ACRP Problem No. 12-02-09

Modeling Reduced Thrust Takeoffs in Standard Environmental Tools

ACRP Staff Comments: The proposed research would build on work previously completed or nearing completion under ACRP Project 02-03A, Measurement of Gaseous HAP Emissions from Idling Aircraft as a Function of Engine and Ambient Conditions and ACRP Project 02-27, Aircraft Taxi Noise Database for Airport Noise Modeling. The proposed research should also consider ACRP Project 02-37, Integrated Noise Model Accuracy for General Aviation Aircraft, which explores the potential for improving INM accuracy by modifying approach and departure profiles of GA aircraft. It appears to complement ACRP Project 12-02-08, Modeling Tailored Aircraft Arrivals in Standard Environmental Tools.

TRB Aviation Group Committees Comments: ENVIRONMENTAL IMPACTS OF AVIATION CMTE - Support. This should be expanded to include the Aviation Environmental Design Tool (AEDT), not just the Integrated Noise Model (INM). It is (and has been for a long time) a deficiency in our modeling capabilities and should be addressed. The funding should be increased to about $400,000 to properly make use of flight data recorder (FDR) and other radar information. If implemented, the result needs to recognize that the user will have no more information than that "reduced power takeoffs" are used; i.e., it shouldn't result in complicated modeling process requiring such things as reduced power thrust profiles.

Review Panel Comments: Recommended — The effort needs to be broadened to make sure the modeling process applies equally well to more than one aircraft company. The project review panel recommends merging this with Problem Statement 12-02-12, with 12-02-12 serving as the primary problem statement. Another alternative is to open the scope to additional engine and airframe manufacturers. If left as a stand-alone project, the budget is sufficient; if merged, the budget should be increased accordingly.

AOC Disposition: No funds allocated. The efforts associated with this problem statement were combined with ACRP Problem Statement 12-02-12, Improved Take-off Thrust Setting Estimates for Airport Emissions Inventories.
I. PROBLEM TITLE

Modeling Reduced Thrust Takeoffs in Standard Environmental Tools

II. RESEARCH PROBLEM STATEMENT

The FAA’s Integrated Noise Model (INM) relies on a full power takeoff thrust coefficients to model departures. However, operators use reduced thrust takeoff universally to reduce costs associated with engine wear. The typical implementation of reduced thrust is the Assumed Temperature Method. The operator calculates the takeoff thrust setting for a higher assumed temperature than ambient, and reduces the engine thrust to that allowed for that higher temperature. The SAE AIR-1845 thrust equation allows for this high temperature calculation. It may be possible to use these existing high temperature coefficients to approximate the operational reduced thrust takeoff condition. The basic coefficient model including the high temperature coefficients embodied in SAE AIR 1845 was validated for the Boeing fleet in previous NASA funded research work.

III. OBJECTIVE

The high temperature thrust coefficient model used in the INM is adapted for the performance envelope used in Assumed Temperature. Coefficient data is developed for Boeing aircraft in the INM fleet database and guidance is provided in handling variations in takeoff weight and runway length.

IV. RESEARCH PROPOSED

Use the INM to calculate assumed temperature takeoffs for selected Boeing aircraft and run comparisons of predicted performance using Boeing performance tools. Develop a simplified model of balanced field length for use in the INM method.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $150,000
Research Period: 12 months

VI. URGENCY AND PAYOFF POTENTIAL

Existing models do not reflect operators’ actual use of takeoff power. Only access to flight data from the operator or manufacturer can account for typical takeoff thrust settings. A simplified model based on operator behavior would improve this.

VII. RELATED RESEARCH

The SAE A-21 Committee (Aircraft Noise Measurement and Emissions Modeling) is investigating different methods to account for reduced thrust takeoff including the above proposal and General Thrust Coefficients (%N1C).

VIII. PERSON(S) DEVELOPING THE PROBLEM

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IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement was developed by David Forsyth with the consultation of Boeing Noise and Emissions.

X. DATE AND SUBMITTED BY

This problem was submitted by David Forsyth on March 3, 2011.

Submit to:

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