PURDUE
UNIVERSITY

School of Aeronautics and Astronautics
Special Seminar

Tip-to-Tail Integrated Aircraft Modeling

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Tuesday, December 7, 2010
1:30 p.m.
ARMS 1021

Abstract

A new subsystem-based approach, INtegrated Vehicle and ENergy Technology program (INVENT), to solve on demand aerospace vehicle energy management issues is being pursued by the Air Force Research Laboratory, Energy, Power and Thermal Division (AFRL/RZP). The goal of this approach is to create an "Energy Optimized Aircraft" that will maximize energy utilization for broad capabilities while minimizing complexity. On demand systems require attention to issues of system integration and energy management for optimal performance and capability. Integrated system modeling and simulation spans a broad range of technical expertise such as thermal management, power generation, power distribution and load management in a highly dynamic environment. Energy conversion is critical in the efficient design of on demand systems. For aircraft applications, the majority of energy conversion takes place in the gas turbine. Therefore, significant opportunities exist for optimizing this process especially consideration of auxiliary systems and how they interface with the hot gas engine sections. Gear boxes and starter/generators are key components of power generation leading to power distribution which is then connected to load management. Methods of storing and dissipating energy such as high-energy density batteries, super-capacitors and heat exchangers are also vital for on demand system optimization, which has regenerative energy capability. Underlying these system integration issues is the basic energy management issue of on demand highly dynamic thermal management. Finally from an experimental view, hardware in the loop (HIL) system integration optimization for energy management is being pursed. Initial results of recent in-house AFRL/RZP research will be present which is focused strongly on the development of high fidelity aircraft modeling and simulation capabilities. As a part of this initiative, AFRL has undertaken the development, integration and demonstration of a mission level tip-to-tail thermal model. The major components of the integrated model include the Air Vehicle System (AVS), the Fuel Thermal Management System, the engine models, and Power Thermal Management System (PTMS). The integrated model is then flown over a complete aircraft flight mission from ground idle thru take-off, climb, cruise, descent, landing and post-flight ground hold.

Bio

Mitch Wolff is Scientific Advisor for INVENT. He is an IPA on assignment from Wright State University. He has been in this position for the past two years and will continue for two more years then he will return to WSU as a professor of mechanical engineering.