PhD project proposal

Power Electronics Supply for P*lasma Actuators to Enable Closed Loop* Air *Flow control in Aircraft Applications*

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The more electric aircraft follows the technological trend in modern aerospace industry to increasingly use electrical power on-board in place of mechanical, hydraulic, and pneumatic power to drive aircraft subsystems such as flight surface actuators, flight control, passenger entertainment, etc. The higher use of electrical power presents significant advantages such as optimization of performance and life cycle cost of the aircraft, reduction of the fuel consumption, reduction of weight and size of the system equipment as well as the potential for improved condition monitoring and maintenance cycles. This new approach to aircraft design it is in line with the Advisory Council for Aviation Research in Europe (ACARE) ambitious target on emissions. In fact to address key issues indicated in the report by the Intergovernmental Panel on Climate Change (IPCC), the next generation of aircraft must be based on radically different technologies.

Among such innovative technologies for aircraft aerodynamics, active flow control for turbulent skin-friction reduction is most promising for a design of future green aircraft. By integrating active flow control strategies over the aircraft surface, for example, it is possible to reduce the skin-friction drag more than 10%, or 5% net aircraft drag reduction. Similar amount reduction in fuel burn and CO2 emissions from aircraft can be expected through this technology, which also brings flow noise reductions.

In particular, a research on closed-loop control of unsteady flow separation by using plasma actuators has been already proposed within this scheme in order to enable a full and efficient airflow regulation over an aerofoil. The plasma actuator needs to be supplied by an AC voltage, which will be used as control input so that the generated Lorentz force would affect the turbulent flow dynamics.

Therefore the core and vital part of this project is the design of a suitable and innovative power converter able to supply the required power to the plasma actuator and also capable of being controlled adaptively in a closed-loop to meet the system operating requirement. Plasma actuators require high AC voltages (up to 50kV) at low currents, so their rated power is in the order of few kW. In order to create a feasible technology to be installed on-board an aircraft, the power supply needs to be very small and very light. No power electronics supply of this kind and at this rating has ever been investigated before.

This project is characterised by a multidisciplinary approach since it ranges from fluid mechanics, modelling and numerical methods for partial differential equations to control theory and power electronics.