraft (Paper 172)
Ye Yuan,* David Anderson, Douglas Thomson, University of Glasgow;

10:00 AM - 10:30 AM
How Sikorsky Adapted to Meet US Army FARA Program Timeline (Paper 1333)
Ryan Patry,* Sikorsky, a Lockheed Martin Co.;

11:00 AM - 11:30 AM
Lichten Award Paper: Variational Tolerance Analysis (VTA) - Design and Manufacturing Optimization Using Statistical Simulation (Paper 1338)
Andrew Lavoie,* Sikorsky, a Lockheed Martin Co;
Modeling and Simulation

Modeling and Simulation I
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
S-97 RAIDER® GenHel Model Development and Correlation with Flight Test Data (Paper 69)
Hong Xin,* Andrew Black, Thomas Herrmann, Patricia Jaeger, Matthew Luszcz, Todd Smith, Adam Thorsen, Chi Zhang, Sikorsky, a Lockheed Martin Co.;

9:30 AM - 10:00 AM
Invited Presentation: NATO AVT 296 Overview (Paper 1336)
Mark Tischler,* Tischler Aeronautics;

10:00 AM - 10:30 AM
Simulation Fidelity Assessment for Rotorcraft? Methods and Metrics Sketches from the Work of NATO AVT-296 (Paper 167)
Marilena Pavel,* Delft University Technology;

11:00 AM - 11:30 AM
Extraction of Flight Dynamics Data from Level D Qualification Flight Tests. Application to Training Simulators
Model Fidelity Enhancement (Paper 157)
Armin Taghizad,* ONERA; Sylvain Richard, Thales Training & Simulation; Robert Clark, Mark Tischler,* US Army TDD;

11:30 AM - 12:00 PM
Simulation Model Fidelity Enhancement Using Corrective Force and Moment Increments - Review of Activity Performed in NATO-AVT Panel 296 (Paper 188)
Armin Taghizad, ONERA; Vincent Myrand-Lapierre,* Michel Nadeau-Beaulieu, CAE; Ilkay Yavrucek, Middle East Technical University; Sylvain Richard, Thales Training & Simulation; Mark Tischler, US Army TDD; Neil Cameron,* Gareth Padfield, Mark White, University of Liverpool;

12:00 PM - 12:30 PM
Updating Rotorcraft Simulation Environments by Using Black-Box Input Filters (Paper 130)
Steffen Greiser,* Univ. of Applied Sciences Osnabruceck/Lingen; Vincent Myrand-Lapierre, Michel Nadeau-Beaulieu, CAE; Pavle Scepanovic, Susanne Seher-Wei, German Aerospace Center (DLR); Arthur Gubbels, National Research Council of Canada;

Modeling and Simulation II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Fault-Tolerant Control Allocation on a Compound Helicopter in Cruise (Paper 159)
Praneet Vayalali,* Farhan Gandhi, Michael McKay, Rensselaer Polytechnic Institute;

9:30 AM - 10:00 AM
Rotorcraft Countermeasure Release Simulation (Paper 213)
Robert McKillip,* Todd Quackenbush,* Michael Yu, Continuum Dynamics Inc.;

10:00 AM - 10:30 AM
Fidelity Enhancement of a Multi-Rotor Dynamic Inflow Model via System Identification (Paper 43)
Feyyaz Guner,* J. V. R. Prasad, Georgia Institute of Technology; Chengjian He, Advanced Rotorcraft Technology, Inc.; David A. Peters, Washington University St. Louis;

11:00 AM - 11:30 AM
Development of a Reconfigurable Control Equivalent Turbulence Input Model for Multirotor UAS (Paper 121)
Kevin Truong,* San Jose State University; Tom Berger, Anthony Gong, Mark Tischler, US Army CCDC AvMC; Christina Ivler, University of Portland;

11:30 AM - 12:00 PM
Bell V-280 Hover Flight Dynamics Model Validation and Update with Flight Test Data (Paper 229)
Modeling and Simulation III
Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
The Effect of Atmospheric Turbulence on Helicopter Recovery to a Twin-Island Aircraft Carrier (Paper 26)
Neale Watson,* Ieuan Owen, Mark White, University of Liverpool;

