



## Project 037 CLEEN II System Level Assessment

### Georgia Institute of Technology

#### Project Lead Investigator

Dimitri Mavris (PI)  
Regents Professor  
School of Aerospace Engineering  
Georgia Institute of Technology  
Mail Stop 0150  
Atlanta, GA 30332-0150  
Phone: 404-894-1557  
Email: dimitri.mavris@ae.gatech.edu

#### University Participants

Georgia Institute of Technology

- P.I.(s): Dr. Dimitri Mavris (PI), Mr. Christopher Perullo (Co-PI), Dr. Jimmy Tai (Co-PI)
- FAA Award Number: 13-C-AJFE-GIT-013
- Period of Performance: September 1, 2015 – February 25, 2017

#### Project Funding Level

The project is funded at the following levels: Georgia Institute of Technology (\$200,000).

The Georgia Institute of Technology has agreed to a total of \$200,000 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 the 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  
Noise Modeling Technical Lead: Greg Busch

#### Project Overview

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 create system level EDS models using a combination of both CLEEN II and other public domain N+1 and N+2 technologies. 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.

Long term goals of this project include the vehicle and fleet level assessments of fuel burn, emissions, and noise benefits for the aircraft and engine technologies funded for development under CLEEN II. More specifically, the first period of performance for this work has sought to establish working relationships with each of the chosen CLEEN II contractors to identify system level modeling needs within EDS for each contractor. At the conclusion of this first period of performance, GT has system level modeling roadmaps in place for each contractor along with non-disclosure agreements (NDA) and working timelines to conduct the assessments for each contractor.

More specifically, this year has focused on in-depth interviews with the CLEEN II contractors and working with the FAA on using EDS to model specific CLEEN II technologies. GT has attended contractor kickoff meetings and has worked with awarded contractors to discuss proposed modeling approaches and working timelines for assessment. Now that GT understands the breadth and number of technologies to be assessed under CLEEN II, modeling and assessment roadmaps have been constructed for each CLEEN II contractor. These roadmaps include working schedules for data exchange between GT and each contractor and expected system assessment modeling start and end dates. Roadmaps are broken out by technology and will be used to plan out resources and modeling efforts for the remainder of the CLEEN II program. The roadmaps will also include descriptions of the technology modeling approaches for each CLEEN II technology and whether or not the underlying assessment models (independent of CLEEN II data) are leveraged from prior FAA work, must be newly developed under this work, or are from another effort such as a NASA funded project. GT and the FAA have also jointly identified who is responsible (GT or FAA) for the actual EDS modeling. At this stage GT and the FAA are beginning modeling efforts with two of the eight contractors. Additional information and details on this effort are proprietary and can be obtained through the FAA technical project manager for qualified personnel.

### **Major Accomplishments**

- GT has signed non-disclosure agreements with all CLEEN II contractors
- Modeling roadmaps established for all of the CLEEN II contractors
- Preliminary modeling activities underway with FAA
- Several working meetings with FAA to define modeling roadmaps and tutorials on using EDS to model technology.

### **Publications**

None.

### **Outreach Efforts**

None.

### **Awards**

None

### **Student Involvement**

None yet; students will be involved later in the period of performance once modeling work begins.

### **Plans for Next Period**

Per the modeling roadmaps, GT and the FAA will begin assessing the Aurora, GE, PW, UTAS, and Delta technologies.

### **References**

None