

Unique and Transformational Flight Systems

Papers Presented at the AIAA Aviation Forum 2021

Online
2-6 August 2021

Volume 1 of 2

ISBN: 978-1-7138-4368-9

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 34922 Uwytkug'Xcmg{'Ftkxg.'Uwky'422, Reston, VA 20191, USA.

TABLE OF CONTENTS

ON-DEMAND MOBILITY CONCEPTS AND MARKET STUDIES

A SURVEY TO MODEL DEMAND FOR EVTOL TRIPS TO AIRPORTS	1
<i>Caroline Leonard, Laurie A. Garrow, Jeff Newman</i>	
PROPOSING A SCENARIO-BASED ESTIMATION OF GLOBAL URBAN AIR MOBILITY DEMAND	49
<i>Anna Straubinger, Fabian Helmchen, Kay O. Ploetner, Jochen Kaiser</i>	
ASSESSING THE SUITABILITY OF URBAN AIR MOBILITY VEHICLES FOR A SPECIFIC AERODROME NETWORK.....	66
<i>Ryan J. Howard, Ethan Wright, Sai V. Mudumba, Nicholas I. Gunady, Brandon E. Sells, Apoorv Maheshwari</i>	
URBAN AIR MOBILITY: AIRPORT GROUND ACCESS DEMAND ESTIMATION	80
<i>Mihir Rimjha, Susan Hotle, Antonio Trani, Nicolas Hinze, Jeremy Smith, Samuel Dollyhigh</i>	
COMPARATIVE STUDY OF URBAN AIR MOBILITY (UAM) LANDING SITES FOR THREE STUDY AREAS.....	99
<i>Sayantan Tarafdar, Mihir Rimjha, Mia K. Li, Nicolas Hinze, Susan Hotle, Antonio Trani, Jeremy Smith, Samuel Dollyhigh, Ty Marien</i>	

ON-DEMAND MOBILITY AND CIVIL SUPERSONICS CONCEPTS AND MARKET STUDIES

MOBILITY IMPACT ASSESSMENT OF INNOVATIVE AIRCRAFT INSIDE THE EUROPEAN MULTIMODAL TRANSPORT NETWORK.....	116
<i>Gianluigi A. Miste, Giovanni Venturelli, Ernesto Benini</i>	
PARAMETRIC STUDY OF STATE-OF-CHARGE FOR AN ELECTRIC AIRCRAFT IN URBAN AIR MOBILITY.....	132
<i>Priyank Pradeep, Chetan S. Kulkarni, Gano Broto Chatterji, Todd A. Lauderdale</i>	
A MARKET SEGMENTATION ANALYSIS FOR AN EVTOL AIR TAXI SHUTTLE	145
<i>Conor Hill, Laurie A. Garrow</i>	
GLOBAL DEMAND MODEL TO ESTIMATE SUPERSONIC COMMERCIAL SERVICES	162
<i>Edwin R. Freire Burgos, Antonio Trani, Nicolas Hinze, Ty Marien, Karl Geiselhart, Samuel Dollyhigh, Jonathan Seidel</i>	
SUPERSONIC OVERLAND WITHOUT A SONIC BOOM – QUANTIFYING THE SPEED ADVANTAGE OF MACH-CUTOFF FLIGHT	184
<i>Bernd Liebhardt</i>	

MDAO APPLICATIONS TO AIRCRAFT AERODYNAMICS & STRUCTURES

STRUCTURAL OPTIMIZATION OF BLENDED WING BODY TRANSPORT AIRCRAFT WITH BUCKLING CONSTRAINTS.....	197
<i>Jason Qian, Juan Alonso</i>	

MULTIDISCIPLINARY DESIGN OPTIMIZATION OF AIRCRAFT LANDING GEAR 212
Chris Douglas, Andrew Ellis, R. Kyle Schmidt, Ilyong Kim

MIXED INTEGER OPTIMIZATION OF AIRCRAFT ROLLING STOCK AND BOGIE..... 235
Haifeng Xia, Andrew Ellis, R. Kyle Schmidt, Ilyong Kim