9:30 AM - 10:00 AM
A New Approach to Comprehensive Rotorcraft Aeromechanics Simulation (Paper 272)
Johannes Hofmann,* Maximilian Mindt, Felix Weiss, German Aerospace Center (DLR);

10:00 AM - 10:30 AM
Numerical Investigation on the Role of Control Inceptors Layout in Rotorcraft-Pilot Couplings (Paper 208)
Andrea Zanoni, Alessandro Cocco,* Pierangelo Masarati, Politecnico di Milano;

11:00 AM - 11:30 AM
Experimental Investigation of Unsteady Inflow for a Helicopter Model in Shipboard Operations (Paper 108)
Neda Taymourtash,* Giuseppe Gibertini, Giuseppe Quaranta, Alex Zanotti, Politecnico di Milano;

11:30 AM - 12:00 PM
Linear Model Identification for Rotorcraft Using Adaptive Learning (Paper 271)
Gonenc Gursoy,* Aerotim Engineering LLC; Ongun Hazar Aslandogan, Ilkay Yavrucuk, Middle East Technical University;

12:00 PM - 12:30 PM
Linear Time-Invariant Models of Rotorcraft Flight Dynamics, Vibrations, and Acoustics (Paper 11)
Umberto Saetti,* Georgia Institute of Technology; Kenneth Brentner, Joseph Horn, Pennsylvania State University;

12:30 PM - 1:00 PM
Linear Time-Invariant Models of the Dynamics of Flapping-Wing Flight (Paper 13)
Umberto Saetti,* Jonathan Rogers, Georgia Institute of Technology;
Operations

Operations
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Height-Velocity Characteristics Comparisons of Single-rotor and Coaxial Helicopters (Paper 80)
Yanqin Zhao,* Renliang Chen, Xin Yu, Nanjing University of Aeronautics and Astronautics;

9:30 AM - 10:00 AM
TEAMX or Manned and Unmanned Cooperation (Paper 97)
Lionel Thomasssey,* Lionel Arlen, Airbus Helicopters;

10:00 AM - 10:30 AM
Assessment of the Operational Costs and the Passengers' Willingness-to-Pay to Evaluate the Financial Viability of an Air Taxi Service (Paper 187)
Maximilian Fischer,* Denis Heckmann, Alexander Nase, FEV Consulting;

11:00 AM - 11:30 AM
Improvements to a Helicopter Gun System Controller Using Active Damping and Ramp Rates for the Bending Corrections (Paper 140)
Andres Sandoval, Mark Handley,* Boeing Co.;

11:30 AM - 12:00 PM
Parameter Sensitivity studies for the Performance of an Electric BiCP-VTOL UAV (Paper 216)
Sergio Esteban,* Lvaro Martinez Nez Blanco,* University of Seville;

12:00 PM - 12:30 PM
Air Launched Effects Payload and Air Vehicle Integration (Paper 220)
J. Michael Lengyel,* Elbit Systems of America; Patrick Sosa, Areq I Inc.;

12:30 PM - 1:00 PM
A Retrospective & Historical Analysis of Vertical Lift Infrastructure Accidents for the Purpose of Operational Risk Identification and Accident Prevention (Paper 286)
Rex Alexander,* Five-Alpha LLC; Cliff Johnson, Federal Aviation Administration; Raymond Syms, HeliExperts International; John Roberts, US DOT Transportation Safety Institute;
Product Support Systems Technology

Product Support
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Advanced Manufacturing in Sustainment (Paper 243)
Heather Woodworth,* Alexander Mark, Caitlyn Slezak, Sikorsky, a Lockheed Martin Co.;

9:30 AM - 10:00 AM
Multi-physics Predictive Modeling Platform for Qualification of Material Microstructure and Mechanical Performance of Aerospace Additive Manufacturing Parts (Paper 107)
Behrooz Jalalahmadi,* Jason Rios, Sentient Science;

10:00 AM - 10:30 AM
Mike Gralish,* Bell;

