# Study of the contribution of noise sources during rocket take-off using LES

M. S. Escartí-Guillem[a,b], S. Hoyas[b] and L. M. Garcia-Raffi[b]

The acoustic load generated during the launch of space vehicles is one of the most severe dynamic environments a satellite must withstand. This acoustic environment causes a severe acoustic and vibration load on the payload, endangering the mission and potentially resulting in financial losses. Hence, predicting and mitigating acoustic levels during lift-off is critical in the design since it enhances the reliability of the launcher while also increasing payload comfort. The exhaust gas jet of the rocket engine and its collision with the launchpad produce severe acoustic waves, which are the primary sound sources during lift-off. This work aims to analyse the noise contribution of the different sources generated during lift-off. As the measurement during the launch is unfeasible due to the hostile environment, the sound generation and propagation were studied using dedicated computational fluid dynamics, CFD. The CFD model is a Large Eddy Simulation, efficiently designed to run on graphics processing units, GPU. This model has shown excellent agreement with experimental data at a low computational cost. First, the noise of the free jet is analysed with a simulation of the rocket without any other surface in the domain. Then, different simulations were prepared by successively introducing the take-off platform surfaces: the platform floor without deflector, the plume deflector, and the service tower. The main shock waves have been identified to assess noise generation, and the evolution of the generated sound pressure has been assessed. Moreover, the sound pressure level, SPL, at the fairing surface has been assessed to understand the impact of the noise contribution. These results provide insight into the phenomena that occur during a rocket lift-off.

[a] COMET Ingenieria, C/Convento Carmelitas n2, 46010, Valencia, Spain

[b] Instituto Univeristario de Matema`tica Pura y Aplicada, Universitat Politècnica de València, Camino de Vera s/n, 46022, Valencia, Spain