FAA JOINT UNIVERSITY PROGRAM FOR AIR TRANSPORTATION RESEARCH
QUARTERLY REVIEW MEETING SUMMER 2016 hosted by

OHIO UNIVERSITY

RUSS COLLEGE OF ENGINEERING AND TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE
AVIONICS ENGINEERING CENTER

August 1-2, 2016
Agenda

Monday, Aug 1, 2016 – Ohio University, Athens, OH, Baker Center, Room 239

1:00 - 1:30 PM Meet and Greet.

1:30 – 3:00 PM MIT Research Activities – Dr. R. John Hansman

- **A Multi-Attribute Airport Capacity Model: A System Level Study of Runway Throughput Components and New Wake Vortex Separation Concepts**
  Tamas Kolos-Lakatos
- **Tools for Rapid Aviation Environmental Assessment**
  Morrisa Brenner
- **Environmental Negotiation Frameworks for Multi-Stakeholder Air Transportation Systems**
  Luke Jensen

3:00 - 3:30 PM BREAK

3:00 - 4:30 PM MIT Research Activities – Dr. R. John Hansman

- **A Data Mining Approach for Characterization of Traffic Flows in Complex Airspace: The New York Metroplex Case**
  Mayara Condé Rocha Murça
- **Operational Aspects of On Demand Mobility: A Case Study in Los Angeles**
  Parker Vascik

6:30 - 9:00 PM Picnic at Ohio University, Gordon K. Bush Airport (KUNI), Albany, OH

Tuesday, Aug 2, 2016 – Ohio University, Athens, OH, Baker Center, Room 239

8:30 AM - 9:00 AM Coffee and pastries

9:00 - 10:00 AM Princeton University Research Activities – Dr. Luigi Martinelli

- **Continuing progress of high-order accurate simulation tool for cargo hold fires**
  Mark Lohry
- **Uncertainty Quantification for Airfoil and Wing Icing**
  Anthony DeGennaro

10:00 – 10:30 AM BREAK

10:30 – 11:30 AM Ohio University Research Activities – Dr. Chris Bartone

- **Bird Strike Mitigation for Aviation Using Radar and Aviation Data Links**
  Christopher Drummond
- **A Flexible e-textile Antenna and Body Area Network to Wirelessly Monitoring Biometric Information**
  Meenakshi Kohli, Levi Moore

11:30-12:00 PM Principal Investigators' Meeting

Abstracts

MIT Abstracts

Introduction*: R. John Hansman*

A Multi-Attribute Airport Capacity Model: A System Level Study of Runway Throughput Components and New Wake Vortex Separation Concepts
Tamas Kolos-Lakatos

As air travel demand continues to grow, there is a greater need to introduce new procedures that can increase airport capacity without adding new infrastructure. For most congested airports, the airport capacity is most tightly constrained by runway capacity. Runway capacity at an airport can be limited by a number of factors. The first part of this research work analyzes the various factors affecting runway capacity, identifies the interactions and multidimensional tradeoffs between them, and quantifies their impact. A fast-time Monte-Carlo simulation based runway capacity model is built for this purpose. The second part of this work focuses on new wake vortex separation concepts, and evaluates their impact on runway capacity at a set of U.S. airports. The objectives of this study are to identify sensitive or important runway capacity variables, test the robustness of new wake separation concepts, develop flexible recommendations that depend on operational circumstances, and estimate the impact of new procedures on runway throughput.

Tools for Rapid Aviation Environmental Assessment
Morrisa Brenner

As the FAA explores the impacts of various NextGen procedures and other policy actions, it is critical to be able to rapidly assess the potential impacts of many options. While further analysis may need to be conducted in the course of refining procedures or policy options, rapid analysis allows the FAA to explore a substantially larger design space and more effectively evaluate the tradeoffs between fuel burn, emissions, and noise. Our team has been developing a set of tools based on the current FAA methodologies that allow for more automated and rapid evaluation of the fuel burn, emissions, and noise generated by different approach and departure procedures at airports for current and notional future aircraft fleets.

Environmental Negotiation Frameworks for Multi-Stakeholder Air Transportation Systems
Luke Jensen

Changes in air transportation systems intended to improve economic or safety metrics often have associated environmental impacts, resulting in disaggregate costs and benefits for different stakeholders. Design solutions are most effective when all impacted stakeholders have a perception of equitability. Therefore, calculating and valuing multi-stakeholder environmental trade spaces is an important problem in air transportation system design. This talk introduces the methods by which multi-stakeholder negotiation frameworks can be applied to air transport technology changes, with an emphasis on the tradeoffs involved with trajectory design and community noise.

A Data Mining Approach for Characterization of Traffic Flows in Complex Airspace: The New York Metroplex Case
Mayara Condé Rocha Murça

Air travel demand in high density metropolitan areas is often served by a set of closely located airports usually called multi-airport system or metroplex. Because of the spatial proximity between

airports, metroplex airspace tend to present very complex design with significant interdependencies between arrival and departure operations. The airspace complexity and the high traffic levels make the management of metroplex flows a challenging task that is critical to the overall performance of the National Airspace System. In order to increase the operational efficiency of these systems, it is important to have an accurate characterization of the actual major flow patterns and their associated performance at individual and aggregate perspectives under different conditions so that better capacity management can be performed. This work aimed to provide such characterization for the New York Metro airspace. A data mining framework was developed in order to identify the actual airspace structure and major coupled operational patterns in the terminal area from radar tracks. An assessment of aggregate system capacity is then performed through performance curves derived from individual pattern historical behavior.