11:00 AM - 11:30 AM
Boiling Down Aviation Data: Development of the Aviation Data Distillery (Paper 177)
Steven Nixon,* Applied Research Lab at Pennsylvania State University; Mike Augustin, AVX Aircraft Company; Dennis Dunaway, PeopleTec, Inc.; Dy Le, Texas Tech University;

11:30 AM - 12:00 PM
Product Support in a Maintenance Free Operating Period Strategy (Paper 211)
Andrew Bellocchio,* Steven Chetcuti, Kathryn Pegues, US Military Academy;

12:00 PM - 12:30 PM
Advancement of U.S Army Maintenance Practices for Rotorcraft using MSG Techniques (Paper 258)
Abdel-Moez Bayoumi, Evan Barnett,* Rhea Matthews, University of South Carolina;
Propulsion

Propulsion I
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Mission Performance and Cost Calculation for variable Rotor Speed Drivetrain (Paper 47)
Hanns Amri,* Andreas Auer, Christoph Gross, Zoerkler Gears;

9:30 AM - 10:00 AM
The Effect of Hub Moment on Main Rotor Shaft Drive Gears (Paper 197)
David Binney,* Brian Hunte,* Lin Liu, Zach Wright, Sikorsky, a Lockheed Martin Co.;

10:00 AM - 10:30 AM
Fast Multi-Objective Aeroacoustic Optimization of Propeller Blades (Paper 168)
Dominic Lallier-Daniels,* Francois Bolduc-Teasdale, Optis Engineering; Stéphane Moreau, David Rancourt, Université de Sherbrooke;

11:00 AM - 11:30 AM
Minimum Weight Design of a Two Speed Dual Clutch Offset Compound Gear Transmission for Rotorcraft Applications (Paper 299)
Hans DeSmidt,* Zhisheng Ai, University of Tennessee;

11:30 AM - 12:00 PM
New Flying Craft with no Exterior Moving Parts (Paper 70)
Tom Daily,* Tom Daily Contracting LLC;

Propulsion II
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Digital Displacement Hydrostatic Transmission for Rotorcraft and Distributed Propulsion (Paper 148)
Niall Caldwell, Peter McCurry,* Uwe Stein, Flowcopter Ltd.; David Rancourt, University of Sherbrooke;

9:30 AM - 10:00 AM
Distributed Electric Propulsion and Flight Control Concept to Meet EASA SC-VTOL-01 10-9 Catastrophic Failure Criteria (Paper 289)
Patrick Darmstadt,* Andrew Arkebauer, Allan Beiderman, Ephraim Chen, Caitlin Dillard, Sheevangi Pathak, Boeing Co.; Mihir Mistry, Anduril Industries, Inc.;

10:00 AM - 10:30 AM
Optimizing Turbogenerators for Hybrid-Electric Applications (Paper 228)
Craig Heathco,* New Centerline Design;

11:00 AM - 11:30 AM
Multi-Domain Electric Drivetrain Modeling for UAM-Scale eVTOL Aircraft (Paper 163)
Meaghan Podlaski,* Farhan Gandhi, Robert Niemiec, Luigi Vanfretti, Rensselaer Polytechnic Institute;
Safety

Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Implementation of a Voluntary Design and Manufacturing Safety Management System at Bell Textron (Paper 75)
Scott Harris,* Bell; Amy Garzaro,* Federal Aviation Administration;

9:30 AM - 10:00 AM
A Physics-Based Investigation of Loss of Tail Rotor Effectiveness (Paper 176)
Paola Zanella,* Dimitri Mavris, J.V.R. Prasad, Georgia Institute of Technology; Charles Johnson, FAA William J. Hughes Technical Center;

10:00 AM - 10:30 AM
Anomaly Detection in Initial Climb Segments for Helicopter Operations (Paper 191)
Hsiang-Jui Chin,* Dimitri Mavris, Alexia Payan, Georgia Institute of Technology; Charles Johnson, Federal Aviation Administration;

11:00 AM - 11:30 AM
Integration of System Reliability Theory into Quantitative Risk Assessment (Paper 241)
John Hewitt,* Loan (Joan) Pham,* Sikorsky, a Lockheed Martin Co.;