SENSITIVITY-BASED GENERATION OF PARETO FRONTS FOR DESIGN OF POWERED
AIRCRAFT SUBJECT TO A COMPREHENSIVE SET OF LOADS..... 255
*Mohammad Abu-Zurayk, Andrei Merle, Caslav Ilic, Stefan Goertz, Matthias Schulze, Thomas
Klimmek, Christoph Kaiser, David Quero Martin, Jannik Häßy, Richard-Gregor Becker,
Benjamin Frohler, Johannes Hartmann*

MDAO APPROACHES TO ADVANCED AIRCRAFT DESIGN

ONTOLOGY-REPRESENTED DESIGN SPACE PROCESSING..... 269
Ludvig Knoos Franzen, Ingo Staack, Petter Krus, Christopher Jouannet, Kristian Amadori

MULTISCALE COMPLIANT TOPOLOGY OPTIMIZATION FOR TWISTABLE WING
DESIGN 284
Dustin D. Bielecki, Darshil Patel, Linda Alegria, Rahul Rai, Gary Dargush, William Menasco

STABILIZATION ENVIRONMENT FOR SWING STABILIZATION AND MEDEVAC
HOISTS 295
*Austin Morock, Thomas Aldhizer, Mary Y. Lanzerotti, Andrea Arena, Walter Lacarbonara,
Jacob Capps*

INVESTIGATION OF MISSION PERFORMANCE SENSITIVITIES FOR UNMANNED
AERIAL VEHICLES BASED ON PARAMETRIC SIMILARITY ASSESSMENT OF MISSION
REQUIREMENTS 309
Tim Klaproth, Mirko Hornung

A FIRST-PRINCIPLE POWER AND ENERGY MODEL FOR EVTOL VEHICLES 340
Emils Senkans, Max Skuhersky, Brian Kish, Markus Wilde

MDAO APPLICATIONS FOR URBAN AIR MOBILITY CONCEPTS

MONOCOQUE MULTIROTOR AIRFRAME DESIGN WITH ROTOR ORIENTATIONS
OPTIMIZED FOR DIRECT 6-DOF UAV FLIGHT CONTROL..... 360
James Strawson, Pengcheng Cao, Danny Tran, Thomas Bewley, Falko Kuester

TOWARDS EFFICIENT AERODYNAMIC AND AEROACOUSTIC OPTIMIZATION FOR
URBAN AIR MOBILITY VEHICLE DESIGN 371
*Bernardo Pacini, Anil Yildirim, Behdad Davoudi, Joaquim R. Martins, Karthikeyan
Duraissamy*

FULL-ENVELOPE AERO-PROPULSIVE MODEL IDENTIFICATION FOR LIFT+CRUISE
AIRCRAFT USING COMPUTATIONAL EXPERIMENTS..... 397
Benjamin M. Simmons, Pieter G. Buning, Patrick C. Murphy

ELECTRIC PROPULSION INTEGRATION AND CONTRIBUTORY TECHNOLOGIES

FEASIBILITY OF USING FUEL CELL IN A SMALL AIRCRAFT..... 423
Ana Lidia D. Castro, Pedro T. Lacava, Carlos Henrique B. Mourao

METHODOLOGY USED FOR AN ELECTRIFIED AIRCRAFT PROPULSION DESIGN EXPLORATION	442
<i>Ty Marien, Nathaniel J. Blaesser, Zachary J. Frederick, Mark D. Guynn, Jason Kirk, Kenneth Fisher, Steven Schneider, Robert P. Thacker, Peter Frederic</i>	
DISTRIBUTED ELECTRIC PROPULSION FOR YAW CONTROL: TESTBEDS, CONTROL APPROACH, AND FLIGHT TESTING	457
<i>Ole Pfeifle, Michael Frangenberg, Stefan Notter, Jan Denzel, Dominique Bergmann, Johannes Schneider, Werner Scholz, Walter Fichter, Andreas Strohmayer</i>	
X-57 MAXWELL HIGH-LIFT PROPELLER TESTING AND MODEL DEVELOPMENT	469
<i>Brandon L. Litherland, Nicholas K. Borer, Nikolas S. Zawodny</i>	

