Using Aircraft Allocation and Fleet-Level Metrics to Analyze NASA's Subsonic Fixed Wing Emission Goals

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NASA's Subsonic Fixed Wing (SFW) Project places high importance on reducing fuel burn, nitrogen oxide (NO_X) emissions and noise exposure in future generations of aircraft. However, the SFW goals only incorporate individual aircraft performance and do not account for how fleet-level emissions will change with the introduction of new, more efficient aircraft. Furthermore, the environmental and economical impact of a new aircraft is not only a function of the aircraft's performance but also how the airline uses the new aircraft with other existing aircraft. The allocation of existing and future aircraft models over a network of 257 airports evaluates the fleet-level impact of new aircraft by measuring changes in fuel burn, NO_X emissions, local noise exposure, and direct operating costs (DOC) at the fleet-level. Examining these fleet-level metrics helps to determine if NASA's SFW goals are acceptable for meeting environmental goals established by various international organizations, such as ICAO and IATA, or whether attaining these goals requires more ambitious emission goals for future and current aircraft. Studies examined how fleet-level metrics evolve from 2005 to 2050 with the introduction of new aircraft concepts. Two specific studies concentrate on the year 2008 with a study on the impact of winglets, and on the year 2050 where additional studies explore fuel burn efficiency vs. passengers served tradeoffs. This allocation approach shows that while meeting future aggressive technology development goals for individual aircraft, the total fleet emissions will continue to increase as travel demand increases, but emissions per passenger mile will decrease. Furthermore, goals set forth for the year 2050 by IATA become unattainable without drastic decreases in passengers served, substantial improvements in fuel burn efficiency, or a substantially different introduction rate of new aircraft.

About The Presenter

Isaac Tetzloff is currently a PhD Student in the School of Aeronautics and Astronautics at Purdue University working in the Aerospace Systems group under advisor Professor William Crossley. He is funded through a NASA GSRP Fellowship, with NASA Langley Research Center mentor Dr. Natalia Alexandrov. Isaac is also working concurrently towards a Master of Science in Industrial Engineering with an emphasis in operations research. He completed his Master of Science in Aeronautics and Astronautics in May 2010, with his thesis entitled "An Allocation Approach to Investigate New Aircraft Concepts and Technologies on Fleet-Level Metrics". For his PhD work, he plans to expand his allocation tool and implement various decomposition approaches to increase the complexity of the model while keeping computation times low. Isaac has two undergraduate degrees from the Massachusetts Institute of Technology in Aerospace Engineering with Information Technology and in Management Science.