Project 037 CLEEN II System Level Assessment

Georgia Institute of Technology

Project Lead Investigator

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University Participants

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P.I.(s): Dr. Dimitri Mavris (PI), Dr. Jimmy Tai (Co-PI)
FAA Award Number: 13-C-AJFE-GIT-013
Period of Performance: August 31, 2017 – August 31, 2018

Project Funding Level

FAA funding was distributed at the following levels.

- Georgia Institute of Technology ($170,000).

The Georgia Institute of Technology has agreed to a total of $170,000 in matching funds. This total includes salaries for the project director, research engineers, graduate research assistants and computing, financial and administrative support, including meeting arrangements. The institute has also agreed to provide tuition remission for any students paid for by state funds.

Investigation Team

Georgia Institute of Technology
Principal Investigator: Dimitri Mavris
Co-Investigators: Christopher Perullo, Jimmy Tai
Fleet Modeling Technical Lead: Holger Pfaender

Project Overview

The objective of this research project is to support the FAA by independently modeling and assessing the technologies that will be developed under the CLEEN II program. This will involve direct coordination and data sharing with companies developing technologies under CLEEN II, in order to accurately model the environmental benefits of these technologies at the vehicle and fleet levels.

Georgia Tech (GT) was previously selected to perform all of the system level assessments for the CLEEN program under PARTNER Project 36 and ASCENT Project 10. As a result, Georgia Tech has a unique position from both a technical and programmatic standpoint to continue the system level assessments for CLEEN II. From a technical perspective, GT has significantly enhanced the Environmental Design Space (EDS) over the last 5 years to incorporate advanced, adaptive, and operational technologies targeting fuel burn, noise, and emissions. EDS was successfully applied to all CLEEN I contractor technologies including: GE open rotor, TAPS II combustor, FMS-Engine and FMS-Airframe; Pratt & Whitney geared fan; Boeing adaptive trailing edge and CMC nozzle; Honeywell hot section cooling and materials; and Rolls-Royce turbine cooling technologies. GT also gained significant experience in communicating system level modeling requirements to industry engineers and translating the impacts to fleet level fuel burn, noise, and emissions assessments. This broad

technical knowledge-base covering both detailed aircraft and engine design and high level benefits assessments puts GT in a unique position to assess CLEEN II technologies.

As the ultimate goal of this work is to conduct fleet level assessments for aircraft representative of future 'in-service' systems, GT will need to create system level EDS models using a combination of both CLEEN II and other public domain N+1 and N+2 technologies. The outcomes of the technology and fleet assumptions setting workshops conducted under ASCENT Project 10 will be heavily leveraged for this effort. Non-CLEEN II technologies for consideration along with potential future fleet scenarios will help to bound the impact of CLEEN II on future fleet fuel burn, emissions, and noise. In the first year, non-disclosure agreements have already been signed with all of the CLEEN II contractors.

Since the FAA will also be performing a portion of the EDS technology modeling work, EDS training has been provided to the FAA in 2016 under the ASCENT Project 10. The training has provided the requisite skill set required to use EDS.
In the prior year of this project, Georgia Tech began modeling activities with Aurora, Pratt and Whitney, and GE. This modeling process included validation of underlying EDS models, information and data exchange necessary to model the individual technologies, and related EDS modeling activities. In addition, Georgia Tech has assisted the FAA with in-house modeling of Delta/MDS and GE combustion technologies. This process has increased the FAA's use of FAA personnel for EDS system level assessment modeling.

This year has focused on modeling the GE MESTANG, Boeing Compact Nacelle, GE TAPS III, Boeing Structurally Efficient Wing, Honeywell Blade Outer Air Seal (BOAS) and UTAS zoned liner technologies.

Major Accomplishments

- GT has signed non-disclosure agreements with all CLEEN II contractors.
- The Delta/MDS modeling is complete.
- The Aurora modeling is complete.
- The modeling for GE FMS is completed, pending further updates to technology.
- The modeling for GE TAPS III is completed.
- The modeling framework for GE MESTANG is complete.
- The modeling for Boeing Compact Nacelle is complete.
- The data exchange and assumptions were defined for Honeywell Blade Outer Air Seal and Combustor.
- The discussions on the modeling process were held with all contractors.
- The modeling assumptions and framework were defined for UTAS zoned liner technology.

Publications

None

Outreach Efforts

None

Awards

None

Student Involvement

Siyuan Wu is a graduate student who has been assisting with modeling of UTAS noise technologies.

Plans for Next Period

Future work will focus on completing technology modeling and conducting preliminary fleet analysis assessments for presentation at the May 2019 Consortium.

This work will also support attendance at CLEEN consortium meetings and contractor preliminary and detailed design reviews to identify any updates required to technology models developed in prior years.

References

None