11:30 AM - 12:00 PM
Deep Ensemble for Rotorcraft Attitude Prediction (Paper 242)
Hikmat Khan,* Nidhal Bouaynaya, Ghulam Rasool, Rowan University; Charles C. Johnson, Lacey Thompson, Tyler Travis, Federal Aviation Administration;

12:00 PM - 12:30 PM
Hazard Analysis and Failure Modes and Effects Analysis for NASA Revolutionary Vertical Lift Technology (RVLT) Concept Vehicle (Paper 287)
Allan Beiderman,* Patrick Darmstadt, Boeing Co.;

12:30 PM - 1:00 PM
Intelligent Helipad Detection from Satellite Imagery (Paper 293)
David Specht,* Nidhal Bouaynaya, Ghulam Rasool, Rowan University; Charles Johnson, FAA William J. Hughes Technical Center;
Structures and Materials

Structures and Materials I
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
**H160 Composite Fuselage: Multidisciplinary Approach** (Paper 83)
Stefan G. Rlich, Rainer Arelt,* Jan-Christoph Arent, Airbus Helicopters;

9:30 AM - 10:00 AM
**Surface Tolerant Adhesives for Bonded Airframe Structures** (Paper 170)
Majid Sharifi,* Huntsman Corporation; Ian Brown, AVX Aircraft Company; Delaney Jordan, U.S. Army Combat Capabilities Development Command Aviation & Missile Center; Gyaneshwar Tandon, University of Dayton Research Institute;

10:00 AM - 10:30 AM
**Vitrimer Composites for Rotorcraft Components** (Paper 298)
Mithil Kamble,* Nikhil Koratkar, Catalin R Picu, Rensselaer Polytechnic Institute;

11:00 AM - 11:30 AM
**A Combined X-Ray CT and Mechanistic Characterization of Bearing Failure Mechanisms in Bolted Composite Components** (Paper 254)
Jim Lua,* Xiaodong Cui, Jian Xiao, Global Engineering and Materials, Inc.; Ethan Fulghum, Supun Kariyawasam, Caleb Saathoff, NIAR at Wichita State University;

11:30 AM - 12:00 PM
**Numerical Investigation of Autonomous Camber Morphing of a Helicopter Rotor Blade using Shape Memory Alloys** (Paper 310)
Etana Ferede,* Farhan Gandhi, Rensselaer Polytechnic Institute; Anargyros Karakalas, Dimitris Lagoudas, Texas A&M University;

Structures and Materials II
Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
**Quick Iteration Algorithm for Cylindrical Gear Contact Pattern Development** (Paper 31)
Biqiang Xu,* Sikorsky, a Lockheed Martin Co.;

9:30 AM - 10:00 AM
Mark Gurvich,* Collins Aerospace;

10:00 AM - 10:30 AM
**Lessons Learned For Application to Rotorcraft Structural Integrity Programs** (Paper 106)
Chad DeMontfort,* Sam Forgerson, Brian Harper, Mercer Engineering Research Center;

11:00 AM - 11:30 AM
**Novel Multi-Physics-based Modeling of a Quenching Process with Thermal-Metallurgical-Mechanical Interactions in Aluminum Components** (Paper 253)
Jim Lua,* Anand Karuppiah, Peipei Li, Michael Stuebner, Global Engineering and Materials, Inc.; Jinhui Yan, Ze Zhao, University of Illinois;

11:30 AM - 12:00 PM
**Comprehensive Simulation Based Rotorcraft Loads/Fatigue Analysis and Alleviation Method** (Paper 54)
Chengian He, Dooyong Lee,* Advanced Rotorcraft Technology, Inc.; Eui Sung Bae, Joby Aviation; Tzikang Chen, Mulugeta Haile, US Army Research Lab;
System Engineering Tools/Processes

