The FAA's Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

Led by Mississippi State University

2016 Alliance for System Safety of UAS through Research Excellence Annual Research Report

Alliance for System Safety of UAS through Research Excellence

ASSURE, led by Mississippi State, is the FAA's Center of Excellence for UAS Research
Annual Research Report

Thank you for taking the time to review the FAA's Unmanned Aircraft Systems Center of Excellence first annual report. The future of UAS in the United States is almost limitless, but it will never be able to reach it's potential unless these aircraft are safely integrated into the National Airspace System (NAS). To give an idea of the sheer number of unmanned aircraft in the United States, the Federal Aviation Administration expects the sales of UAS to grow from 2.5 million systems this year to 7 million in 2020. While hobbyists sales will double from 1.9 million to 4.3 million, the commercial use of drones are forecast to triple with an increase in sales from 600,000 to 2.7 million systems. These are sobering numbers and indicate the magnitude of the integration task.

The greatest area of growth which will impact the NAS is the commercial UAS market, which reflects industry taking advantage of opportunities that UAS provide to do things cheaper, faster, and safer. Some examples of these mission areas include: precision agriculture, mapping, linear infrastructure inspections (of pipelines, power lines, and transportation infrastructure like bridges), film, news, science, research, emergency response, and many more. To help meet the integration challenge, the FAA selected a team, led by Mississippi State University, and 21 other world leading research institutions and over a hundred leading industry, and government partners as the FAA's Center of Excellence for UAS. The Alliance for System Safety of UAS through Research Excellence (ASSURE) features expertise across a broad spectrum of research including: air traffic integration, UAS airport ground operations, control and communications, detect and avoid, human factors, UAS noise reduction, UAS wake signatures, UAS pilot training and certification, low altitude operations safety, spectrum management, and UAS traffic management. We have utilized the skills and expertise of almost all our core partners in our first year of operations, and are already providing valuable research data to the FAA to support integration. As we move into our second year, our priorities are to continue our overall research program including several follow-on projects based on the results of our first year, and to increase our inclusiveness with industry, academia, government, and the UAS test sites.

Our first year of operation has been a tremendous learning experience for the entire team, but we've had great mentors, teachers, and leadership, and on reflection there is very little we would have changed if we had the chance. I am justifiably proud of our team, the research we have completed and that is underway, and the tremendous potential of this team to positively impact the safe integration of UAS into the NAS, and I'm already looking forward to reporting our progress to you next year.

MARTY ROGERS
Executive Director

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ASSURE Leadership

MSU Vice President of Research and Economic Development
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Executive Director
Marty W. Rogers
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Associate Director
Colonel Stephen 'Lux' Luxion (ret.)
sluxion@assure.msstate.edu

Program Coordinator
Kelsey Stewart
kstewart@assure.msstate.edu

Mission:
Our mission is to provide the Federal Aviation Administration the research they need to quickly, safely, and efficiently integrate unmanned aerial systems into our National Airspace System with minimal changes to our current system.

Vision:
Our vision is to help the unmanned aerial system market grow into its multibillion dollar market potential by conducting research that quickly, safely, and effectively get UAS flying alongside manned aircraft around the world.

ASSURE Tag line
We transform UAS problems into FAA-approved solutions

www.ASSUREuas.org

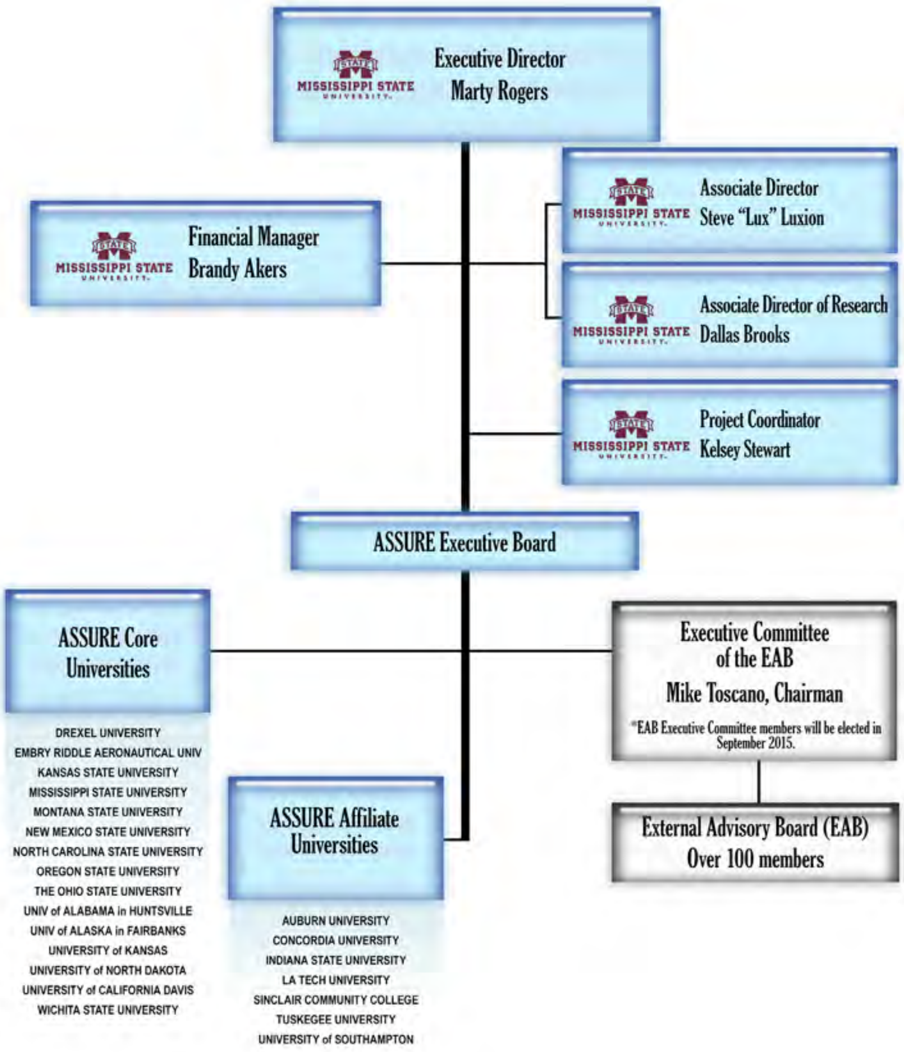
Social Media:

@ASSUREUas ASSUREUAS ASSURE-UAS

Credits:
Creative Director: Diane L. Godwin, HPC[2] Publishing Group, Mississippi State University
Writers: Lux Luxion, ASSURE, and Diane L. Godwin, Mississippi State University
Designer: Bethany Stroud, HPC[2] Publishing Group, Mississippi State University
Photographers: Diane L. Godwin and Bethany Stroud, HPC[2] Publishing Group, Mississippi State University

The ASSURE Organization

ASSURE, the FAA UAS Center of Excellence, is Turning Research into FAA Rules that Work.



The ASSURE team's partners know unmanned systems, and they know the FAA. That means they can take advanced UAS research and turn it into FAA rules that make sense for the agency and industry. ASSURE sits on 16 FAA and international aviation rules and safety committees. The coalition has more UAS than the US Air Force, and only the DoD flies more UAS hours yearly than ASSURE.

Acknowledgements

Dr. Patricia Watts, National Program Director of FAA Center's of Excellence, and Sabrina Saunders-Hodge, FAA Program Manager ASSURE UAS Center of Excellence have been key to the establishment and success of the ASSURE program's first year of operation. Like any new program, especially one as large as ASSURE, there is a significant amount of education and guidance needed to enable the team to function and provide optimal results. Dr. Watts, and Ms. Saunders-Hodge have made themselves available to members of the ASSURE team at all times, are always very responsive to our inquiries, and do a great job answering our occasional "what if" questions.

We would not be here today without the vision and leadership of Dr. David Shaw, Vice President for Research and Economic Development at Mississippi State University, who envisioned a UAS COE more than six years ago, and as he has since the beginning, makes sure the ASSURE team has the resources and strategic guidance to help fulfill our obligations to both the FAA and our partners.

I also would like to acknowledge three individuals who have gone "above and beyond" in their duties. Without the honest feedback, unstinting support, and positive attitudes of Paul Rumberger, FAA UAS Center of Excellence Deputy Program Manager; Stephen Luxion, ASSURE Associate Director; and Brandy Akers, ASSURE Financial Manager we would not have been successful and met our commitments and obligations to our partners and sponsors.

If you look at the totality of the ASSURE program, it encompasses almost 150 core, affiliate, government, academic, and industry partners. To acknowledge every member of the several teams involved in the management and execution of the ASSURE mission would not be possible. Support from these partners comes from great people who are experts in aviation, aerospace, human factors, training, maintenance, logistics, operations, finance, and administration, and many who freely give their time every day to ensure the success of this center. A day never passes that I don't think of the tremendous talent and goodwill that makes ASSURE successful, and I'm personally grateful to all our partners and stakeholders.

The ASSURE University Coalition

ASSURE has the Knowledge of a 22 Member University Coalition

The world's leading UAS universities are on the ASSURE team, and their researchers offer unmatched capabilities with facilities and capacity that are second to none in over 200 locations in 16 states and nine countries. ASSURE members lead three FAA UAS test sites.

