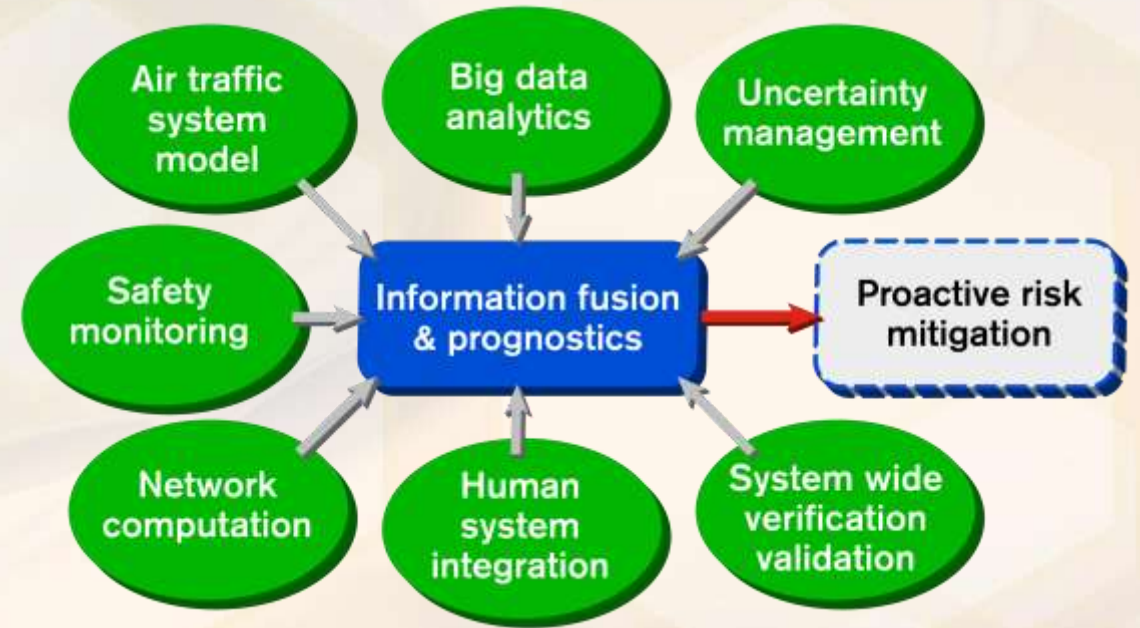


# Multidisciplinary team and research



- Diverse, multidisciplinary team that includes faculty in ASU's Ira A. Fulton Schools of Engineering and collaborators from Vanderbilt University, Southwest Research Institute and Optimal Synthesis Inc.
- Big data analysts, applied statisticians, image processors, psychologists, computer scientists, and structural engineers

Number of students supported (graduate and undergraduate students): **30**

Number of postdocs supported (including past and current): **9**

Number of journal articles published/accepted: **4** published / **8** under review

