

VALVE HIGH PERFORMANCES FOR FLOW CONTROL SEPARATION IN AIRCRAFTS

PROJECT OBJECTIVE

The VIPER (Valve high PERformances for flow control separation in aircraft) Cleansky project aims at developing, manufacturing and testing piezoelectric-based high speed valves to accurately control the air flow (Active Flow Control Actuators) on transport and business aircrafts. The objective is to delay the separation of the boundary layer in flows over airfoils which results in drag reduction.

This Cleansky project is under the SFWA (Smart Fixed Wing Aircraft) ITD (Integrated Technology Demonstrator). The project is coordinated by Cedrat Technologies and performed with the help of Onera DMS, acting as subcontractor and Fraunhofer ENAS, acting as topic manager.

Cedrat Technologies (CTEC) & Onera DMS have been working together for over 4 years in a close partnership over high-performance pulsed jets valves based on APA® (Amplified piezoelectric Actuators). The main advantages of using piezoelectric technology for this type of valves lie in the controllability and fast-response time allowed.

The targeted performances of the valve (ejection speed and mass flow) are currently world records:

- Air exit velocity of 340m/s
- Air linear mass flow of 425 g/s/m
- Actuation frequency of 500Hz

The duration of the VIPER project is 42 months and it started on 1st of November 2012 (ending on 31st of December 2015).

DESCRIPTION OF WORK

This customized APA® integrates a CTEC designed Eddy Current Sensor (ECS) for a direct, contactless and extremely precise measurement of the shell deformation (Fig 1).

Other technological solutions to reach the highest possible bandwidth include CTEC's SA75D high power Switching Power Amplifier (dedicated to piezo actuators) completed with signal pre-shaping adapted to fast valve application (Fig 2).

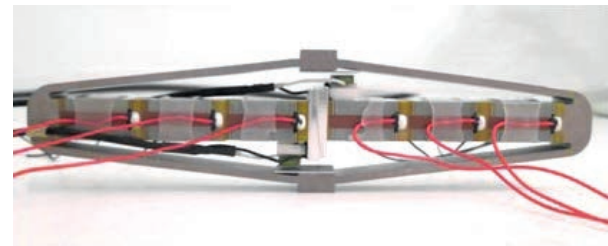


Fig1: APA® actuator integrating two ECS sensors



Fig2: APA® CFRP actuator driven by CTEC's SA75D high power amplifier

As of today, one VIPER fast Active Flow Control valve has been designed and manufactured (Fig 3).

It reproduces an 80mm wide wing section (leading edge), with a slit ejecting the pulsed compressed air. Its functionality was tested by CTEC and tests at ONERA DMS are ongoing to assess the achieved pulsed jet performances (speed, mass flow), with complete results expected middle of 2016.

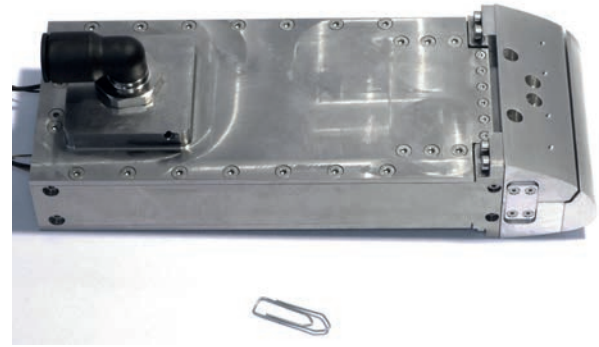


Fig3: VIPER valve assembled

EXPECTED OUTCOMES

The reduced weight and the high dynamic capabilities of the piezo actuator in VIPER associated to high power and efficient electronics add a real value for other embedded applications such as:

- Active flaps in helicopter blades for noise reduction
- Optical stabilization in embedded cameras
- Active tunable antennas in telecom satellites
- Active mirrors in space astronomy
- Portable dynamic shakers

The VIPER valve concept can be used for various fluidic applications where high flow and fast actuation is required.

These innovative fast piezoelectric valves can also be used for synthetic jets (no air supply required), a topic that is currently investigated through the ASPIC project.