ASSURE Funding Summary

	Award Amount	Expenditures	Remaining	Cost Share
Total Funding	**$8,149,437.52**			
Program Office Funding	**$1,752,204.52**	**$1,089,406.61**	**$662,797.91**	**$593,861.43**
Core Schools	**$6,397,233**	**$3,658,037.85**	**$2,739,195.15**	**$3,603,223.01**
Drexel University	$570,000.00	$125,980.60	$444,019.40	$117,922.63
Embry-Riddle Aeronautical Univeristy	$548,618.00	$302,612.97	$246,005.03	$278,100.53
Kansas State University	$812,901.00	$389,710.39	$423,190.61	$558,539.27
Mississippi State University	$608,000.00	$361,074.65	$246,925.35	$246,358.54
Montana State University	$297,000.00	$250,316.89	$46,683.11	$121,377.67
New Mexico State University	$746,000.00	$406,797.52	$339,202.48	$888,659.70
North Carolina State University	$229,916.00	$169,787.68	$60,128.32	$7,411.66
Ohio State University	$682,425.00	$310,514.42	$371,910.58	$58,645.12
Oregon State University	$75,000.00	$0.00	$75,000.00	$0.00
University of Alabama-Huntsville	$248,233.00	$240,962.34	$7,270.66	$253,725.83
University of Alaska-Fairbanks	$0.00	$0.00	$0.00	$0.00
University of California-Davis	$0.00	$0.00	$0.00	$0.00
University of Kansas	$92,000.00	$91,945.16	$54.84	$72,951.62
University of North Dakota	$801,166.00	$402,221.23	$398,944.77	$393,416.44
Wichita State University	$685,974.00	$606,114.00	$79,860.00	$606,114.00
Totals	**$8,149,437.52**	**$4,747,444.46**	**$3,401,993.06**	**$4,197,084.44**

Summary by Project

	Award Amount	Expenditures	Remaining	Cost Share
Program Management Funding	**$2,052,204.52**	**$1,165,656.18**	**$886,548.34**	**$810,642.06**
Projects	**$6,097,233.00**	**$3,581,788.28**	**$2,279,167.90**	**$3,386,442.38**
A1: Certification Test Case to Validate sUAS Consensus	$300,001.00	$294,302.22	$5,698.78	$307,234.63
A2: Small UAS DAA Requirements for BVLOS Operations	$799,992.00	$608,622.67	$191,369.33	$1,117,961.81
A3: UAS Airborne Collision Severity Evaluation	$1,000,000.00	$879,448.55	$120,551.45	$639,216.59
A4: UAS Ground Collision Severity Evaluation	$382,500.00	$370,688.41	$11,811.59	$309,783.58
A5: UAS Maintenance, Modification, Repair, Inspection, Training and Certification	$800,000.00	$437,656.98	$362,343.02	$508,190.32
A6: Surveillance Criticality for Sense and Avoid (SAA)	$799,855.00	$464,560.53	$335,294.47	$65,288.91
A7: UAS Human Factors Station Design Standards	$750,000.00	$317,162.50	$432,837.50	$257,993.16
A8: UAS Noise Certification	$50,000.00	$50,000.00	$0.00	$38,311.70
A9: Control and Communications (C2) and Spectrum Management	$250,000.00	$6,861.59	$6,861.59	$0.00
A10: Human Factors: UAS Control Station Certification and Spectrum Management	$813,152.00	$5,859.14	$807,292.86	$9,776.72
A11: Low Altitude Safety Case Study: Part 107 Waiver for Flight Over People	$151,733.00	$146,625.69	$5,107.31	$132,684.96
Totals	**$8,149,437.52**	**$4,747,444.46**	**$3,165,716.24**	**$4,197,084.44**

Cost Share Summary	
Drexel University	$44,292.63
Embry Riddle Aeronautical University	$278,100.53
Mississippi State University	$576,776.94
Montanta State University	$121,377.67
New Mexico State University	$888,659.70
North Dakota Department of Commerce	$328,029.46
North Dakota State University	$65,386.98
Ohio State University	$58,645.12
State of Kansas	$500,748.86
University of Alabama-Huntsville	$142,092.03
University of Kansas	$72,951.62
Wichita State University	$606,114.00
Adaptive Aerospace Group, Inc.	$13,309.00
DJI	$35,514.80
Mike Toscano	$147,500.00
National Institute for Aviation Research	$84,189.00
NUAIR Alliance Inc.	$20,923.02
R Cubed Engineering	$6,970.09
Rockwell Collins	$4,015.80
Simlat Software	$73,630.00
The Cirlot Agency	$70,066.78
Westar Energy	$57,790.41
Total	**$4,197,084.44**
Summary by Source:	
Universities	$2,854,397.22
State Contributions	$828,778.32
3rd Party Contributions	$513,908.90
Total	**$4,197,084.44**

Participants, Publications, and Presentations

Airworthiness Research Participants

Certification Test Case to Validate sUAS Consensus

	Name	Origin
1.	Kurt Carraway (PI)	USA
2.	Andi Meyer	USA
3.	Tim Bruner	USA
4.	Tom Aldag (PI)	USA
5.	Kim Reuter	USA
6.	Joel White	USA

Graduation Dates of Students:

Name	Graduation Date
Tim Bruner	12/2015

Placement of Previous Research Students:

Name:	Placement
Tim Bruner	Kansas State University Applied Aviation Research Center

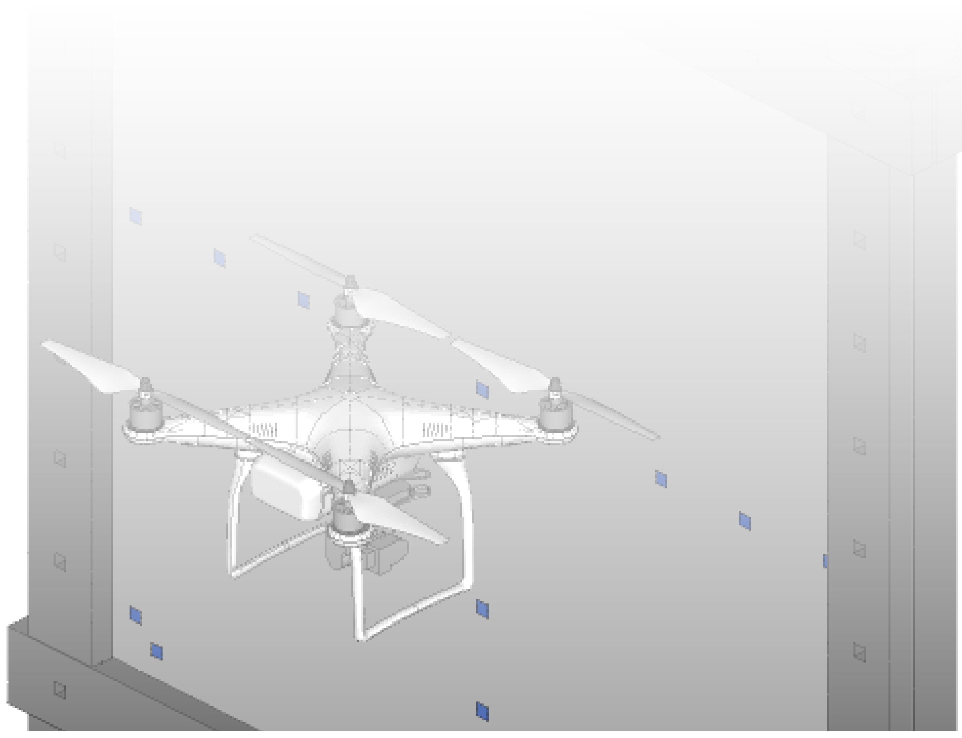
UAS Airborne Collision Severity Evaluation

	Name	Origin
1.	Kiran D'Souza	USA
2.	Troy Lyons	USA
3.	Erica Johnson	USA
4.	Mike Dunn	USA
5.	Jim Gregory	USA
6.	Gerardo Olivares Ph.D.	USA, WSU
7.	Tom Aldag	USA, WSU
8.	Chandresh Zinzuwadia	Tanzania, WSU
9.	Jaime Espinosa Monteros	Spain, WSU
10.	Russel Baldridge	USA, WSU
11.	Adrian Gomez	Spain, WSU
12.	Luis Gomez	Spain, WSU

UAS Airborne Collision Severity Evaluation

Graduation Dates of Students:

Name	Graduation Date
Troy Lyons	05 /2020 (Ph.D.)
Erica Johnson	05/2018 (BSE)
Rodrigo Marco (WSU)	12/2017
Sameer Naukudkar (WSU)	08/2017
Hoa Ly (WSU)	08/2017
Akshay S. Patil (WSU)	12/2017
Nathaniel Baum (WSU)	06/2017
Armando Barriga (WSU)	08/2017
Viquar Hasan (WSU)	08/2017
Obaidur Mohammed (WSU)	08/2017
Ankit Gupta (WSU)	04/2019
Akhil Bhasin (WSU)	08/2020



UAS Ground Collision Severity Evaluation

	Name	Origin
1.	David Arterburn, UAH	USA
2.	Chris Duling, UAH	USA
3.	Nishanth Goli, UAH	India
4.	Emily McGuire, UAH	USA
5.	Mack Wood, UAH	USA
6.	Jasleen Kaur, UAH	India
7.	Eduardo Divo, ERAU	USA
8.	Feng Zhu, ERAU	China
9.	Victor Huayamave, ERAU	USA
10.	Alexander Dori, ERAU	USA
11.	Arkas Das, ERAU	India
12.	Xianping Du, ERAU	China
13.	Mark Ewing, KU	USA
14.	Shawn Keshmiri	USA
15.	George Blake, KU	USA
16.	John Pritchard, KU	USA
17.	Eric Bodlak, KU	USA
18.	Ratneshwar Jha, MSU	USA
19.	Thomas Lacy, MSU	USA
20.	Calvin Walker, MSU	USA
21.	Raj Prabhu, MSU	India
22.	Lakeisha Williams, MSU	USA
23.	June Liao, MSU	China
24.	Prateek Jolly, MSU	Nepal
25.	David Francis, MSU	USA
26.	Hannah Stealey, MSU	USA
27.	Anna Dulaney, MSU	USA
28.	Parker Bertheslon, MSU	USA
29.	Ashma Sharma, MSU	Nepal

UAS Ground Collision Severity Evaluation

Graduation Dates of Students:

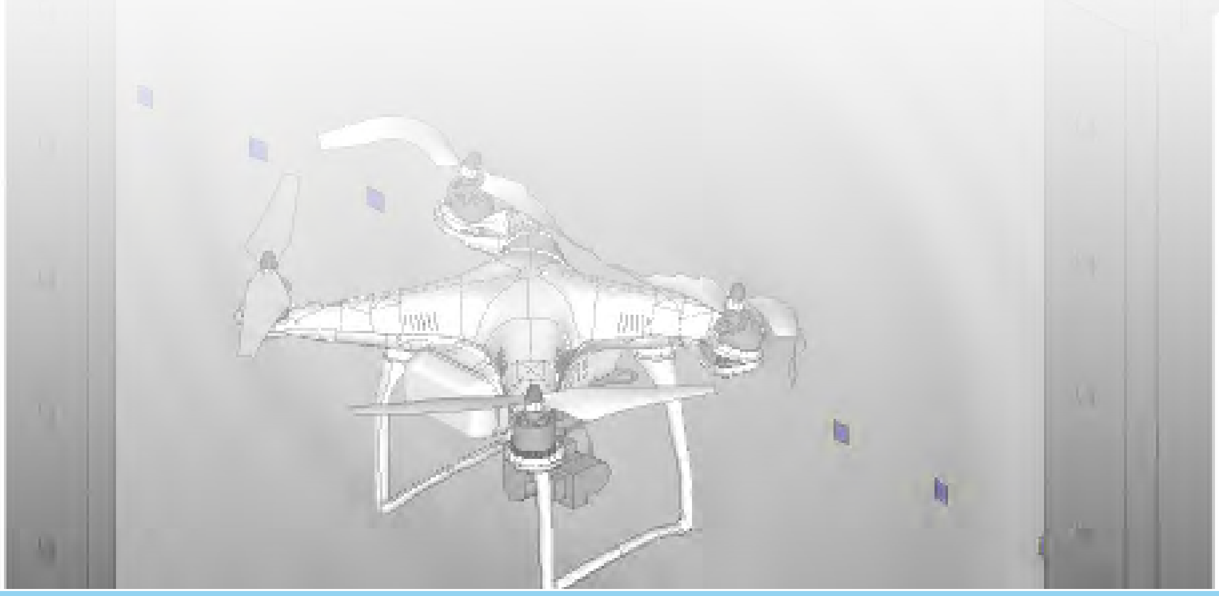
Name	Graduation Date
Mack Wood, UAH	Fall 2019
Jasleen Kaur, UAH	Fall 2018
Alexander Dori, ERAU	Fall 2016
Arkas Das, ERAU	Fall 2018
Xianping Du, ERAU	Fall 2017 - Spring 2018
Eric Bodlak, KU	Summer 2016
Prateek Jolly, MSU	12/2015
David Francis, MSU	Summer 2017
Hannah Stealey, MSU	Summer 2018
Anna Dulaney, MSU	Summer 2016
Parker Bertheslon, MSU	Summer 2016
Ashma Sharma, MSU	Summer 2019

