ASCENT Project 056

Turbine Cooling through Additive Manufacturing

The Pennsylvania State University

PI: Karen Thole / co-PI: Stephen Lynch

Research Staff: Scott Fishbone

Graduate Students: Justin Wolff, Nicholas Gailey

PM: Roxanna Moores

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

Research Approach:

- Cast turbine blades from a prior FAA CLEEN II program are scanned using CT technology, replicated using additive manufacturing (AM), and tested in a rotating turbine facility at Penn State at conditions relevant to aviation gas turbines.
- High resolution infrared images of blade temperatures and CT scans will be used to relate manufacturing variations to blade life variation.
- A number of novel microchannel design concepts are tested in a stationary linear cascade at Penn State for potential to reduce necessary cooling air.

Major Accomplishments (to date):

- Cast turbine blades were CT scanned and AM versions have recently been manufactured.
- Aerodynamics of the stationary turbine blade cascade were benchmarked. Novel microchannel designs were created and are being fabricated.

Future Work / Schedule:

- Additively manufactured turbine blades will be tested in the rotating turbine facility this summer and compared to cast airfoils.
- Novel microchannel designs will be tested in the stationary cascade, and a method to analyze microchannel performance in-situ will be validated.

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