EMERGING URBAN AND ADVANCED AIR MOBILITY NOISE I

STATISTICAL ASSESSMENT OF THE INFLUENCE FROM UNCERTAINTIES IN ACOUSTICAL DATA FOR UAM VEHICLES ON NOISE METRICS	490
<i>Michael Bauer</i>	
EXPERIMENTAL CHARACTERIZATION OF AN ELECTRIC DUCTED FAN UNIT'S ACOUSTIC EMISSIONS	498
<i>Jakob Schmidt, Manfred Kaltenbacher, Andreas Furlinger, Stefan Schoder</i>	
CLOSED-FORM ANALYTICAL APPROACH FOR CALCULATING NOISE CONTOURS OF DIRECTIVE AIRCRAFT NOISE SOURCES.....	506
<i>Daniel C. Amargianitakis, Rodney H. Self, Antonio J. Torija, Anderson Proenca, Athanasios P. Synodinos</i>	
MACHINE LEARNING METHODS FOR ESTIMATING PROPELLER SOURCE NOISE SPHERES.....	529
<i>Andrew Patterson, Naira Hovakimyan, Kyle A. Pascioni, Irene M. Gregory</i>	

UNMANNED SYSTEMS

PRELIMINARY DESIGN AND DYNAMICS OF A SEMI-EXPENDABLE UNMANNED GROUND-AERIAL VEHICLE.....	541
<i>Yao Ma, Donald Docimo, Victor Maldonado</i>	
SKYVISION: ENABLING BEYOND VISUAL LINE OF SIGHT (BVLOS) FLIGHT OPERATIONS BY UNMANNED AERIAL SYSTEMS (UAS) IN THE NATIONAL AIRSPACE SYSTEM (NAS).....	550
<i>Arthur F. Huber, Jason B. Wierzbanski, Jason B. Porter</i>	
LONG ENDURANCE FLIGHT TESTING RESULTS FOR THE UIUC-TUM SOLAR FLYER.....	568
<i>Or D. Dantsker, Mirco Theile, Marco Caccamo</i>	

VOLUME 2

NAILED IT: AUTONOMOUS ROOFING WITH A NAILGUN-EQUIPPED OCTOCOPTER.....	590
<i>Matthew M. Romano, Yuxin Chen, Prince Kuevor, Owen Marshall, Ella Atkins</i>	
ENHANCING 1D LIDAR SCANNING FOR ACCURATE STOCKPILE VOLUME ESTIMATION WITHIN DRONE-BASED MAPPING SYSTEMS	603
<i>Ahmad Alsayed, Mostafa R. Nabawy, Akilu Yunusa-Kaltungo, Farshad Arvin, Mark K. Quinn</i>	

EMERGING URBAN AND ADVANCED AIR MOBILITY NOISE II

SURFACE VIBRATION MEASUREMENT AND ANALYSIS FOR UAM/UAS ELECTRIC MOTOR NOISE.....	612
<i>Jordan D. Cluts, Dennis L. Huff, Brenda S. Henderson, Charles Ruggeri</i>	
NOISE MEASUREMENTS FROM GROUND TESTS OF THE MOOG SUREFLY VEHICLE	625
<i>Dennis L. Huff, Brenda S. Henderson, Jordan D. Cluts, Devin K. Boyle, Jeffrey Bennett, Justin Janzen</i>	
SIMULATION OF EMERGING URBAN AIR MOBILITY NOISE PROPAGATION USING ACOUSTIC RAYTRACING TECHNIQUES IN COMPLICATED 3D URBAN ENVIRONMENTS	678
<i>Kevin Nelson, Bryan Franklin</i>	
A SYNTHESIS PLUGIN FOR AURALIZATION OF ROTOR SELF NOISE	691
<i>Siddhartha Krishnamurthy, Aric R. Aumann, Stephen A. Rizzi</i>	
SUAS ROTOR-AIRFRAME INTERACTION.....	706
<i>Jeremiah Whelchel, William N. Alexander</i>	