Placement of Previous Research Students:

Name:	Placement
Prateek Jolly, MSU	Unknown

UAS Noise Certification

NAME	Origin
Ratan Jha (PI)	India
Adrian Sescu	Romania
Calvin Walker	USA



Control and Communications Participants

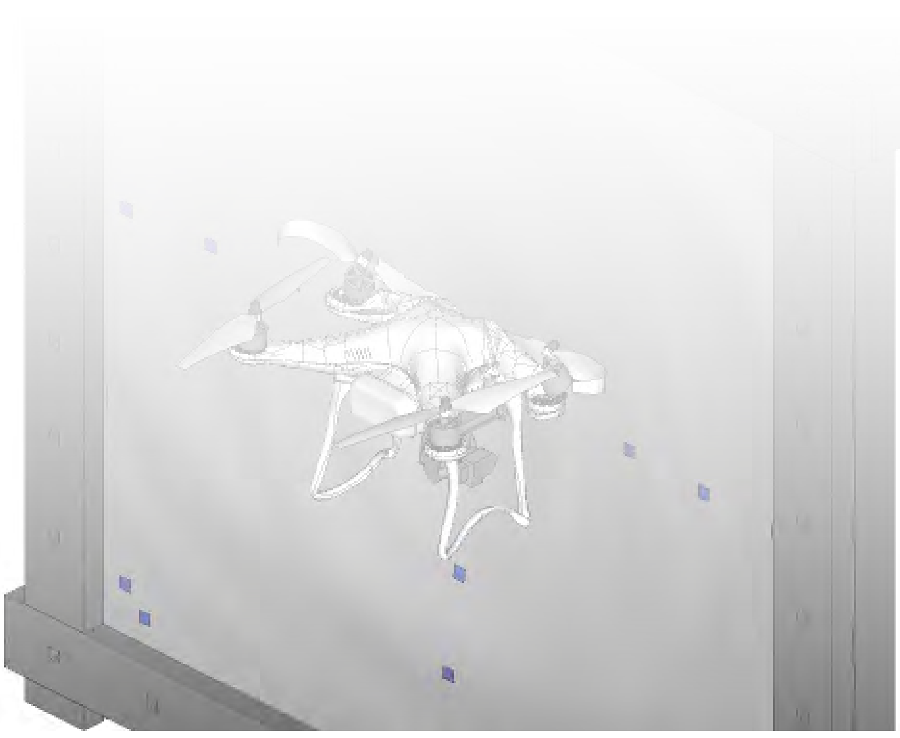
Research Focus Area

Surveillance Criticality for Sense and Avoid (SAA)

Name	Origin
1. Kyle Snyder	USA
2. Evan Arnold	USA
3. Dawson Stott	USA
4. Mohammad Moallemi	Iran
5. JW Bruce	USA
6. Michael Wing	USA
7. Matt McCrink	USA
8. Jim Gregory	USA
9. Will Semke	USA

Graduation Dates of Students:

Name	Graduation Date
Asma Tabassum (UND)	TBD
Nick Allen (UND)	TBD



Detect and Avoid Participants

Research Focus Area

Small UAS DAA Requirements for BVLOS Operations

Name	Origin
1. Henry M. Cathey, Jr. – NMSU	USA
2. Stephen B. Hottman – NMSU	USA
3. Eric Johnson – NMSU	USA
4. Dennis Zaklan – NMSU	USA
5. Alexander Vanhoudt – NMSU	USA
6. Zach LaRue - NMSU	USA
7. Davis Edmonds – NMSU	USA
8. Carlos Gomez – NMSU	USA
9. Devon Gutierrez – NMSU	USA
10. Tristan Likes – NMSU	USA
11. Courtney Telles – NMSU	USA
12. Dylan Whitener – NMSU	USA
13. Mark Askelson – UND	USA
14. William Semke – UND	USA
15. Naima Kabouch – UND	USA
16. Ron Marsh – UND	USA
17. Hassan Reza – UND	USA
18. Douglas Olsen – UND	USA
19. Chris Theisen – UND	USA
20. Scott Kroeber – UND	USA
21. Trevor Woods – UND	USA
22. Paul Snyder – UND	USA
23. Gary Ullrich – UND	USA
24. Michael Mullins – UND	USA
25. Kyle Foerster – UND	USA
26. Ian Nordeng – UND	USA
27. Farhad Akhbardeh – UND	Iran
28. Debesh Adhikari – UND	Nepal
29. Rosa Brothman – UND	USA

Small UAS DAA Requirements for BVLOS Operations

Graduation Dates of Students:

Name	Graduation Date
Alexander Vanhoudt	08/2016
Zach LaRue - NMSU	05/2018
Davis Edmonds – NMSU	05/2017
Carlos Gomez – NMSU	12/2016
Devon Gutierrez – NMSU	05/2018
Tristan Likes – NMSU	TBD
Courtney Telles – NMSU	12/2016
Dylan Whitener – NMSU	05/2017
Michael Mullins – UND	TBD
Kyle Foerster – UND	12/2016
Ian Nordeng – UND	05/2017
Farhad Akhbardeh – UND	05/2021
Debesh Adhikari – UND	05/2017
Rosa Brothman – UND	05/2017

Human Factors Participants

Research Focus Area

UAS Human Factors Station Design Standards

Name	Origin
1. Ellen Bass (PI)	USA
2. Philip Smith (Institutional PI)	USA
3. John Bridewell (Institutional PI)	USA
4. Igor Dolgov (Institutional PI)	Russian Federation
5. Carl Pankok, Jr.	USA
6. Douglas Lee	USA
7. Zachary Waller	USA
8. Scott Kroeber	USA
9. Ric Ferraro	USA
10. Tom Petros	USA
11. Paul Cline	USA
12. Amy Spencer	USA
13. Ermest Anderson	USA

Training Participants

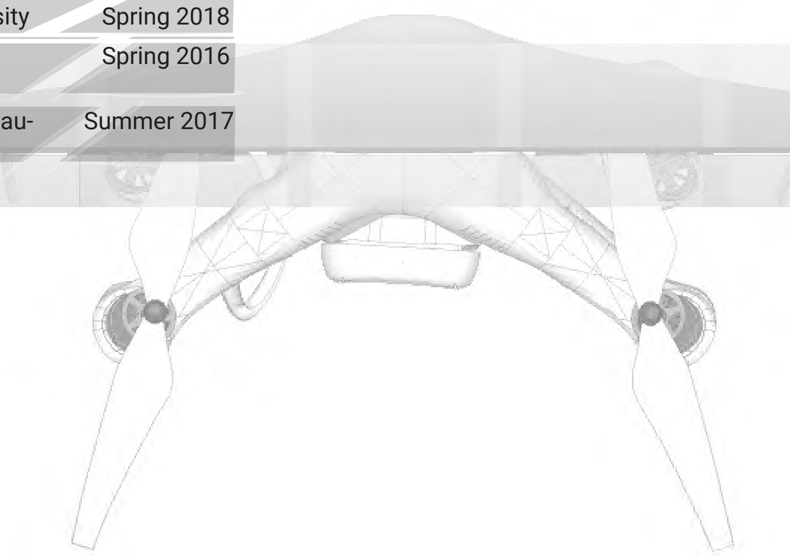
Research Focus Area

UAS Maintenance, Modification, Repair, Inspection, Training, and Certification

	Name	Origin
1.	Dr. Kurt Barnhart	USA
2.	Andi Meyer	USA
3.	Stephen Ley	USA
4.	Caleb Scott (student)	USA
5.	Dr. Michael Most	USA
6.	Dr. Doug Cairns	USA
7.	Daniel Samborsky	USA
8.	Daniel Guest	USA
9.	Kyle Rohan (student)	USA
10.	Femi Ibitoye (student)	Nigeria
11.	Dr. John Robbins	USA
12.	Mitchell Geraci	USA
13.	Richard Stansbury	USA
14.	Tom Haritos	USA
15.	Paul Carlson (student)	USA
16.	Charles Nick	USA

Graduation Dates of Students:

Name	Graduation Date
Kyle Rohan, Montana State University	Spring 2019
Femi Ibitoye	Spring 2017
Caleb Scott, Kansas State University	Spring 2018
Kimberly Bracewell, Embry-Riddle Aeronautical University	Spring 2016
Paul Carlson, Embry-Riddle Aeronautical University	Summer 2017



Presentations/Conference Proceedings

Name	DATE
ASSURE Research Panel at AIAA Demand for Unmanned Systems Conference	June 2016
ASSURE Research Panel at Association for Unmanned Vehicle Systems International (AUVSI) XPONETIAL 2016	May 2016
ASSURE Associate Director key note address at Academic Summit, Dayton Ohio	August 2016
ASSURE Associate Director key note address at UAS Midwest Conference, Dayton Ohio	August 2016
Multipoint Constraint Cohesive Zone Modeling, CAMX 2015, Nov 2015. (Montana State)	December 2015
Project A1: Certification Test Case to Validate sUAS Industry Consensus Standards Outbrief of F38 SVP to ASTM	May 2016
Project A1: Certification Test Case to Validate sUAS Industry Consensus Standards Update Briefing to ASTM	January 2016
Project A2: sUAS Detect-and-Avoid Beyond-Visual-Line-of-Sight Update Briefing to SARP	March 2016
Project A2: sUAS Detect-and-Avoid Beyond-Visual-Line-of-Sight Update Briefing to SARP	March 2016
Project A2: sUAS Detect-and-Avoid Beyond-Visual-Line-of-Sight Update Briefing to Association for Unmanned Vehicle Systems International (AUVSI) XPONENTIAL 2016	May 2016
Project A3: Airborne Collision Severity Update Briefing to the FAA and Members of the National Institute for Aviation Research Laboratories	January 2016
Project A3: Airborne Collision Severity Support to the Small UAS Group Committee, Washington D.C.	March 2016
Project A3: Airborne Collision Severity Update Briefing to Association for Unmanned Vehicle Systems International (AUVSI) XPONENTIAL 2016	May 2016
Project A4: Ground Collision Severity Update Briefing to Association for Unmanned Vehicle Systems International (AUVSI) XPONENTIAL 2016	May 2016

