Surface plasma actuators are electromechanical convertors used particularly in the field of flow control. These systems are recognized for their efficiency in imposing localized periodic fluidic perturbation, using the ionic wind they produce. This technology presents a very low electromechanical efficiency (less than 1%), a significant part of the electrical power being dissipated by conduction and radiation in the dielectric material between the conductive electrodes that compose the geometry of the actuator. The conversion of electrical energy to thermal energy is considered as a lost in flow control applications. The idea of using these 'losses' as a thermal source in other types of applications emerged a few years ago. In particular, the opportunity to use these actuators as a de-icing or anti-icing system in aeronautical applications is currently being studied especially for Unmanned Aerial Vehicles.

The objective of the internship proposed by the EFD team of the Institut PPRIME is to experimentally study plasma actuators with porous ceramic dielectric. The idea is to determine the minimal conditions under which a plasma can be generated within the microcavities of this type of dielectric, to identify the main electrical characteristics of the constructed actuators and to visualize the ionization phenomenon by ultra-fast non-intrusive imaging techniques (intensified CCD camera measurements). Different porosities will be studied (from 9 to 100 μm) and the influence of open or non-open surface will also be studied parametrically. The measurements to be performed are mainly electrical and consist in measuring ignition voltages of the order of kV and to precisely measure currents of the order of mA. Complementary tests will be carried out in altitude chamber in order to evaluate the operation and the electrical characteristics of these actuators during an operation in temperature condition such as met in real flight condition (t~45°C). These measurements are an essential preliminary step to determine if the use of this type of material can be envisaged in deicing system. Indeed, the basic assumption is that the generation of plasma discharge within the pores of the dielectric may lead to a significant increase of the temperature rise within the dielectric, this increasing further the performance of the actuator in deicing application.

The internship will be completed within the EFD team of the FTC department. The student will be hosted in the H2 building on the Futuroscope site. The ElectroFluidoDynamic research group of PPRIME Institute is specialized in experimental approaches combining electrostatics engineering and fluid mechanics to explore new perspectives in a wide range of research areas by exploiting the electromechanical transfer produced by a plasma discharge in interaction with a neutral gas.