SPECIAL SESSION: HORIZONUAM SESSION 1 – UAM IN GERMANY

URBAN AIR MOBILITY RESEARCH AT THE DLR GERMAN AEROSPACE CENTER – GETTING THE HORIZONUAM PROJECT STARTED.....	734
<i>Bianca I. Schuchardt, Dennis Becker, Richard-Gregor Becker, Albert End, Thomas Gerz, Frank Meller, Isabel C. Metz, Malte Niklaß, Henry Pak, Sebastian Schier-Morgenthal, Karolin Schweiger, Prajwal Shiva Prakasha, Jean D. Sülberg, Majed Swaid, Christoph Torens, Chen Zhu</i>	
URBAN AIR MOBILITY USE CASES, MISSIONS AND TECHNOLOGY SCENARIOS FOR THE HORIZONUAM PROJECT	746
<i>Lukas Asmer, Henry Pak, Prajwal S. Prakasha, Bianca I. Schuchardt, Peter Weiland, Frank Meller, Christoph Torens, Dennis Becker, Chen Zhu, Karolin Schweiger, Andreas Volkert, Roman Jaksche</i>	
HORIZONUAM: SAFETY AND SECURITY CONSIDERATIONS FOR URBAN AIR MOBILITY	763
<i>Christoph Torens, Andreas Volkert, Dennis Becker, Daniel Gerbeth, Lukas Schalk, Omar Garcia Crespillo, Chen Zhu, Tim Stelkens-Kobsch, Tanja Gehrke, Isabel C. Metz, Johann Dauer</i>	

SPECIAL SESSION: HORIZONUAM SESSION 2 – SIMULATION DRIVEN APPROACHES FOR URBAN AIR MOBILITY

SYSTEM OF SYSTEMS SIMULATION DRIVEN URBAN AIR MOBILITY VEHICLE DESIGN	776
<i>Prajwal S. Prakasha, Patrick Ratei, Nabih Naeem, Bjorn Nagel, Oliver Bertram</i>	
URBAN AIR MOBILITY: VERTIDROME AIRSIDE LEVEL OF SERVICE CONCEPT.....	805
<i>Karolin Schweiger, Franz Knabe, Bernd Korn</i>	
AIR TAXIS VS. TAXICABS: A SIMULATION STUDY ON THE EFFICIENCY OF UAM.....	820
<i>Fares Naser, Niklas Peinecke, Bianca I. Schuchardt</i>	

ELECTRIC/HYBRID-ELECTRIC AIRCRAFT DESIGN AND OPERATIONAL CONSIDERATIONS

PARALLEL HYBRID-ELECTRIC POWERTRAIN SIZING ON REGIONAL TURBOPROP AIRCRAFT WITH CONSIDERATION FOR CERTIFICATION PERFORMANCE REQUIREMENTS	838
<i>Dominik Quillet, Vincent Boulanger, David Rancourt, Richard Freer, Pierre Bertrand</i>	
PARALLEL-HYBRID POWERTRAIN ARCHITECTURES AND THEIR CHALLENGES FOR A REGIONAL AIRCRAFT	858
<i>Vincent Boulanger, Dominik Quillet, David Rancourt, Alexandre Pelletier, Jerome Cros, Richard Freer, Pierre Bertrand</i>	
MODELING FRAMEWORK FOR IDENTIFICATION AND ANALYSIS OF KEY METRICS FOR TRAJECTORY ENERGY MANAGEMENT OF ELECTRIC AIRCRAFT	877
<i>Seumas M. Beedie, Caleb M. Harris, Johannes A. Verberne, Cedric Y. Justin, Dimitri Mavris</i>	