Significant Events

NAME	Date
UAS Center of Excellence (COE) Selection announced by FAA Administrator Huerta	May 2015
ASSURE met with FAA UAS Program Manger to establish priorities, operating norms and procedures	May 2015
UAS COE Kick-Off Meeting to begin defining the FAA research agenda including 59 unique research proposals from ASSURE	June 2015
ASSURE conducted a public media event at Mississippi State University, and held the second of four required face-to-face meetings with the FAA required during its first year of execution	September 2015
Initial research grants awarded	September 2015
ASSURE conducts semiannual meeting of its members in Albuquerque, New Mexico	December 2015
Sinclair College becomes the first Community College to join ASSURE UAS COE	January 2016
Hosted UAS COE EXPO on ASSURE research at FAA HQ and held ASSURE Program Management Review fulfilling third of four required face-to-face meetings with the FAA required during its first year of execution	February 2016
ASSURE supports (committee member, briefings and subject matter expertise) Micro UAS Advisory Rulemaking Committee	March 2016
Thirty grants awarded for $5.6 million (90% return on investment via university matching)	March 2016
ASSURE conducted its fourth and last required face-to-face meeting with the FAA required during its first year of execution in New Orleans, Louisiana	May 2016
ASSURE Annual Report Due	October 2016

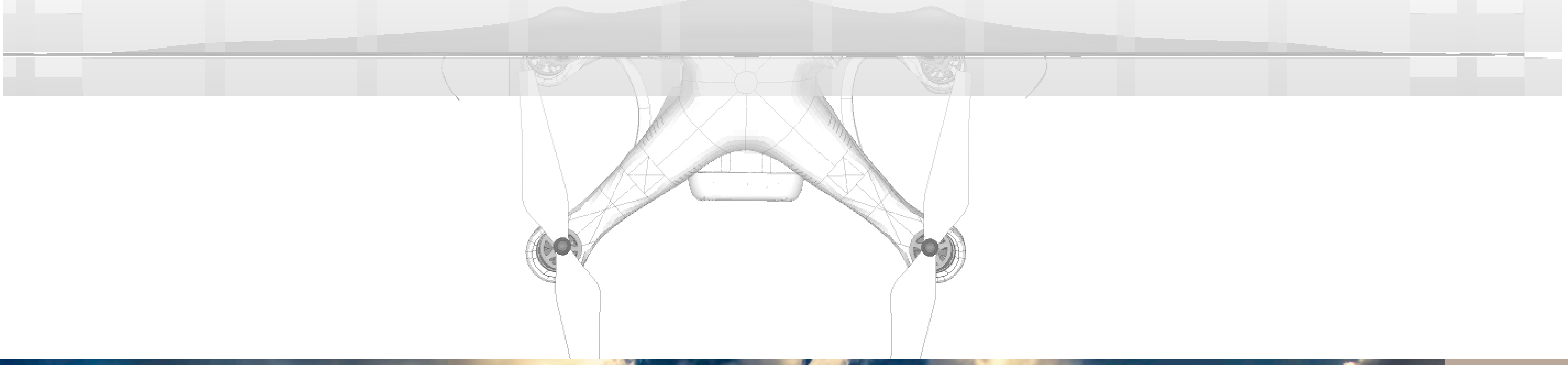
Journal Articles

- A Practical, Three-dimensional, Dynamical Progressive Damage Model, ***Composites: Part A***, in preparation (Montana State)
- Progressive Damage Modeling in Adhesive Joints, ***International Journal of Fracture***, in preparation (Montana State)

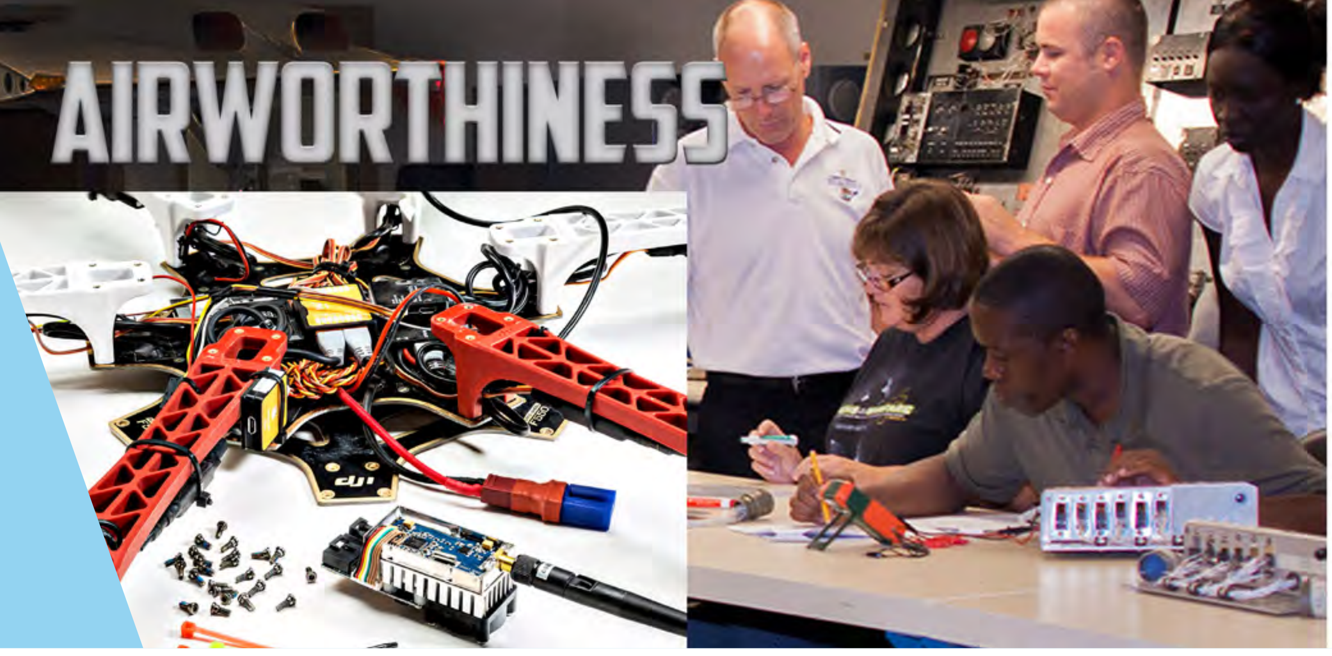
2017 Research

Each of the on-going research projects has identified knowledge gaps and needs for additional research. Below are the areas of research that the FAA appears most interested in funding, with its limited resources, at the time of writing of this Annual Report. This is ASSURE's best guess; the priorities for future research supporting the mission to safely integrate UAS into the national airspace system NAS may change.

- White Paper 42 – UAS Airworthiness Council (Airworthiness)
- White Paper 43 – Safety Management System Process for BVLOS Operations in Populated Areas (Detect and Avoid)
- White Papers 51 & 54 – Secure Communication Links and Spectrum Management (C2)
- White Paper 60 – Human Factors Considerations of UAS Pilot and Crew Training, Procedures, and Control Stations (Human Factors / Training)
- White Paper 63 – Lithium Polymer Battery Failure Mode Effects Analysis (Low Altitude Safety)
- White Paper 64 – Falling Multirotor Dynamics Study (Low Altitude Safety)
- White Paper 65 – Small UAS Probability of Striking Ground Objects in Operational Areas (Low Altitude Safety)
- White Paper 68 – Testing of Small UAS Detect and Avoid Systems for Limited BLVOS Operations (Low Altitude Safety)
- White Paper 69 – Performance Assessment & Standards Development for Small UAS Parachute Recovery Systems for Use as a Mitigation for Flight Over People (Low Altitude Safety)
- Pending White Paper – Small UAS Risk-based Airworthiness Standards Using Tools Developed in Project A1 (Airworthiness)
- Follow-on air-to-air collisions between UAS with General Aviation Aircraft and Rotor-Aircraft
- Follow-on research to develop modeling and ultimately validate model predicting the results of a UAS being ingested into an aircraft engine fan section



AIRWORTHINESS

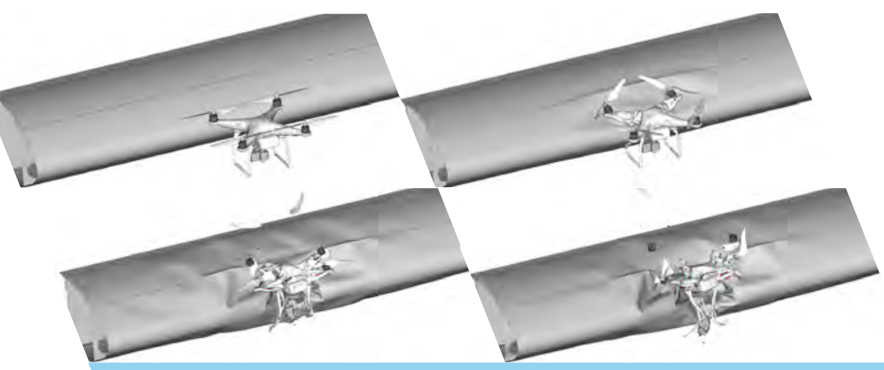


TEAM

WICHITA STATE UNIVERSITY
RESEARCH FOCUS LEAD

MISSISSIPPI STATE UNIVERSITY
DEPUTY LEAD

Advances in technology have greatly increased the affordability and accessibility of UAS to potential commercial operators and the general public. Accordingly, when the FAA develops and issues regulations that enable the commercial and private operation of small (sUAS) in the NAS below 400 feet, we can expect a significant increase in the number of aircraft operating in this space. In addition, these sUAS will operate in airspace that puts them in closer proximity to people than conventional aircraft now operate.



