ASCENT Project 67

Impact of Fuel Heating on Combustion and Emissions

Purdue University

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Cost Share Partner: Purdue University

Objective:

This project will **characterize global and local impact of hot fuel injection** on the performance of aviation gas turbine combustion systems in high-OPR aircraft engines using extractive exhaust sampling and advanced optical and laser-based diagnostics. Conditions where the fuel temperature is near the critical temperature are of great interest.

Project Benefits:

This project will **advance low emissions gas turbines** to the next level of cycle efficiency by providing key insights needed to design combustion devices for operation with hot fuels.

Research Approach:

Purdue's COMRAD facility houses a high-pressure, liquid-fueled, swirl injector (GE TAPS) in an optically-accessible chamber that closely replicates engine conditions. An 81 kW fuel heater heats liquid fuel to temperatures up to 800F. To detect changes in combustion behavior, optical diagnostics and exhaust gas sampling are performed. Advanced laser diagnostics include planar laser-induced (PLIF) OH fluorescence for reaction zone imaging, particle imaging velocimetry, PLIF and Mie scattering for fuel vapor and liquid imaging, and coherent anti-Stokes Raman scattering (CARS) for temperature measurements.

Major Accomplishments (to date):

- Designed and built fuel heating system.
- Completed initial emissions sampling at two rig pressures and three fuel temperatures.
- Completed 10 kHz stereo-PIV measurements of near-injector flow-field for emissions conditions.
- Began OH-PLIF imaging study.

Future Work / Schedule:

- Complete OH-PLIF imaging study (Dec. 2021).
- Fuel PLIF and Mie scattering measurements of fuel spray (March 2022).
- CARS temperature measurements of reaction zone (June 2022).

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