IAF SPACE PROPULSION SYMPOSIUM (C4)
Hypersonic Air-breathing and Combined Cycle Propulsion, and Hypersonic Vehicle (7)

Author: Dr. Pietro Roncioni
CIRA Italian Aerospace Research Centre, Italy

Dr. Marco Marini
CIRA Italian Aerospace Research Centre, Italy
Dr. Oscar Gori
Politecnico di Torino, Italy
Dr. Roberta Fusaro
Politecnico di Torino, Italy
Prof. Nicole Viola
Politecnico di Torino, Italy

# AERODYNAMIC CHARACTERIZATION AND AERODATABASE DEVELOPMENT OF STRATOFLY MR3 HYPERSONIC VEHICLE

**Abstract**

The H2020 STRATOFLY Project is a highly-multidisciplinary project and is the last one of a series of projects co-funded by the European Commission in the last fifteen years, combining technological and operative issues for hypersonic civil aircrafts and aiming to study the feasibility of high-speed passenger stratospheric flight. Technological, environmental, operational and economic factors, that allow the global sustainability of new air space's exploitation, are considered, drastically reducing transfer time (i.e. antipodal flights in less than two to four hours), emissions and noise, and guaranteeing the required safety levels. The main project objectives are to refine the design and the concept of operations of the LAPCAT-II MR2.4 vehicle, and to reach the ambitious goal of TRL=6 by 2035 for the concept, considering that the crucial technologies of STRATOFLY MR3 vehicle may represent a step forward to reach the goal of future reusable space transportation systems. In this framework, a detailed aerodynamic characterization of the hypersonic cruiser configuration was conducted targeting the generation of an aerodynamic database covering all flight speed regimes (from Mach 0.3 to Mach 8). In addition to the wide range of flight conditions to be considered, STRATOFLY MR3 presents a highly integrated structure which is characterized by a complex waverider configuration with dorsal mounted propulsive subsystem. Therefore, even at conceptual design stage, the aerodynamic characterization of the configuration has been achieved by means of engineering tools coupled with low-fidelity CFD simulations to precisely describe external vehicle layout, the contribution of the internal vehicle propulsive flowpath and eventually of all the flight control surfaces. The understanding of the contribution of the flight control surfaces and consequently their correct sizing are crucial to properly assess the trim-ability and the fly-ability of the vehicle concept. The results of this activity will be shown in terms of global aerodynamic coefficients, control surfaces effects, stability derivatives and trim analysis. In addition, a comparison of the results coming from the engineering methods and CFD will be included. Eventually, the paper will highlight the crucial role of the developed aerodynamic database as a unique and reliable base for mission analysis and trajectory simulation.