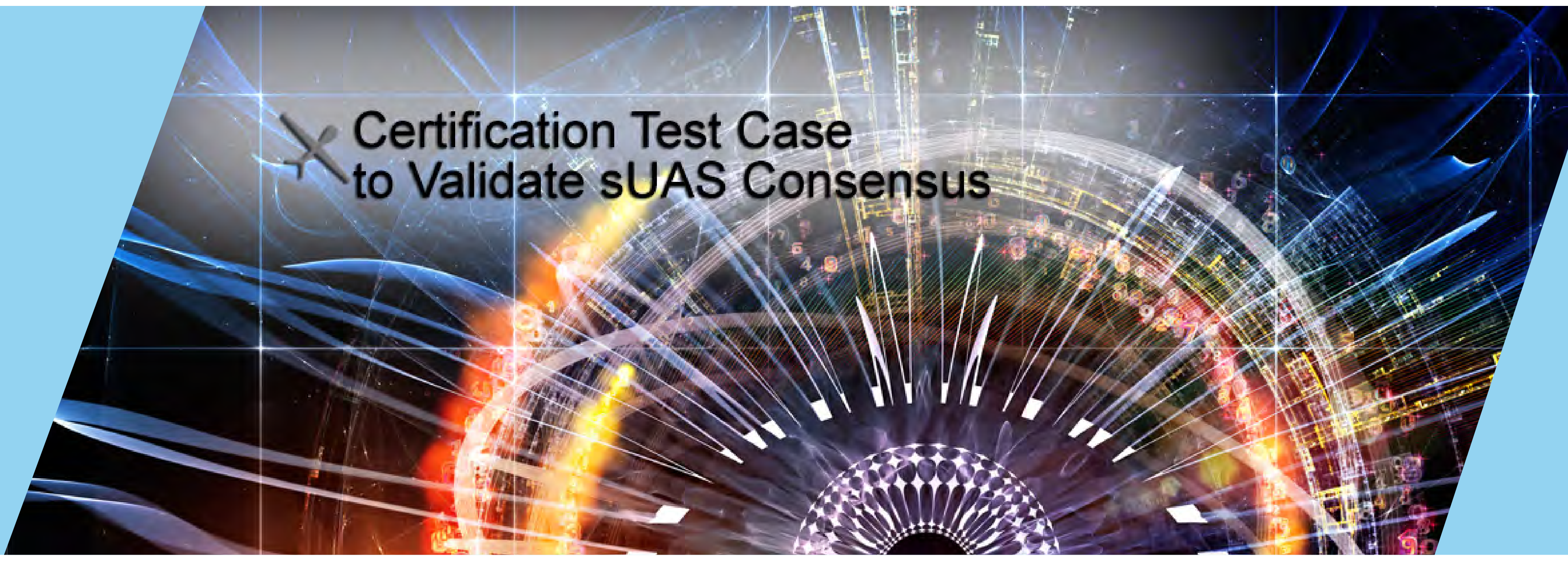
ASSURE Team Capabilities

ASSURE institutions offer metallic and composite material expertise and finite element modeling and simulation capability, including dynamic and crash simulations, as well as aircraft certification experience. They also offer a broad range of test capabilities, ranging from material and structural testing, flight testing, crash and impact testing, wind tunnels, system integration, environmental (DO-160), and propulsion fan blade testing. All institutions have experience working with FAA, DoD and industry.

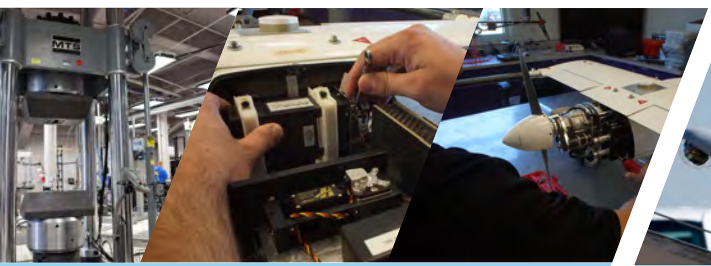
Research Focus

The ASSURE team is aiding the FAA in defining UAS related parameters that will allow safe, efficient and effective UAS operation in the NAS by accounting for UAS variations in size, performance and operating environments. Researchers are taking into account these variations and the practical need for different levels of certification. Airworthiness is a broad topic and research includes:

- Definition of structural load processes, loads spectrum, appropriate factors of safety, and methods for proving structural integrity.
- Establishment of design and construction standards around material design values, fabrication process controls, hazards to structure and systems/structures interaction .
- Development of power plant related criteria for engines, installation and propellers .
- Assurance of the environmental suitability of equipment installations.
- Determination of conventional certification requirements and probabilistic reliability .
- Identification of continued airworthiness inspections, repair standards and operating limitations .
- Evaluation of hardware and software tools for UAS certification and safety assessment .



Certification Test Case to Validate sUAS Consensus



Current Research & Results

Kansas State University is leading a team with Wichita State and the University of North Dakota to see if airworthiness, maintenance, and flight proficiency standards/requirements proposed by the UAS industry (ASTM F38) are safe as the basis for certification of a fixed wing small unmanned aircraft system (sUAS). KSU provided the UAS operations know-how; Wichita State used their airworthiness test facilities; and the University of North Dakota tested UAS software standards.

Phase 1 - sUAS Flight Testing

In collaboration with the FAA Small Airplane Directorate in Kansas City, the ASSURE team developed a flight test framework with requirements found within the ASTM F38 standards and additional flight test requirements gaps not covered by F38. The framework was developed from elements of accepted flight test documentation found within 14 CFR Part 23 Subpart B, the F37 Light Sport Aircraft (LSA) standards, and the ASTM F38 standards for sUAS. The ASSURE team has recommended that the comprehensive list of flight test requirements for fixed-wing sUAS be considered during the development of sUAS standards.

Phase 2 - Compliance Checklist

The FAA Small Airplane Directorate considers the compliance checklist a valuable certification tool for sUAS. The team developed a spreadsheet containing all the requirements or line items from the various ASTM F38 standards. Each line item has notes related to potential issues or gaps, appropriate methods of compliance (MOCs), and whether or not a common sUAS could be expected to comply with the requirement. Flight test requirements were also incorporated into the checklist. The compliance checklist highlights distinctions between design guidance and certification requirements, and identifies requirements for which flight testing could serve as the primary MOC. Finally, a compliance report was created to discuss issues and gaps with compliance and recommend ways to address them.

Phase 3 - Final Report

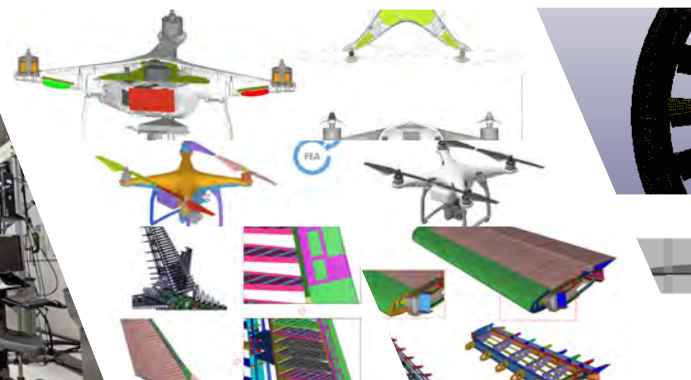
The ASSURE team has completed its milestones for providing the FAA the following reports:

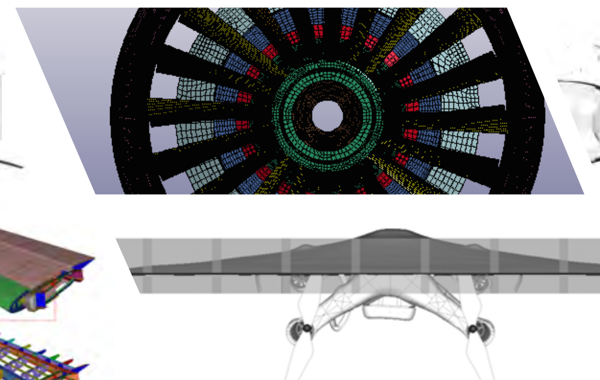
- Comprehensive Flight Test Framework
- Compliance Checklist Review and Issues Paper

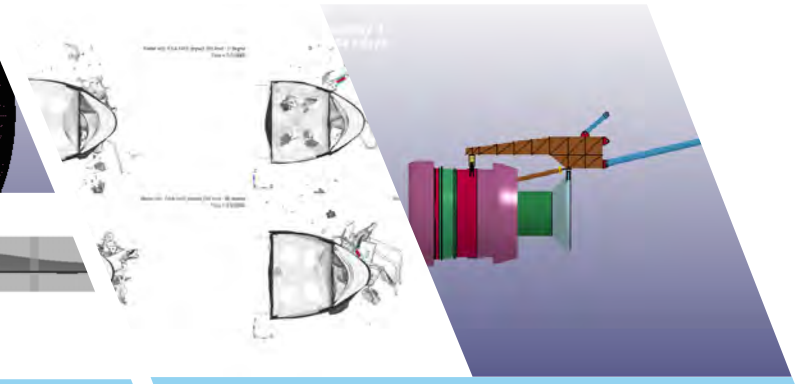
At time of publication, final report results were in progress. The FAA will use this research to set airworthiness standards for small UAS as an avenue for waivers to specific elements of Part 107.

UAS Airborne Collision Evaluation

At time of publication, final report results were in progress that detail modeling efforts including defining UAS projectiles, narrow-body aircraft, and results of collisions between the two with recommendations to the FAA. This research will help inform the FAA airworthiness standards for UAS that lessen damage in airborne collisions.







Current Research & Results

If all safety measures fail and a small UAS does hit a manned aircraft, it's important to understand what happens. Wichita State University is leading a team with The Ohio State University, Mississippi State University and Montana State University to conduct computer simulations of UAS air-to-air collisions and jet engine ingest.

UAS Models & Simulations

Built Numerical Finite Element models for the wing, windshield, horizontal stabilizer, and vertical stabilizer for both a commercial aircraft (similar to 737) and a business jet aircraft (similar to Learjet 31A).

- Built a Numerical Finite Element models for the most common "small" UAS (Quad-Copter and Fixed-Wing).
  - A reverse engineering process was followed to obtain the CAD geometry.
  - All the components were discretized in order to match the actual weight and geometry of the UAS.
  - Different component level tests have been conducted to evaluate and validate the UAS numerical model.

First Stage Review

- Preliminary analyses have been conducted to understand worst case impact scenario when impacting the UAS against the different aforementioned aircraft structures.
- Preliminary analyses have been conducted comparing 4 lb. bird strike and UAS impact damage.
  - Current preliminary results seem to indicate that bird strike impact damage is very different from UAS impact damage.

