Active Project (2014 - 2016)

A Novel Plasma-Based Compressor Stall Control System, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Modern aircraft gas turbine engines utilize highly loaded airfoils in both the compressor and turbine to maximize performance while minimizing weight, cost, and complexity. However, high airfoil loading increases the likelihood of flow separation at lower mass flow rates. Dielectric Barrier Discharge (DBD) plasma actuators have been shown to be a very promising technique for compressor stall control. DBD devices can either be installed directly on rotor/stator surfaces or the compressor endwalls to control rotor tip flow. A fundamental challenge in driving DBD actuators is providing appropriate electrical waveforms to the devices. Creare proposes the development of an innovative compressor stall system which enables (1) substantially higher produced thrust than existing DBD actuator systems, (2) implements a unique excitation waveform that optimizes thrust production by DBD actuators, and (3) provides the potential ability to control spike-type compressor stall through controlling compressor tip leakage flow.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: This technology supports NASA's mission to help improve the performance of commercial aviation through development of advanced gas turbine engine systems. The technology also has the potential for enabling improved gas turbine engine performance for applications as far reaching as Unmanned Aerial Vehicles (UAVs) proposed for extraterrestrial exploration. An efficient DBD actuator system can provide active stall control for compressor blading and low-pressure turbine blades. Implementation of a practical DBD actuator system, including the necessary driving and control electronics, should allow significantly improved low mass flow operation of turbine engines, as well as greatly increased operational envelopes.

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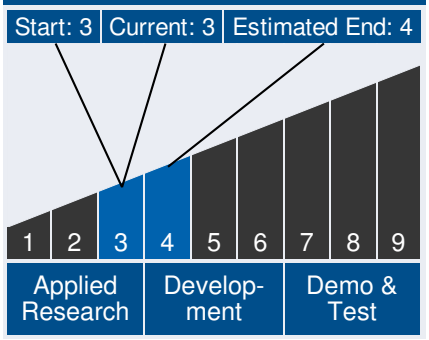
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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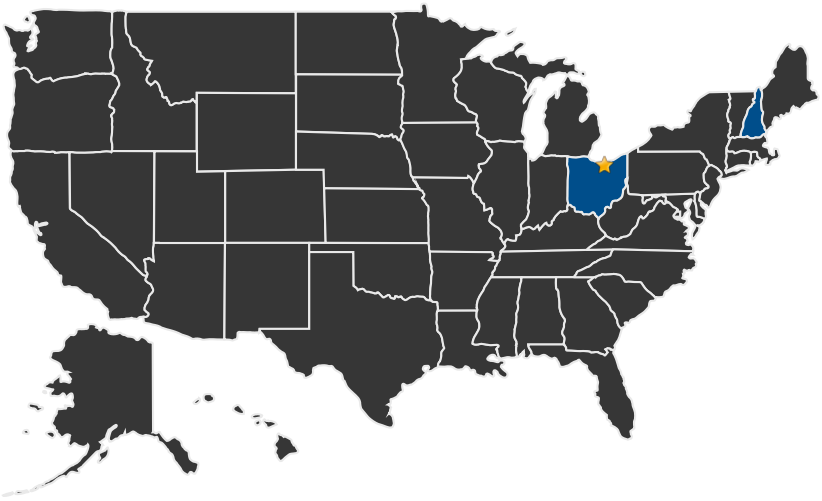
To the commercial space industry:

Potential Non-NASA Commercial Applications: In addition to military and NASA customers, a fully developed active flow control technology for turbomachinery may also prove useful in commercial applications in which separation phenomena are known to cause performance issues, including turbine engines (for both power generation and aircraft use) and aerial vehicles. The implementation of an effective and efficient compressor stall control system can greatly improve the operational envelopes for both existing retrofitted compressors, as well as enable new compressor designs with significantly lower stall limits.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Glenn Research Center

Other Organizations Performing Work:

- Creare, Inc. (Hanover, NH)
- Creare, LLC (Hanover, NH)

Management Team *(cont.)*

Project Manager:
- David Ashpis

Principal Investigator:
- Richard Kaszeta

Technology Areas

Secondary Technology Area:
Science Instruments, Observatories, and Sensor Systems (TA 8)
└ Remote Sensing Instruments and Sensors (TA 8.1)

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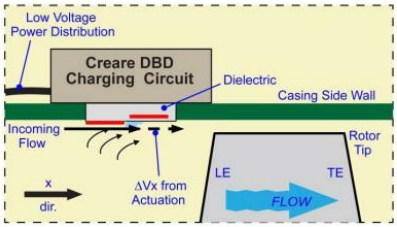
PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23069)

IMAGE GALLERY



A Novel Plasma-Based Compressor Stall Control System, Phase II

DETAILS FOR TECHNOLOGY 1

Technology Title

A Novel Plasma-Based Compressor Stall Control System

Potential Applications

This technology supports NASA's mission to help improve the performance of commercial aviation through development of advanced gas turbine engine systems. The technology also has the potential for enabling improved gas turbine engine performance for applications as far reaching as Unmanned Aerial Vehicles (UAVs) proposed for extraterrestrial exploration. An efficient DBD actuator system can provide active stall control for compressor blading and low-pressure turbine blades. Implementation of a practical DBD actuator system, including the necessary driving and control electronics, should allow significantly improved low mass flow operation of turbine engines, as well as greatly increased operational envelopes.