Investigations the Influence of One and Two-sided Jet Deflector on Acoustic Environment of Multi-nozzle Launch Vehicle at Lift-off

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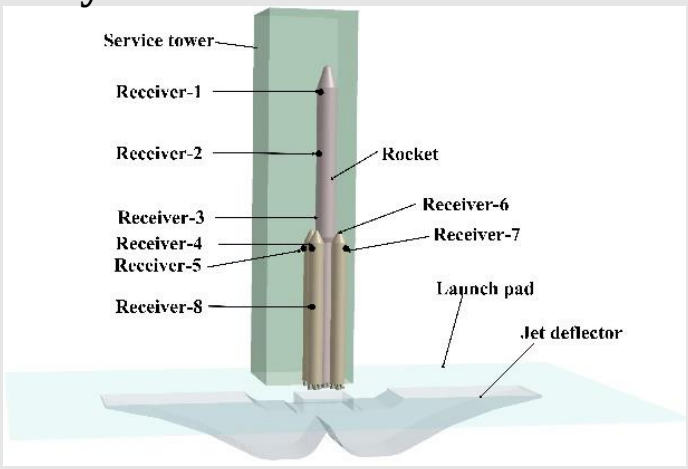
Introduction

The high-temperature and high-pressure gas in the combustion chamber discharges the hot high-speed gas through the Laval nozzle and interacts with the stationary air to induce strong jet noise during the ignition lift-off stage of Multi-nozzle Launch Vehicle. The sound wave radiated by the acoustic source has a very high acoustic load on the rocket body of the launch vehicle, which has an impact on the astronauts and the precision instrument equipment in the cabin section, which seriously affects the launch safety of the rocket. Therefore, it is of great significance to correctly predict the rocket lift-off noise to improve the acoustic environment and to improve the design of the jet deflector.

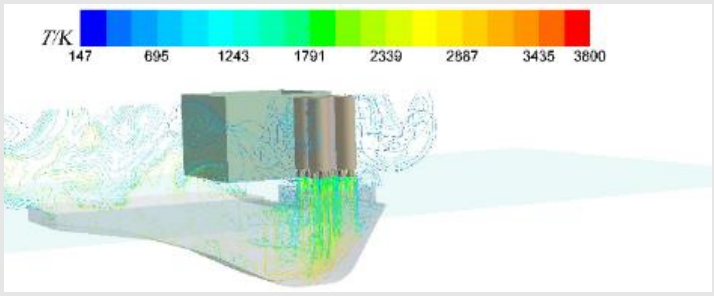
Physical models



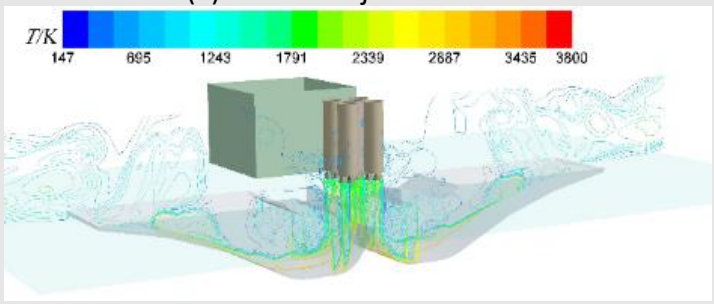
The schematic diagram of the gas impacting jet deflector

The Mach number at the nozzle outlet is 3.93. the external boundary of the calculation domain is the atmospheric environment.

Flow field

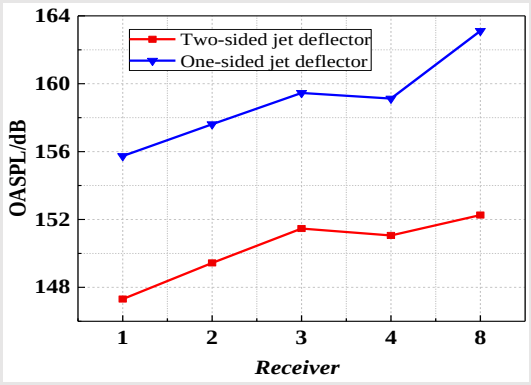


(a)One-sided jet deflector

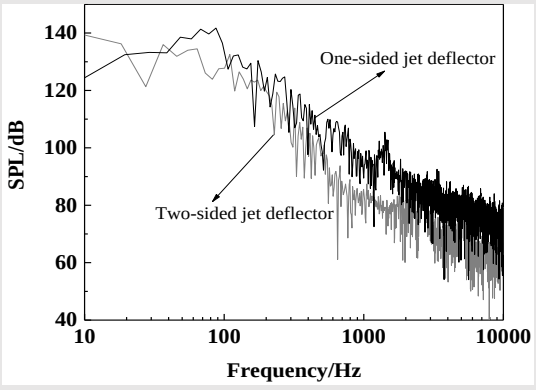


(b) Two-sided jet deflector

Temperature contours with the different jet deflector



OASPL variation of receivers



Spectral variation of Receiver-1

Conclusions

- At the outlet of the jet deflector, the one-sided jet deflector will cause more expansion waves, as well as more fluctuations.
- Compared with the two-sided jet deflector, the one-sided jet deflector increases large-scale turbulent noise sources and the fine-scale turbulent noise sources