Number of conference papers/abstracts: **37**

Number of awards (best paper, poster, student award, etc.): **5**

- Best Theory Paper award PHM 2018

- SwRI Best Student Paper Award in Non-Deterministic Approaches AIAA Scitech

2019

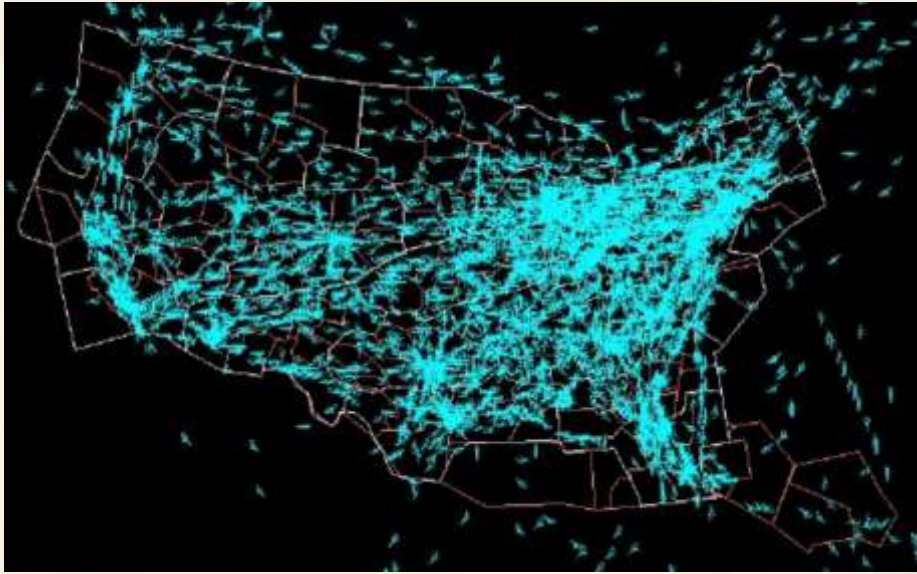
- Airport Cooperative Research Program (ACRP) Graduate Research Award 2018

- Best poster: PHM society 2018 Best poster award

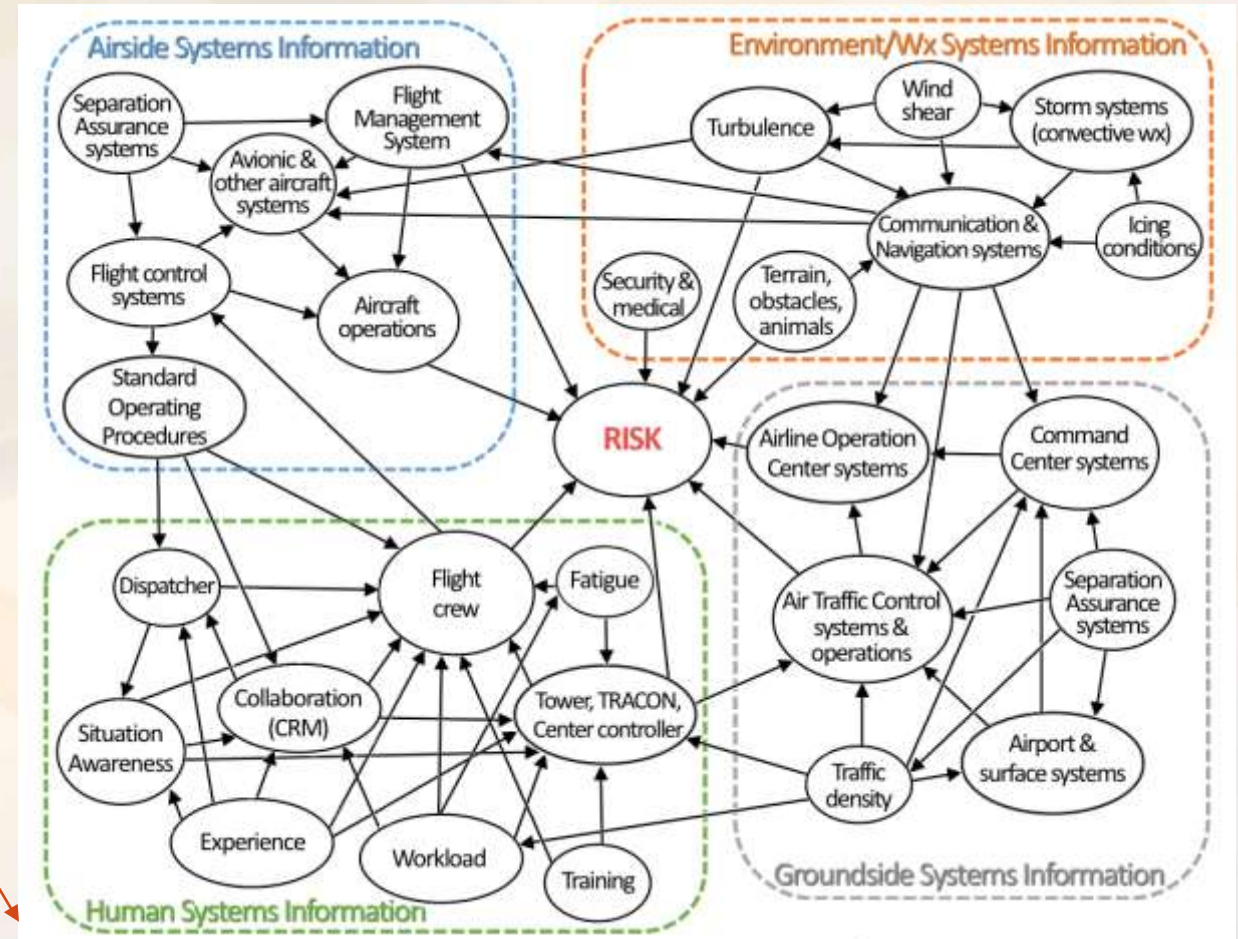
- Student award: several PHM society 2018/2019 Doctoral Symposium Award

