A crucial aspect for supersonic flights is the strong shock wave that forms in front of the air vehicle. By modifying the supersonic incoming flow, one can adjust this wave -which is the most contributing factor of the drag coefficient of an aircraft- and have consequently positive effects on the fuel consumption and on the noise produced by the object due to the sonic boom. Lately, plasma associated flow control actuators have been in the center of flow control research and especially of supersonic applications.

The Plasma Virtual Aerodynamic Spike (PVAS) is a plasma spike (or a plasma column), created by a femto-second laser (or another source) and focused in front of a bulk body. The energy disposition due to the plasma plays here the principal role in modifying the propagation and intensity of the shock wave. In [1], simulations of a bulk body (nose of an aircraft) traveling in supersonic speed (Mach 3), show that a high density plasma column of a small radius (on the order of 10s of micrometers) can lead to a significant reduction of the body’s drag coefficient. The plasma column generated by the femto-second laser must be maintained and energized. One of the methods that have been proposed for this purpose is a to launch a surface wave propagating at the plasma-air interface along the plasma column.

Numerical simulations of this complex and multi-scale/multi-physic problem could provide data for a better understanding and optimization of the phenomenon as well as food for thought to re-initialize the supersonic aviation programs.

In this paper, a simplified plasma model based on the effective field and diffusion approximations has been coupled with a FDTD solver for the Maxwell equations. Axi-symmetric 2D simulations prove the existence of the surface waves and their ability to treat the plasma column. The ADI-FDTD method was implemented too, showing its efficiency and its capability to perform accurate simulations in less time, especially regarding microwave breakdown under atmospheric pressure.