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Abstract #XXX *(to be filled by the organizers)*
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Title

Low-frequency shock oscillations in supersonic planar nozzles

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Abstract

The study of shock interactions in the presence of a fixed or mobile wall is of great importance in aeronautical and space applications. This field of research encompasses all supersonic aviation and is particularly relevant to flows in supersonic air intakes, nozzle flows with separation, and external flows along the fuselage. When a spacecraft travels at very high Mach numbers, shock waves are formed and give rise to complex flows such as shock wave/turbulent boundary layer interactions (SWBLI). These interactions have a significant impact on aerodynamic and thermodynamic design, leading to issues such as increased internal machine losses, increased heat transfer rates and thermal and structural fatigue, as well as flow unsteadiness and broadband noise emission.

In the present study, we look at the effects of wall temperature in nozzle flows by means of both wall-resolved/modeled three dimensional LES simulations. The focus is on the changes in shock structure and the role of these change in controlling the shock movement.

The study examines, as well, the effects of different wall conditions, such as cooling, heating and adiabatic conditions, on the nozzle's performance. Special emphasis is given to the examination of the shock's low-frequency oscillations and the side loads generated. Particular effort has been made to understand the response of the low frequency phenomena to cooling/heating the walls. Consistently with the previous numerical simulations,wall cooling leads to a considerable reduction of the interaction scales and the size of the separation bubble, whereas the opposite holds for wall heating. The multiple premultiplied spectra presented show a small influence of cooling/heating the walls on the low-frequency shock motion, mainly a drop in the energy of very low-frequency phenomena representing the shock motion are observed. The energy drop is more pronounced in the cooled case where the span of the oscillation is less important. However, the decrease in the pan oscillation is caused by the modification of the shock structure resulting from the cooling/heating. Interestingly, more pronounced λ-shock is observed when cooling/heating the

walls with a larger Mach stem compared to the adiabatic case. This configuration promotes stability because the slip-lines are more widely spaced and mostly parallel.