EMERGING URBAN AND ADVANCED AIR MOBILITY NOISE III

NOISE EXPOSURE MAPS FOR URBAN AIR MOBILITY	903
<i>Jinhua Li, Hok Kwan Ng, Yun Zheng, Sebastian Gutierreznolasco</i>	
URBAN AIR MOBILITY: PRELIMINARY NOISE ANALYSIS OF COMMUTER OPERATIONS	911
<i>Mihir Rimjha, Antonio Trani, Susan Hotle</i>	
EVALUATING THE PERFORMANCE AND ACOUSTIC FOOTPRINT OF AIRCRAFT FOR REGIONAL AND URBAN AIR MOBILITY	926
<i>Matthew A. Clarke, Juan Alonso</i>	

OPERATIONAL ASPECTS OF ON-DEMAND MOBILITY AND TRANSFORMATIONAL FLIGHT I

ENABLING URBAN AIR MOBILITY THROUGH COMMUNICATIONS AND COOPERATIVE SURVEILLANCE	957
<i>Virginia L. Stouffer, William Cotton, Thomas Irvine, Richard Jennings, Ronald Lehmer, Randall Deangelis, Michelle Shaver, Thanh Nguyen, Daniel Devasirvatham</i>	
NOVEL HIERARCHICAL MARKOV DECISION PROCESS FRAMEWORK TO ENABLE RIDESHARING IN ON-DEMAND AIR SERVICE OPERATIONS	977
<i>Apoorv Maheshwari, Dan Delaurentis</i>	
EVALUATING IMPACT OF OPERATIONAL LIMITS BY ESTIMATING POTENTIAL UAM TRIPS IN AN URBAN AREA	992
<i>Apoorv Maheshwari, Brandon E. Sells, Stephanie Harrington, Dan Delaurentis, William Crossley</i>	
RISK-AWARE TRAJECTORY PLANNING USING ENERGY-BASED ANALYSIS FOR AERIAL VEHICLES	1007
<i>Hyunki Lee, Caleb M. Harris, Alexia P. Payan, Dimitri Mavris</i>	

OPERATIONAL ASPECTS OF ON-DEMAND MOBILITY AND TRANSFORMATIONAL FLIGHT II

WEATHER IMPACT ASSESSMENT FOR URBAN AERIAL TRIPS IN METROPOLITAN AREAS..... 1020
Hsun Chao, Apoorv Maheshwari, Dan Delaurentis, William Crossley

ANALYZING IMPACT OF UNUSUAL CHANGES IN TRAVEL PATTERN ON UAM ATTRACTIVENESS 1035
Apoorv Maheshwari, Dan Delaurentis, William Crossley

DESIGN AND OPERATION CONSIDERATIONS FOR THE INTEGRATION OF FLEETS OF REGIONAL AIR MOBILITY AIRCRAFT AT LARGE HUBS..... 1043
Laura Morejón Ramírez, Jeremy Decroix, Cedric Y. Justin, Alexia Payan, Dimitri Mavris

DEMAND MODELING AND OPERATIONS OPTIMIZATION FOR ADVANCED REGIONAL AIR MOBILITY 1078
Cedric Y. Justin, Alexia P. Payan, Dimitri Mavris

ASSESSING AND IMPROVING FLIGHT CREW WORKLOAD

USING UNSTRUCTURED TEXT NARRATIVES TO CORRECT WORK UNIT CODES IN THE WILD..... 1119
Josh Kalin, David Noever, Matt Ciolino, Gerald Hernandez, Jay Coquat

EVALUATING COGNITIVE BIAS DURING AIRBORNE ICING ENCOUNTERS. 1127
John M. Maris, Antonio Cortes

IDENTIFICATION OF POTENTIAL GAPS AND REQUIREMENTS IN WEATHER SOURCES FOR GENERAL AVIATION AND UAS OPERATIONS 1152
Nicoletta Fala, Jw W. Wallace

DATA-DRIVEN FLIGHT STATE IDENTIFICATION VIA TIME-SERIES-INFORMED FEATURES AND CONVOLUTIONAL NEURAL NETWORK 1168
Alexander Belsten, Fotis Kopsaftopoulos

Author Index