Number of invited talks/presentations: **20**

# Information fusion: interplay of data and physics



- Integrate knowledge among multiple domains within the airspace system
- Explore complex system-of-systems with human-autonomy interaction
- Improve safety of air travel through multisystem simulations, multimodality monitoring, and multidisciplinary information fusion
- Develop extreme-scale data analytics and simulation methods to enhance real-time system-of-systems risk management





# Integrated education, training, and research



National Summer Transportation Institute



Fulton Undergraduate Research Initiative

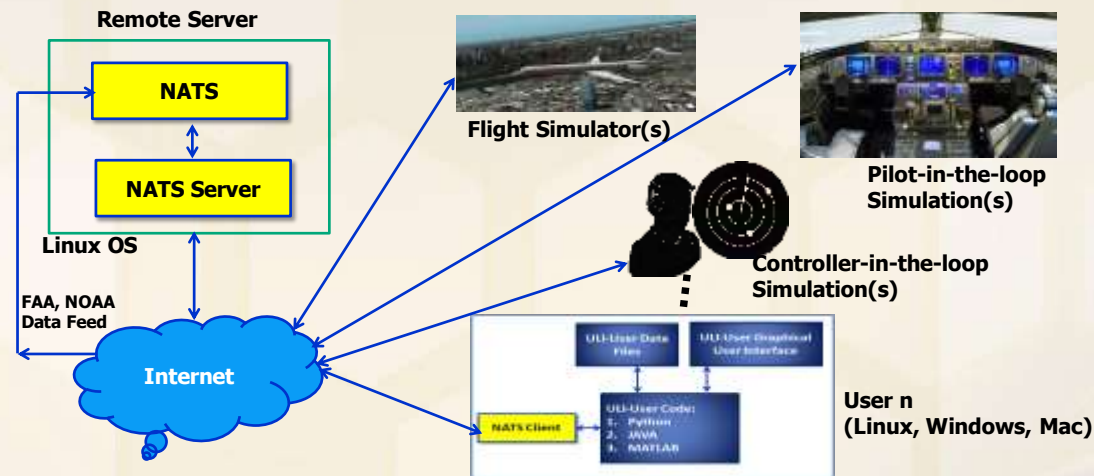


Air Traffic Management Degree Program

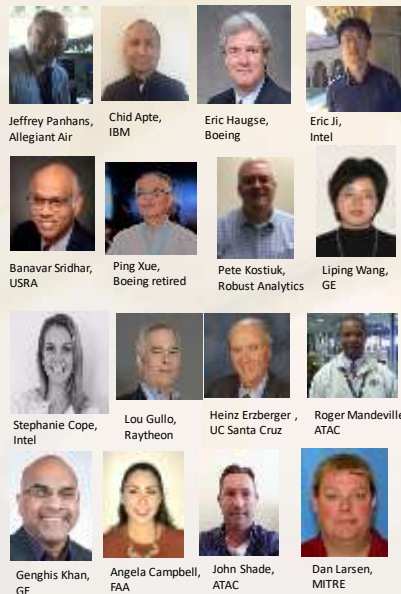


- Multi-level education integration: K-12 Education Outreach Program, Fulton Undergraduate Research Initiative, and graduate student training
- Interaction with actual pilot training and air traffic management program
- Demonstration and data collection with ASU simulator facilities
- Preparation of future engineers in aviation and aerospace industries

