Scaling metrics for accurate prediction of rocket noise.

Gregory Mack & C. E. Tinney
The University of Texas at Austin
Aerospace Engineering & Engineering Mechanics, Austin, Texas, 78712.
email: gregory.mack@utexas.edu, cetinney@utexas.edu
website: http://www.ae.utexas.edu/facultysites/tinney/

Rocket engines generate strong vibro-acoustic loads during start-up on the rocket itself and its sensitive components. This can result in damage to certain function groups or in the worst case, structural failure of the whole launch vehicle. For these reasons, detailed investigations of the start-up process are extremely important. Using sub-scale rocket nozzles which provide similar fluid flow phenomena as that of full-scale nozzle, allow for the running of multiple test setups under various conditions. Two different sizes of sub-scale nozzles were analyzed. The smaller one was used in a further step to study effects caused by clustered rocket nozzles. Arrangements of 3 and 4 rocket nozzles were investigated with and without the presence of one solid rocket booster mock-up on the side. The 3-nozzle-configuration represents the Space Shuttle Main Engine SSME and the 4-nozzle configuration stands for the coming Space Launch System SLS. The present work is focused on the development of reliable predictions of vibro-acoustic loads by rocket engines and the investigation of the different scaling-laws between these different setups. Thus, the influence of various parameters can be demonstrated to then apply to any scale.