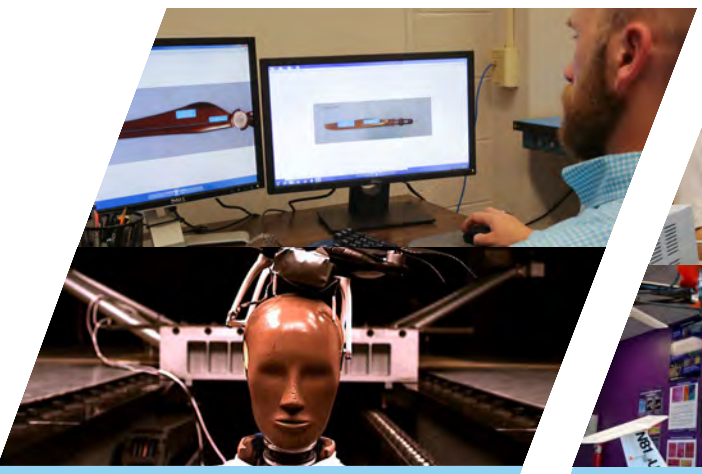
UAV/Aircraft Engine Crash Test

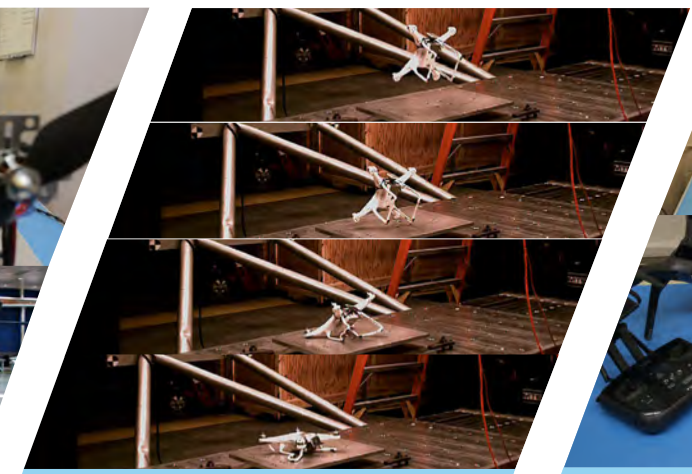
The ASSURE team is also researching the impact of a UAS collision with a commercial aircraft engine.

- The building a fan stage engine model to study the ingestion of a UAS into an aircraft engine:
  - Modifying an engine model developed by the Aerospace Working Group for a blade out simulation.
  - In addition to the model development, an impact simulation of a UAS motor into the fan stage has been developed. The simulation has the component moving at takeoff speed and the fan stage spinning at operational speed to represent a UAS being ingested into an engine at takeoff.
- Conducting component level (motor, battery, and camera) testing by projecting them at various spaces at aluminum plates to validate and adjust models.
- After the models are updated and validated, a full UAS ingestion test will be conducted.

UAS Ground Collision Evaluation

At time of publication, final report results were in progress that will lead to follow-on studies. This research will help the FAA set guidelines for UAS operations over people and possibly set design specifications to reduce risk to people and property.





Current Research & Results

Right now, the FAA doesn't allow UAS operations over people. But what is the risk in a ground collision? Are there ways to reduce the risk? The University of Alabama at Huntsville, Mississippi State, Embry Riddle Aeronautical and Kansas Universities are collaborating to conduct computer simulations of UAS ground collisions to find answers to these questions.

Creating UAS Ground Safety

While conventional 14 Code of Federal Regulations (CFR) system safety analyses include hazards to flight crew and occupants may not be applicable to unmanned aircraft, UAS operations may pose unique hazards to people, property and other aircraft on the ground. The unique characteristics of unmanned aerial systems (UAS) especially small UAS (sUAS) require a more in-depth evaluation to properly characterize the unique characteristics of these platforms as they relate to ground collision severity.

Modeling Efforts

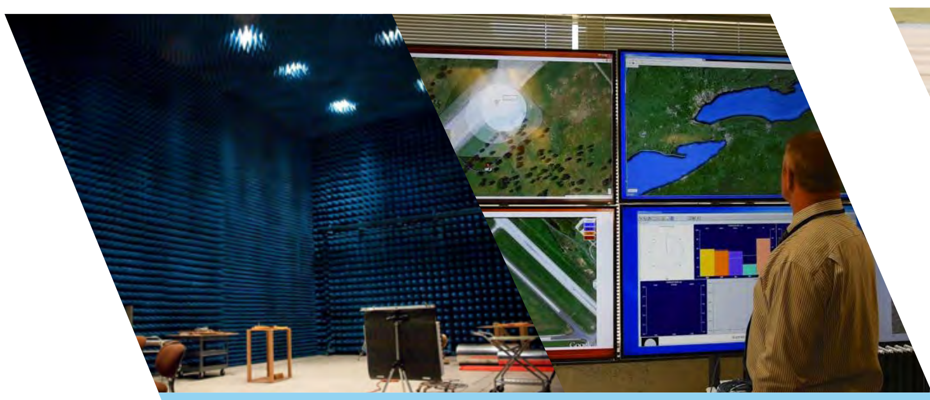
The research effort consists of a literature search, UAS characteristics definition, and a limited modeling effort to fill in gaps in data from the literature search. The modeling effort helped to evaluate credible scenarios and UAS characteristics defined in the literature search.

White Paper Publications

The team submitted a White Paper defining UAS Characteristics and continues to pursue modeling efforts and additional research tasks related to credible scenarios, laceration parametrics for rotors and propellers, payload characteristics and refine analysis originally presented in the UAS Characteristics White Paper.

The Principle Investigator for this project met with the Micro UAS Advisory Rulemaking Committee in March 2016, to inform the members of ASSURE research findings, that in-turn, served as the bases for recommendations from the ARC to the FAA. The team has advised numerous FAA representatives, working on Rule 107, on ground collision severity findings and have also presented results of their efforts to the Department of Defense Science and Research Panel (SARP) throughout 2016.

UAS Noise Certification



Current Research & Results

The FAA has a lot of data on manned aircraft noise signatures, but almost none on UAS. Mississippi State University worked with the NUAIR FAA UAS Test Site to develop procedures to measure UAS noise signatures. This research focused on the collection of noise measurements of UAS using 14 CFR Part 36, Noise Standards, to begin the initial assessment of whether noise certification procedures designed for manned aircraft are appropriate for unmanned aircraft.

Title

- The ASSURE Team ran a series of noise measurements at Griffiss International Airport, Rome, New York, with a TigerShark Block 3 UAS powered by a Herbranden 372 engine with a 31" x 18" blade propeller.
- Twelve events were run varying heights above ground, heading, and engine RPM.
- Detailed plots of the noise readings of the runs will be included in the team's Aug 31, 2016 Final Report.
- Ultimately, this study and its Final Report and follow on studies will help the FAA set standards for UAS mission profiles to minimize noise hazards.

AIR TRAFFIC INTEGRATION

The overall level of safety in the NAS is preserved through integration, which requires adherence to rigorous airworthiness standards and airspace regulations. While they apply equally to manned aircraft, they also recognize the distinguishing characteristics of UAS. This research encompasses those UAS that operate like fixed wing manned aircraft that require use of ramps, taxiways and runways to complete ground operations.

TEAM

EMBRY-RIDDLE Aeronautical University

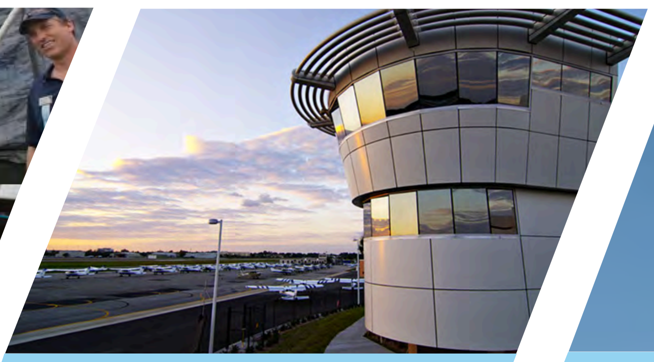
RESEARCH FOCUS LEAD

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

DEPUTY LEAD

ASSURE Team Capabilities

All our institutions have extensive experience with the integration of UAS with air traffic management systems from involvement with DoD projects and engagement with the FAA. Our facilities include the FAA Test Site at the University of North Dakota, The Florida NextGen Test Bed at Embry-Riddle and human factors facilities at Drexel University among others. The team includes course offerings in air traffic management and human factors that mutually supports the research in this focus area. The team includes airport partnerships to conduct airport ground operations research and demonstrations.



The Research Reason

The FAA has recently implemented new rules at a number of airports for keeping airplanes far enough apart so they are not affected by each other's wake turbulence. This wake turbulence re-categorization (RECAT) more narrowly and accurately defines safe wake turbulence separation standards based on the performance characteristics of aircraft. This eliminates conservatively long separation standards that are necessary under current broader wake-turbulence classifications, which are based primarily on aircraft weight classes.

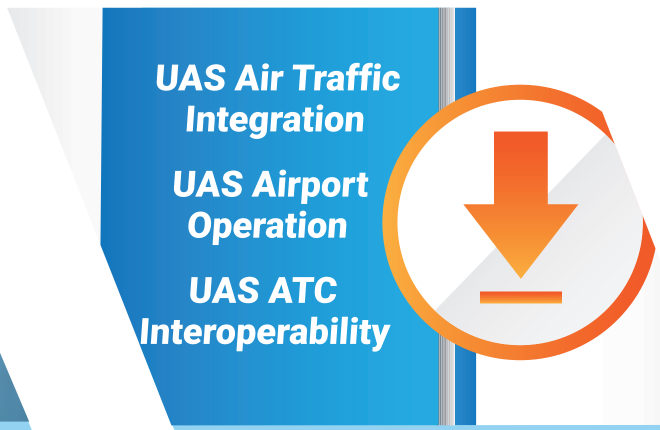
Integrating UAS into NAS

Collaborative Decision Making is a joint government/industry initiative aimed at improving air traffic flow management through increased information exchange among aviation community stakeholders. These stakeholders work together to create technological and procedural solutions to the Air Traffic Flow Management challenges faced by the NAS. New entrants into the NAS such as UAS have previously not been considered.

Air Traffic Control Interoperability

Research Focus

- Investigate the ATC interoperability of new and innovative UAS systems.
- Investigate the uses of ground stations, communications and interoperability systems for safe and efficient airport ground operations.
- Evaluate the integration of UAS into the airport and enroute air traffic management to support safety assessments and the expansion of UAS to Beyond Line-of-Sight Operations (BLOS) in the NAS for all sizes of UAS.



White Paper Publications

While the Air Traffic Control Research Focus Area did not have any projects during this period, the team has developed and submitted to the FAA fourteen white papers proposing research in the areas of UAS Air Traffic Integration, UAS Airport Ground Operations, and UAS ATC Interoperability.

Control and Communication (C²) research is the development of an appropriate C² link between the unmanned aircraft and the control station to support the required performance of the unmanned aircraft in the NAS and to ensure that the pilot always maintains a threshold level of control of the aircraft.

