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Study and Simulation of the Thrust Vectoring in Supersonic Nozzles

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Abstract : In recent years, significant progress has been accomplished in the field of aerospace propulsion and propulsion systems. These developments are associated with efforts to enhance the accuracy of the analysis of aerothermodynamic phenomena in the engine. This applies in particular to the flow in the nozzles used. One of the most remarkable processes in this field is thrust vectoring by means of devices able to orientate the thrust vector and control the deflection of the exit jet in the engine nozzle. In the study proposed, we are interested in the fluid thrust vectoring using a second injection in the nozzle divergence. This fluid injection causes complex phenomena, such as boundary layer separation, which generates a shock wave in the primary jet upstream of the fluid interacting zone (primary jet - secondary jet). This will cause the deviation of the main flow, and therefore of the thrust vector with reference to the axis nozzle. In the modeling of the fluidic thrust vector, various parameters can be used. The Mach number of the primary jet and the injected fluid, the total pressures ratio, the injection rate, the thickness of the upstream boundary layer, the injector position in the divergent part, and the nozzle geometry are decisive factors in this type of phenomenon. The complexity of the latter challenges researchers to understand the physical phenomena of the turbulent boundary layer encountered in supersonic nozzles, as well as the calculation of its thickness and the friction forces induced on the walls. The present study aims to numerically simulate the thrust vectoring by secondary injection using the ANSYS-FLUENT, then to analyze and validate the results and the performances obtained (angle of deflection, efficiency...), which will then be compared with those obtained by other authors.

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