# Beyond University Leadership Initiative



Integrated simulation testbed



External Advisory Board

**NAME: Yongming Liu - Center for Complex System Safety (C2S2)**

<b>PROBLEM STATEMENT</b> <ul style="list-style-type: none"> <li>Current strategies for assessing integrity and safety of emergent and aging systems rely on rules-and monitoring-based decision making. There is a need for more robust and reliable <b>prediction-enabled</b> prognostics for enhanced safety assurance and risk mitigation.</li> <li>Two such system examples are <b>Unmanned aircraft Traffic Management</b> and the <b>US national gas pipeline</b> (which dates back to the early 20<sup>th</sup> century). Both can benefit from using predictive science as a means to limit risk, quantify uncertainty, and model/prevent casualty scenarios.</li> <li>Today, these <b>large-scale interdependent systems</b> lack effective means to project and manage risk, which leaves them vulnerable to the management of their environments.</li> </ul>	<b>CURRENT STATE &amp; APPROACH FORWARD</b> <ul style="list-style-type: none"> <li>The Center represents a paradigm shift, from rules- and inspection-based safety assurance to prognostics-based risk management based on a unique approach combining information fusion, probabilistic physics-based learning, and large network computing and communication to support decision-making process.</li> <li>Prognostics-based risk management is currently being applied to small-scale components, such as smart device batteries and motors in manufacturing.</li> <li>This Center shifts the focus to large scale, <b>system-wide, real-time decision making</b> (e.g., air traffic management, infrastructure networks, and many human-cyber-physical systems).</li> </ul>
<b>SIGNIFICANCE</b> <ul style="list-style-type: none"> <li>Prediction-enabled prognostics will <b>fundamentally impact system safety assurance by enabling proactive rather than reactive response</b>.</li> <li>Urban Air Mobility (UAM), the next big wave in the US economy, is a system that can benefit from predictive capability. It is estimated that UAM will reach one million flights per day in major populated cities (80% of US population) with a market size of more than \$70B in 5-10 years.</li> <li>Tragedies such as the natural gas explosions in Boston in September 2018 can be mitigated/prevented with enhanced prognostic capability. Estimates indicate each natural gas explosion causes \$4M in economic loss accompanied by potential loss of life, and are preventable when appropriately modeled.</li> </ul>	<b>DIFFERENTIATION</b> <ul style="list-style-type: none"> <li><b>Multi-disciplinary</b> – Unique center organization to cultivate non-traditional creative thinking which takes the advantage of the breadth and depth of faculty expertise and facilities related to UAV and robotics, energy, materials, aviation management, computing, and communication at ASU.</li> <li><b>Leadership</b> – Establish ASU's leadership for complex system safety assurance and Dr. Liu is currently leading a \$10M <b>NASA University Leadership Initiative</b> for the national airspace system on safety assurance.</li> <li><b>Synergistic</b> – Leverage existing education-orientated resources (e.g., simulators and drone testing space) and degree programs (e.g., aviation management) to contribute to a large-scale research enterprise with potential national impact.</li> </ul>

State-funded center for sustained development

- Development of simulation testbed to be used for future ATM research
- Wide dissemination of research outcomes to aviation community
  - an open-source prognostics and information fusion environment accessible to the community
- External Advisory Board that links the research with industry
- Sustainable development beyond ULI with various internal and external support