

Ph.D. Thesis

Acoustics of supersonic impinging jets

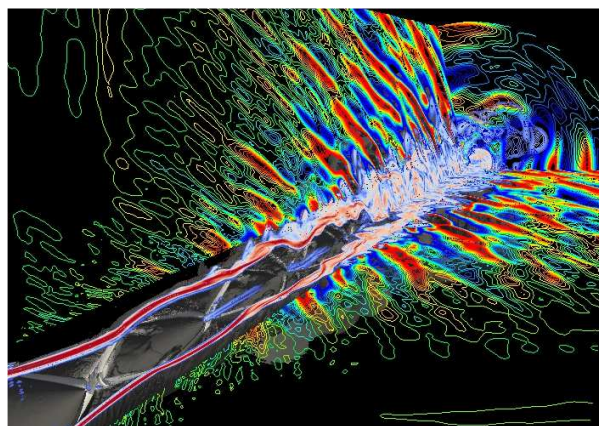
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Propulsive jets generated by booster rockets of space launchers are characterized by high stagnation pressure and temperature. Such jets are known to radiate strong acoustic waves, which are assumed to be dominated by Mach waves [1]. Our research team has developed an original approach for simulating turbulent flows by large-eddy simulation, using a closure based on an explicit relaxation filtering [2]. In combination with this approach, a specific shock-capturing procedure is used to take into account discontinuities in the turbulent flow as well as in the near acoustic radiated field. The aim of the present work is to study installation effects, and more specifically the role of deflectors found in launch pads. This work will be performed in collaboration with the French and Japanese space agency (CNES & JAXA).

[1] de Cacqueray, N., Bogey, C. & Bailly, C., 2011, Investigation of a high-Mach-number overexpanded jet using large-eddy simulation, *AIAA Journal*, 49(10), 2171-2182.

[2] Bogey, C. & Bailly, C., 2009, Turbulence and energy budget in a self-preserving round jet: direct evaluation using large-eddy simulation, *Journal of Fluid Mechanics*, 627, 129-160

[3] Bogey, C., de Cacqueray, N. & Bailly, C., 2009, A shock-capturing methodology based on adaptative spatial filtering for high-order non-linear computations, *Journal of Computational Physics*, 228(5), 1447-1465.



Large eddy simulation of an overexpanded supersonic jet [1]. Snapshot of density gradient norm in gray scale, azimuthal vorticity in color scale in the jet, and fluctuating pressure in color scale outside the jet. Pressure levels from -8000 to 8000 Pa (color bar from -5000 to 5000 Pa). Reynolds number of 100000, exit Mach number of 3.30, static pressure and temperature of 0.5×10^5 Pa and of 360 K.