ASCENT Project 056

Turbine Cooling through Additive Manufacturing

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Cost Share Partner: Pratt and Whitney

Objective:

Cooling of turbine hot section components is necessary for durability but contributes to increased fuel burn. This study investigates novel cooling designs enabled by additive manufacturing (AM), which are tested in a full-scale rotating turbine facility.

Project Benefits:

- Advanced microchannel technology could lead to lower cooling flow requirements, where even a 5% reduction in needed cooling air would decrease specific fuel consumption of the aircraft by >1%.
- This will be the first public comparison of cast vs AM blades at relevant rotating conditions.

Research Approach:

There are several thrusts to utilize advanced manufacturing to study optimal cooling designs:

- Cast turbine blades from a prior FAA CLEEN II program are CT scanned, replicated using additive manufacturing (AM), and tested in a rotating turbine at PSU to compare cast and AM blades.
- Multiple novel microchannel design concepts are tested in a stationary linear cascade at PSU.
- Best microchannel designs will be integrated into the rotating turbine blades and tested to determine quantitative reductions in cooling flow with advanced microchannel technology.

Major Accomplishments (to date):

- Vendors have fabricated AM turbine blades which have passed initial inspections.
- Linear cascade AM hardware was received and the aerodynamic flowfield was benchmarked in preparation for microchannel tests.

Future Work / Schedule:

- Machining of AM turbine blades for the first round of rotating tests is underway.
- Novel microchannel designs for the linear cascade will be fabricated and tested later this fall.

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