Systems Engineering
Technical Session A: Mon. May 10, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Feature-Driven Specification of VTOL Air-Taxis with the Use of the Model-Based System Engineering (MBSE) Methodology CUBE (Paper 61)
Nicolas J.Ckel,* Abdulsamed Karaduman, FEV Europe GmbH; Jakob Andert, Christian Granrath, Bernhard Rumpe, Louis Wachtmeister, RWTH Aachen University;

9:30 AM - 10:00 AM
Chris Stroncek,* Tricia Hiros, Bell; David Stephan, Avion Solutions; Robert Benton, Dave Cripps, Edwin Martin,* US Army DEVCOM AvMC;

10:00 AM - 10:30 AM
Approach to Architecture Development Assuming a Modular Open Systems Approach (MOSA) for a Family of Systems (FoS) Acquisition (Paper 100)
Thomas DuBois, John Kisor, Robert Matthews,* Michael Orlovsky, L3Harris;

11:00 AM - 11:30 AM
Embedded Software: Automating Tests From Hand-written Requirements (Paper 274)
Matthew Tkac,* CS Group USA;
Test and Evaluation

Test and Evaluation I
Technical Session B: Tues. May 11, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Combining Simultaneous Density and Velocity Measurements of Rotor Blade Tip Vortices under Cyclic Pitch Conditions (Paper 109)
Johannes N. Braukmann,* Andreas Goerttler, Markus Raffel, Clemens Schwarz, C. Christian Wolf, German Aerospace Center (DLR);

9:30 AM - 10:00 AM
Wind Tunnel Test of Optimal Rotor Blade Tip for a Winged Compound Helicopter at High Advance Ratio (Paper 126)
Masahiko Sugiura,* Keita Kimura, Noboru Kobiki, Hideaki Sugawara, Yasutada Tanabe, Japan Aerospace Exploration Agency; Akira Yoshida, Kawai Gifu Engineering co., Ltd.; Takuya Furumoto, Yoshiki Iwasaki, Takahiro Noda, Yoshiyuki Shibata, Tomoka Tsujiuchi, Kentaro Ueda, Hidemasa Yasuda, Kawasaki Heavy Industries, Ltd.; Kuniyuki Takekawa, Ryoyo Systems;

10:00 AM - 10:30 AM
State-of-the-art Experimental Techniques for VTOL Structural Dynamics (Paper 277)
Raphael Hallez,* Emilio Di Lorenzo, Siemens Digital Industries Software;

11:00 AM - 11:30 AM
Aerodynamics and Propulsive Modeling of a Bi-Rotor Convertible Aircraft for the Identification of Trim Conditions in Longitudinal Flight (Paper 129)
Francisco Javier Ortega Coronado,* Sergio Esteban Roncero, Marta N�� Eez Reyes, University of Seville;

11:30 AM - 12:00 PM
Blade Flapping Measurement System for Small Scale Rotorcraft (Paper 239)
Etienne Perron,* Universite de Sherbrooke; Charles Ratelle, Laflamme Aero Inc.; Ludwik Sobiesiak, NGC Aerospace Ltd.; David Rancourt, Université de Sherbrooke;

12:00 PM - 12:30 PM
Motion Amplification and Camera-Based Full Field Vibration Techniques (Paper 238)
Jeff Hay,* RDI Technologies;

12:30 PM - 1:00 PM
Comparative Flight Test Evaluation of Passive and Active External Slung Load Dynamics (Paper 280)
Marc Alexander,* Perry Comeau, National Research Council of Canada; Etienne Perron, David Rancourt, Université de Sherbrooke;

1:00 PM - 1:30 PM
Honeywell Aspire-Series Satellite Communication System Validation on the NRC Bell 412 Advanced System Research Aircraft (Paper 279)
Marc Alexander,* National Research Council of Canada; Erik Tolonen,* Honeywell Aerospace Limited;

Test and Evaluation II
Technical Session C: Wed. May 12, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Scaled Model Testing of Coaxial Rotor Hub Flows (Paper 290)
Charles Tierney,* Nicholas Jaffa, David Reich, Sven Schmitz, Pennsylvania State University;

9:30 AM - 10:00 AM
Computational Characterization of Unsteady Rotor Hub Wakes (Paper 218)
Forrest Mobley,* James Coder, Tristan Wall, University of Tennessee;