TEAM

NC STATE UNIVERSITY

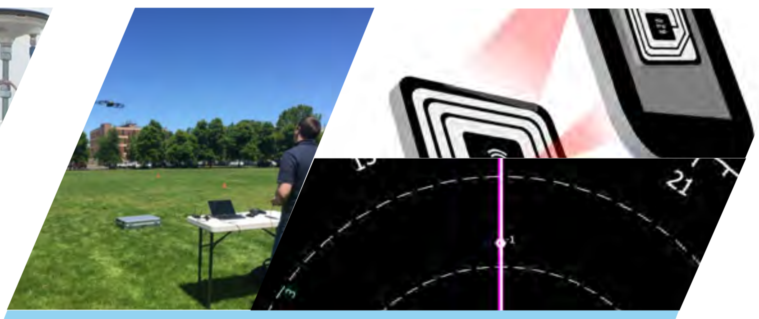
RESEARCH FOCUS LEAD

THE OHIO STATE UNIVERSITY

DEPUTY LEAD

ASSURE Team Capabilities

ASSURE universities have extensive command and control/spectrum experimental facilities that include: test aircraft, an indoor compact range, and comprehensive modeling tools.



Research Focus

Evaluation of C2 link performance requirements based on current systems, including studying the equivalent performance that may be possible via alternative network infrastructure, such as cellphone networks.

- Definition of spectrum requirements for communication, control and surveillance (ADS-B).
- Technical development and standards for secure communications and control links that will be robust to interference (intentional and unintentional).
- Evaluate the capability of passive radar systems for detection of uncooperative aircraft.

The Research Reason

Advanced research is required in data link management, spectrum analysis, and frequency management. Efforts will focus on completing development of C² link assurance and mitigation technologies and methods for incorporating them into the development of standards for the certification of the UAS.

Surveillance Criticality for Sense and Avoid

At time of publication, the ASSURE team was in the process of writing their final report. This research will help the FAA set standards for airborne sense and avoid systems to potentially allow UAS to avoid collisions autonomously.

Current Research & Results

North Carolina State University is leading a team of researchers from the University of North Dakota, Embry-Riddle Aeronautical, Mississippi State, The Ohio State and Oregon State Universities to determine if UAS can safely use current surveillance equipment, such as transponders, GPS beacons and collision avoidance systems. They are studying how manned aircraft and air traffic controllers interact using this equipment to avoid collisions to determine whether the current operational or technical performance requirements of these systems need to change for UAS SAA. Additionally, the team is helping the FAA to determine the criteria for evaluating the "equivalent level of safety" of UAS against piloted-aircraft for SAA functions. Finally, they will evaluate DAA technology failure mitigation strategies and their impact on system safety.

Defining DAA Characterizations

- The ASSURE Team has completed their literature review and defined the DAA System Characterizations focusing on six main factors: closing velocity, position, altitude, latency, aircraft identification, and DAA system specific performance limits.
- The initial test scenarios have been selected for analysis and baseline characterizations and failure analysis are on-going.

This research area focuses on issues related to the detection of potential threats to remain well clear and avoid collisions. It explores sensors, the data produced from sensors, the management and use of that data, and the operational outcome that is considered safe and acceptable.

TEAM

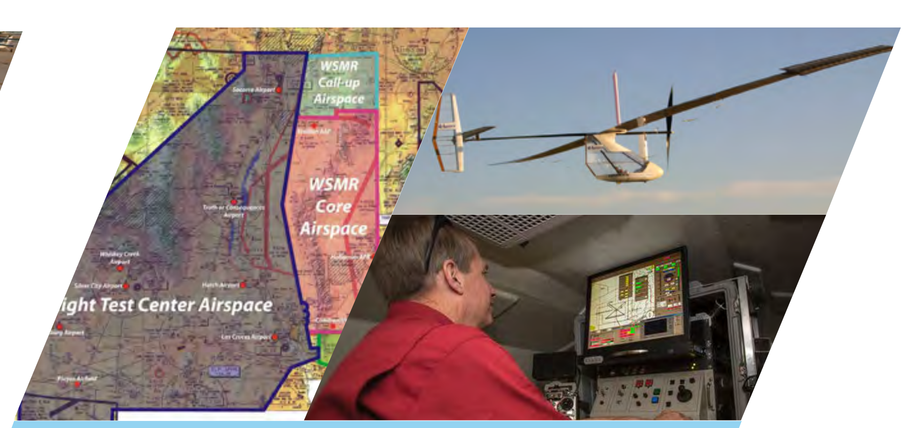
UND UNIVERSITY OF NORTH DAKOTA

RESEARCH FOCUS LEAD

NM STATE UNIVERSITY

ASSURE Team Capabilities

The two teaming research institutions offer extensive experience with UAS operations, demonstrated flight test capabilities with the Northern Plains UAS Test Site, and the NMSU Flight Test Center, excellent safety records, and a proven track record with UAS Detect-and-Avoid (DAA) development and testing.



Research Focus

- Identify use cases for small UAS (sUAS) Beyond Visual Line-of-Sight (BVLOS) operations.
- Develop an operational framework that defines the environment and conditions under which the recommended requirements will enable sUAS operations BVLOS.
- Perform approach comparisons for relevant technologies including ground-based and/or airborne approaches that comprise potential sUAS DAA systems.
- Flight test performance of selected systems and component technologies based on technology maturity, cost and size, weight and power limitations of sUAS.

sUAS Beyond Visual Line of Sight

The FAA's proposed small UAS rules say that operators must be able to see their UAS at all times when flying. This means UAS can only fly a few miles from their operators, restricting their usefulness. NMSU and UND are researching methods to make it safe to fly UAS even when the operator can't see their UAS.

Current Research & Results

Thus far, the BVLOS ASSURE team has:

- Reviewed approved 333-Exemption holder information resulting in a total of 10,136 use cases.
- Developed recommended DAA criteria including encounters between two aircraft timelines and elements; and the infrastructure for evaluating collision avoidance and self-separation (well-clear) thresholds for small UAS operating at low altitudes.
- The ASSURE team has begun work on developing the database of over 70 companies and evaluation system for comparing DAA approaches. This includes categories such as performance (range, scan time, accuracy, etc.), environmental operational conditions (reliability, temperatures, etc.), feasibility (cost, required resources, ease of use, etc.), and others.

BVLOS Operational Framewworks

At time of publication, final report results were in progress. The research will provide the FAA an operational framework for BVLOS operations, recommendations for the minimum operating standards for detect-and-avoid systems, and the proposed operating rules, limitations and guidelines; all to help the FAA decide when it's safe to allow commercial UAS to fly beyond the line-of-sight of their operators.

When the pilot controls the aircraft from a remote control station, several human factors issues emerge with respect to the pilot, the air traffic controller, and their interactions to safely operate UAS in the NAS. Human factors issues in manned aviation are well-known, but further analyses regarding integration of UAS into the NAS is required.

TEAM

Drexel UNIVERSITY

RESEARCH FOCUS LEAD

ASSURE Team Capabilities

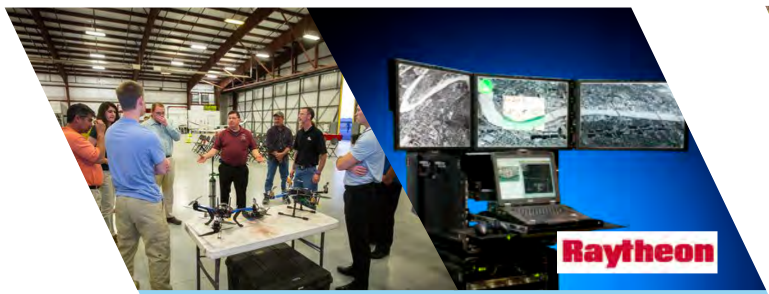
ASSURE capabilities include human factors engineers and scientists, human-in-the-loop simulation and training environments, and associated design and evaluation tools. The team applies theory, principles and methods to consider human performance and limitations to address human factors safety concerns that are unique to UAS operations, and to inform the development of standards, regulations and guidance for civil UAS.

Research Focus

The ASSURE team is aiding the FAA in defining UAS related parameters that will allow safe, efficient and effective UAS operation in the NAS by accounting for UAS variations in size, performance and operating environments. Researchers are taking into account these variations and the practical need for different levels of certification. Airworthiness is a broad topic and research includes:

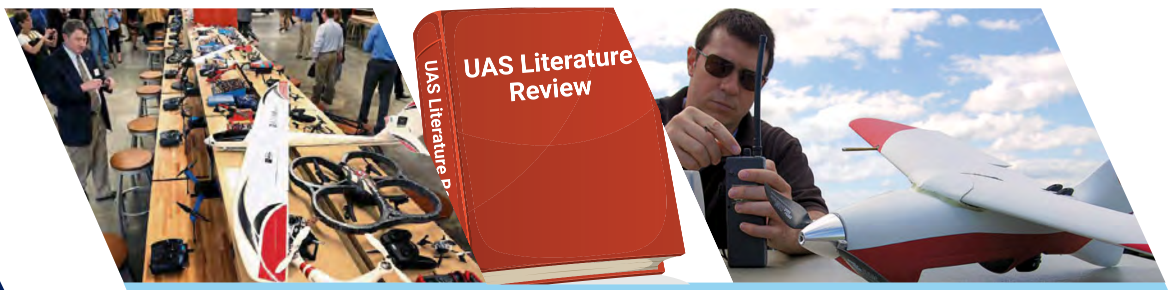
- Support the development of regulatory and guidance material related to control stations (CS), ground observers and pilot certification and training.
- Support the development of minimum information requirements and best practices to ensure safe integration of UASs into the NAS .
- Support the evaluation of potential safety issues with the CS, including that UAS CS buildings and trailers are safe for pilots and crew.
- Support the development of recommended crewmember training and certification requirements, to include pilots and other crewmembers.
- Support the development of recommended UAS crewmember procedures and operational requirements.

UAS Station Design Standards



Current Research & Results

Drexel University is leading a team of experts from New Mexico State, The Ohio State University and the University of North Dakota to develop recommendations of what should - and should not - be automated in UAS (focusing on function allocation between the human and automation) and how to display critical information to UAS crews through the design of pilot ground control workstations. The University of North Dakota and New Mexico State will then research how to train and certify UAS crew based on these requirements.