Operational Aspects of On Demand Mobility: A Case Study in Los Angeles
Parker Vascik

On Demand Mobility (ODM) is an emerging transportation paradigm that leverages increased connectivity through smartphones to enable the real-time matching of consumers and service providers for point-to-point transportation. Through the convergence of advanced electric propulsion and autonomy in aviation, numerous entities now aim to provide ODM services via aircraft within the next decade. However, despite significant advances in small aircraft design, ODM providers and regulators must address five operational challenges to realize market implementation. These five operational challenges are: airspace integration, air traffic interaction, ground infrastructure availability, noise management, and operations certification. This research conducts a case study of Los Angeles to identify the constraints imposed on ODM operations by each of these five categories. A set of twelve reference missions capture the variety of operational needs of early adopting, high-value potential markets. A short-term concept of operations (ConOps) is proposed for each reference mission that enables ODM operations subject to the constraints of the five operational challenges. Future work will develop long-term ConOps that expand the capabilities or coverage of the ODM aircraft network by relaxing specific operational constraints.

Princeton University Abstracts
Introduction*: Luigi Martinelli*

Continuing progress of high-order accurate simulation tool for cargo hold fires
Mark Lohry

Accurate prediction of heat and particulate transfer in fire-induced flow is necessary for predicting the performance of aircraft cargo hold fire detection systems. Past investigations of cargo hold fires include full-scale experiments and simulations using traditional 2nd order accurate finite volume CFD methods. In previous meetings, we have identified several inadequacies in available simulation tools. As a result, we are continuing development of a new flow solver using the discontinuous Galerkin method for discretization, which allows for arbitrarily high order accuracy and geometric flexibility.

In this talk, we present the current state of development of this new tool. Buoyancy driven flow simulations will be demonstrated in cargo hold geometries with varying order of accuracy in order to illustrate the effects of varying the polynomial order and the mesh size independently. We will also present fundamental 2D and 3D flow validation cases to assess the performance of the code. A test case using this tool on a fully 3D fire-driven flow in the B707 cargo hold will be compared with experimental results.

Uncertainty Quantification for Airfoil and Wing Icing
Anthony DeGennaro

Ice accumulation on the surface of a wing can be detrimental to aircraft performance as it can drastically reduce lift, increase drag, lead to lower stall margins, and change the control performance of the airplane.
Experimental evidence indicates that Ice accumulation results in a wide range of realizable geometric shapes and properties of the ice, which depends on a large number of physical parameters and results in a large uncertainty. Hence, our goal is to quantify how simple measures of aerodynamic performance are affected by uncertainty in the icing process.

We have conducted research following two approaches: i) by treating the uncertainty in the icing problem as existing only in the form of several ice shape parameters, which are identified using existing data on ice shapes; ii) by treating the uncertainty in the icing problem from a physical standpoint, which required the implementation of a wing icing model.

We present new results that demonstrate how the techniques of cluster modeling and graph partitioning may be used to segregate a large database of ice shapes into classifications of similar shapes. This approach provides a data-drive empirical classification scheme that makes subsequent UQ studies more tractable.

We also present recent and ongoing work towards developing, testing, and verifying an in-house 2D icing model and discuss recent “physics-based” uncertainty quantification studies.

Ohio University Abstracts
Introduction*: Chris G. Bartone*

Bird Strike Mitigation for Aviation Using Radar and Aviation Data Links
Christopher Drummond
This research investigates taking avian radar target detections and producing target reports that are suitable for distribution to the airport Air Traffic Control (ATC) tower and aircraft users within the operational range of the airport. Formatting the filtered bird detections as avian target reports within the Traffic Information Service-Broadcast (TIS-B) and Flight Information System – Broadcast (FIS-B) message structure are under investigation and will be presented. These TIS-B and/or FIS-B avian target reports will be broadcast using 1090 Extended Squitter (1090ES) and UAT. Recent efforts have concentrated on TIS-B message formatting for the UAT, which will be the focus of this presentation.

A Flexible e-textile Antenna and Body Area Network to Wirelessly Monitoring Biometric Information
Meenakshi Kohli, Levi Moore
Flexible electronics can provide many benefits in various applications due to their flexibility and lightweight. This paper provides details on an e-textile spiral antenna used in a Body Area Network application. The system senses heart rate, has provisions for fall detection using an inertial measurement unit, and measures ambient temperature. An Arduino microcontroller collects and processes the data and interfaces with a low-energy Bluetooth (BLE) transceiver to transmit data via an e-textile antenna. Data is received via BLE on a custom built Android application running on a handheld Nexus 5 Smartphone. Power received measurements were performed to compare the e-textile spiral antenna with a traditional inset-fed patch antenna. We believe this system has potential aviation uses. For example, a BAN system could track a pilots health levels using sensors such as a

heart rate monitor, oxygen sensor, temperature, and even blood pressure. Data collected from BAN systems could be used for pilot training, help improve efficiency, and for possible accident investigation.