10:00 AM - 10:30 AM
Hub Flow Near-Wake Validation using CREATE™-AV Helios and UMD Mercury Framework (Paper 235)
11:00 AM - 11:30 AM
Three Rotor Hub Flow Prediction Workshops (2016-2020) - What did we learn & What's next? (Paper 120)
Sven Schmitz,* Nicholas Jaffa, David Reich, Charles Tierney, Pennsylvania State University; Louis Centolanza, Mathew Thomas, US Army CCDC AvMC;
Unmanned VTOL Aircraft and Rotorcraft

Unmanned VTOL I
Technical Session D: Thurs. May 13, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Onboard Safety Solutions for VTOL UAS Operations (Paper 244)
Jacquelyn Banas,* Andreas Cords, Tim Mehling,* Tobias Paul, Matthias Vyshnevskyy, ESG ELEKTRONIKSYSTEM- UND LOGISTIK-GMBH;

9:30 AM - 10:00 AM
Optimal Trajectory Generation for Transitioning Quadrotor Biplane Tail Sitter using Differential Flatness (Paper 181)
Kristoff McIntosh,* Sandipan Mishra, Di Zhao, Rensselaer Polytechnic Institute; Jean Paul Reddinger, DEVCOM Army Research Lab;

10:00 AM - 10:30 AM
Levels of Autonomation for VTOL Aircraft (LAVA): A Framework (Paper 111)
Ephraim Chen,* Kendra Befort, Joseph Brinker, Brittany Hollhausen, Boeing Co.;

11:00 AM - 11:30 AM
Modeling and Robust Control for Full-flight Envelope Trajectory Tracking of a QuadCP-VTOL Unmanned Aerial Vehicle (Paper 245)
Jonatan Mota Campos, Daniel Neri Cardoso, Guilherme Vianna Raffo,* Federal University of Minas Gerais;

11:30 AM - 12:00 PM
Development of a Long Endurance VTOL UAS Platform for Search and Rescue Missions (Paper 74)
Rachel Axten,* Venkatakrishnan Iyer,* Eric Johnson, Vidullan Surendran, Vitor Valente, Pennsylvania State University;

Unmanned VTOL II
Technical Session E: Fri. May 14, 2021 - 9:00 AM to 1:00 PM

9:00 AM - 9:30 AM
Landing Zone Identification Using A Hardware-accelerated Deep Learning Module (Paper 210)
Sachithra Atapattu,* Oscar De Silva, Raymond Gosine, George Mann, Memorial University of Newfoundland; Narmada Balasooriya, Memorial University; Awantha Jayasiri,* National Research Council of Canada;

9:30 AM - 10:00 AM
Bochan Lee,* Moble Benedict, Vishnu Saj, Texas A&M University;

10:00 AM - 10:30 AM
An Assume-Guarantee Framework for Multiple-Obstacle Collision Avoidance (Paper 212)
Kaushik Nallan,* A. Agung Julius, Sandipan Mishra, Rensselaer Polytechnic Institute;

11:00 AM - 11:30 AM
Deterministic Reconfiguration of Flight Control Systems for Multirotor UAV Package Delivery (Paper 16)
Anthony Gong,* Mark Tischler, US Army DEVCOM AvMC; Ronald Hess, University of California Davis;

11:30 AM - 12:00 PM
Evaluation of a CNN-based Visual Place Recognition system for GPS-denied Navigation of VTOL Vehicles (Paper 1323)
Kusal Tennakoon,* Oscar De Silva, Raymond Gosine, George Maan, Memorial University of Newfoundland; Awantha Jayasiri,* National Research Council of Canada;

12:00 PM - 12:30 PM
Vision-based Autonomous UAS Landing on a Stochastically Moving Platform (Paper 267)
Abhishek Shastry,* Inderjit Chopra, Anubhav Datta, University of Maryland;
Identification and Control Design of a Sub-Scale Flybarless Helicopter (Paper 7)
Jeffry Walker,* Bihrle Applied Research; Mark Tischler, Tischler Aeronautics;