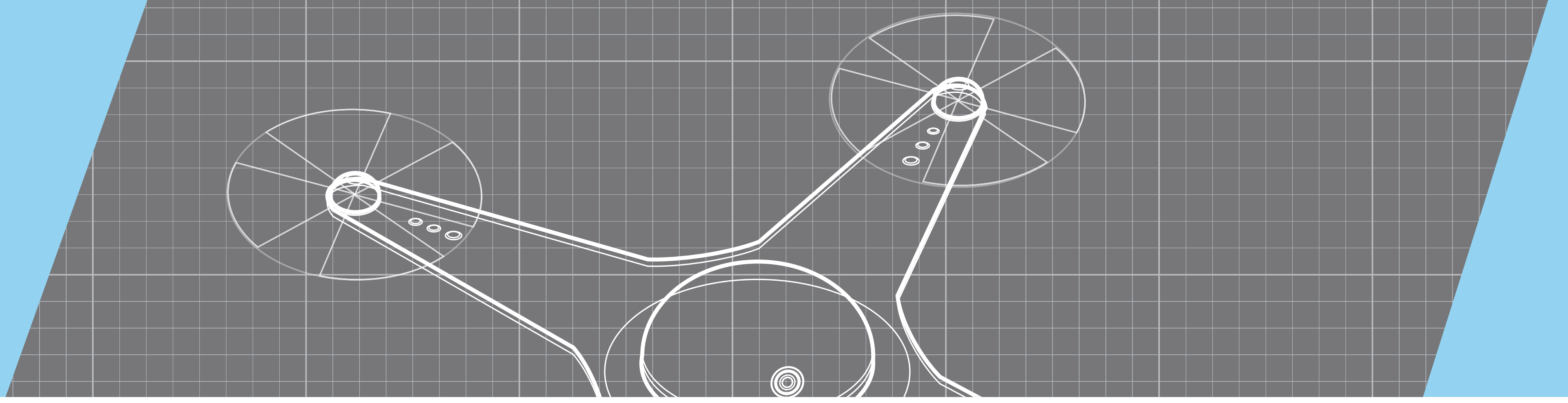


Literature Review

The team has completed their literature review of relevance to UAS human-automation function allocation strategies and UAS, and UAS planning review. Initial high-level conclusions include:

- In order to achieve UAS operations that are at least as safe as current manned operations, significant changes will have to be made, both in terms of the allocation of tasks to people and in terms of the introduction of new information displays, control methods, procedures, decision support tools and automation. This includes changes relevant to preflight planning, taxi operations, departure, arrival and enroute flight.
- The requirements will need to be sensitive to factors defined by the airports and airspace involved.
- There are many tasks that today involve two or more participants in order to increase safety, especially with respect to the planning for and implementation of contingency plans. These task demands need to be identified and explicitly considered in determining how UAS operations can compensate through changes in function allocation and the introduction of technologies.
- The literature also emphasizes the importance of effective monitoring and detection in order to determine when a contingency plan needs to be implemented or whether revised contingency plans need to be developed in response to a changing forecast.
- UASs introduce the need for new types of contingency plans and procedures to be developed, including the design of automation to support the detection and implementation of certain contingency plans and the design of the associated information displays and controls for use by the pilot.
- These considerations have implications in terms of functional and information requirements for the pilot ground control workstation, as well as function allocation.

On-going UAS Research



On-going Research

The team is in the process of interviewing UAS crewmembers to conduct activity theory analysis that will allow them to provide the FAA with recommendations for UAS crewmember and observer and certification requirements. Preliminary results include:

- Training and certification requirements for UAS operations should consider the weight and speed of the aircraft.
- Hands-on training is most valuable across crewmembers.
- Certifications should be a mixture of practical and class based exams.

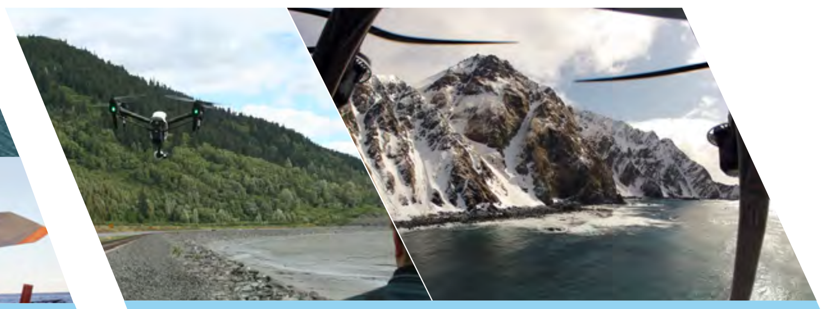
Final Phase Research Status

The final report for all four projects areas: function allocation strategy recommendations, control station design recommendations, training/certification requirements, and visual observer requirements, were in progress at the time of this publication. This research will help the FAA set standards for how critical functions are automated in a UAS ground station and how UAS operators receive vital flight data. It will also help the FAA decide how to certify and train UAS crew.

LOW ALTITUDE SAFETY

TEAM
UAF UNIVERSITY OF ALASKA FAIRBANKS
RESEARCH FOCUS LEAD

The substantial increase in air traffic below 400 feet that is expected with the integration of small unmanned aircraft systems (sUAS) in the NAS also significantly raises the exposure of the general population to the potential effects of a sUAS mishap.



ASSURE Team Capabilities

Team members are experienced with real-world experience in low-altitude UAS missions.

Research Focus

Low altitude UAS operations raise concerns about UAS in close proximity with people and ground-based infrastructure. Safety considerations are heightened due to close proximity to the ground and the relatively short reaction time available to pilots in avoiding collisions and adjusting to changing environmental conditions. These factors make low altitude UAS operations an area that requires a considerable amount of attention from all stake holders, and reinforce the need to develop low altitude operations safety techniques. ASSURE advances the understanding of low altitude operation safety by identifying hazards through UAS implementation in real-world operational scenarios including precision agriculture, wildfire response applications, beyond line-of-sight urban operations, and energy infrastructure and emergency response.

The ASSURE team's approach to establishing low altitude UAS flight operations is based on a safety-driven process that establishes well defined concepts of operations to support the identification of risks, and the development and application of technical and procedural risk mitigation techniques.

Current Research & Results

While the low-altitude safety research focus area has not conducted funded research during this past year, it has provided the FAA four white papers recommending research in the areas of wildfire response, precision agriculture, on and off shore oil, gas, and water infrastructure monitoring and emergency response and vision based navigation.

The substantial increase in air traffic below 400 feet that is expected with the integration of small unmanned aircraft systems (sUAS) in the NAS also significantly raises the exposure of the general population to the potential effects of a sUAS mishap.

TRAINING

TEAM
KANSAS STATE UNIVERSITY
RESEARCH FOCUS LEAD

ASSURE Team Capabilities

All institutions offering UAS coursework have established records in FAA aeronautical training, including air traffic control and are holders of the FAA 141 and 147 Training School Certificates.

Research Focus

- The creation of crewmember training and certification requirements based on instructional system design theory and method.
- Recommendations for training and certification requirements for all crew members toward the safe and efficient integration into the NAS juxtaposed to current manned requirements.
- Investigating the recommended training and certification requirements for visual observers to assist with see-and-avoid in a manner that optimally mitigates the risk of conducting civil UAS operations.

UAS Crew Training and Certification Including Pilots

The substantial increase in air traffic below 400 feet that is expected with the integration of small unmanned aircraft systems (sUAS) in the NAS also significantly raises the exposure of the general population to the potential effects of a sUAS mishap.

At the time of this publication, the final report results were in progress. The FAA will use this research to help set UAS maintenance standards and training certification to ensure UAS are kept safe to fly.

Current Research & Results

The FAA already knows how to certify maintenance procedures and train maintenance professionals for manned aircraft, but UAS are different. Kansas State is leading a team with Embry-Riddle Aeronautical University and Montana State University to test current industry UAS practices against current manned aircraft safety regulations. The team will be providing the FAA various reports with recommendations on maintenance simulation training, ASI Training, Gap Analysis of 14 CFR 145 Repair Station Criteria, UAS Accidents/Incidents Data Recording.

UAS OEM Information Tools

The team completed surveys of UAS Original Equipment Manufacturers (OEMs) and Operators related to maintenance, records keeping, technician training, and repair stations standards for UAS. From this work the team developed tools to inform the FAA:

- UAS maintenance, documentation, and training database practices associated with UAS aircraft across various risk classes.
- Rational Matrix of maintenance and records standards, practices, rules, and guidelines including published information from Advisory Circulars, Federal Aviation Regulations, Consensus Standards (ASTM) and FAA Orders.
- Relational Matrix of FAR Part 147 and NCATT UAS Maintenance Standards.
- Relational Matrix of COA Online/Incident/Accent Report Form and Maintenance & Repair (M&R) Prototype Database aligning COA report data fields to M&R database fields. The ASSURE team also provides recommendations to improve data collection accuracy, ease of use, and improvement/ability to identify trends.

The FAA and its COE for UAS have a strong desire to incorporate Science, Technology, Engineering, and Math (STEM) outreach to students from groups who are underrepresented in STEM fields.

TEAM

NM STATE UNIVERSITY

RESEARCH FOCUS LEAD

ASSURE Team Capabilities

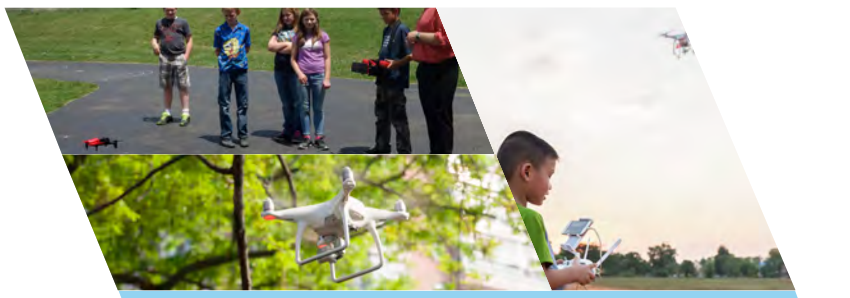
STEM and Minority outreach is important to all our universities and provides opportunities for our industry partners to contribute to their local communities and to emphasize STEM, which is so critical to UAS design, manufacturing, operations, and maintenance.

Outreach Focus

- The performance of K-12 students in math and science.
- Project-based, student engagement, and active learning opportunities designed to enhance team work, communication skills, and understanding of the application of STEM in real life.

UAS as a STEM, Minority, Outreach Learning Platform for K-12

The summer camps are five-day programs that provide team building activities, demonstrate and teach the physics of flight, conduct research on UAS systems, assemble UAS, ground and air test UAS and provide flight opportunities. The initial camps will take place in the summers at Tuskegee and NMSU.



Current Research & Results

The objective of this project is to provide two STEM outreach approaches that use UAS as the central learning platform. The STEM topics will include fundamental related concepts and will include unique UAS related content. While a number of various approaches for STEM outreach have been provided and discussed with the FAA: two specific approaches have been down selected for implementation: Phase I: UAS Educational Roadshows; and Phase II: UAS STEM Summer Camps. The specific objectives of this activity would be for students to learn about:

- How a UAS flies (Physics of Flight)
- Subsystems of UAS
- How UAS are used
- How the FAA is interfacing with UAS

Taking UAS On the Road

The Roadshow events will consist of half-day long events (two) at each location (Tuskegee and New Mexico State University) focused on high school African-American students in the Tuskegee area and middle school Native Americans and Hispanics in New Mexico.

This program began in the last Quarter of FY 2016 and continues until June 2019.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