ACONIT: ACTUATORS FOR SURGE CONTROL IN GAS TURBINE

PROJECT OBJECTIVES

The objective of the ACONIT project is to design, manufacture and test actuators for flow control for an implantation in an aircraft engine. The actuators will fulfill aeronautics requirement in order to increase the Technology Readiness Level (TRL) in this domain. To do so, the first objective of the work is to improve the knowledge of the flow physics of an efficient flow control system by joint numerical and experimental analysis performed in a low speed, single stage axial compressor. The results of this analysis will be used to derive the fluidic specifications for a high TRL actuators and control system. These specifications will be the base for the design and manufacturing of amplified Piezo-electric actuator prototypes whose fluidic performance and operational performance in an environment with vibration and controlled level of temperature will be precisely evaluated before manufacturing final actuators that will be integrated in a full-scale engine test facility. Their performance will be evaluated in terms of Surge Margin Improvement as well as in terms of energy balance between the induced consumption and the machine performance improvements. The consortium grouped for carrying out this project is composed of CEDRAT TECHNOLOGIES (CTEC), two academic institutions (Bundeswehr University Munich and ENSAM) and a Research Center (ONERA). It groups skills ranging from internal flow analysis in turbomachinery to flow control or actuators design, manufacturing, and characterization.

The objective is to develop 8 PJA that can provide a sonic jet with a mass flow of 30 g/s for each one. The upstream pressure needs to be defined whereas the downstream pressure is 0.7 bar.

Fig. 1: Overview of the aircraft engine where PJA will be integrated.

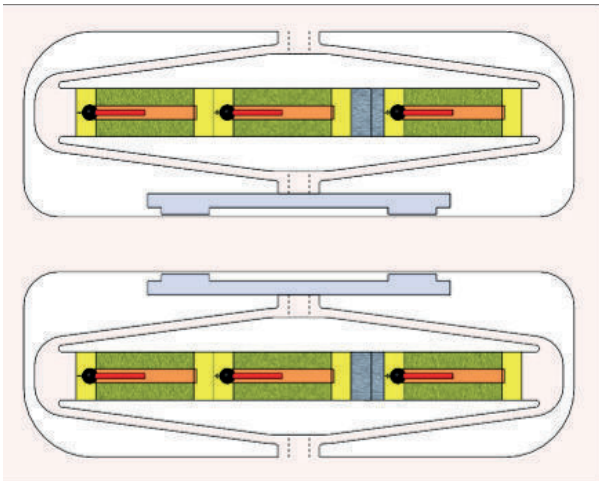

Fig. 2: Overview of the first PJA prototype design

INNOVATION

Previous projects have already studied and designed AFC solutions. We can mention VIPER and GUDGET which focused on the development of a Pulsed Jet Actuator (PJA), an actuator with non-zero mass net flux; and ASPIC or SynJet3C, whose target was a Synthetic Jet Actuator (SJA) based on Amplified Piezo Actuators (APA®) of large dimensions.

In ACONIT project, the Active Flow Control (AFC) solutions would not be positioned within an aircraft wing but in an aircraft engine. This new implementation is creating additional constraints, the two main are vibrations and temperature. Indeed, the PJA designed in ACONIT should be able to operate simultaneously with engine vibrations and with 150 °C pressurized air supply.

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CTEC CONTRIBUTION IN THE PROJECT

In the ACONIT project CTEC oversees:

- Design of a new PJA prototype following requirements needed for aircraft engine integration,
- Development of a new generations of APA® that can operate under 150 °C,
- Manufacturing and tests of the prototype in vibrations and high temperature conditions,
- Optimize the prototype and produce over twenty PJA for integration in the full-scale engine for overall testing,
- Produce the associated drive electronics.

CTEC will use heritage from the former VIPER and GUDGET projects using PJA, also developed for aircraft application. The general principle of such a flow control actuator is to inject a high-speed pulsed air flow on the air foil surface, through slots or holes. The interaction of this secondary flow aims at improving the aerodynamic performance of the aircraft.

PARTNERS

ENSAM: Coordinator

CEDRAT TECHNOLOGIES

ONERA

UniBwM

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