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Computational aeroacoustics of turbulent high-speed jets[1]

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Despite significant scientific investigation, jet noise remains a large component of the overall noise generated by supersonic aircraft. Experiments show that alterations to nozzle geometry, such as the addition of chevrons to the nozzle lip, can significantly reduce jet noise. In this talk, we assess unstructured large eddy simulation as a tool for predicting and understanding the aeroacoustic effects of complex geometry upon supersonic jets. Body-fitted, adaptive meshes are used to simulate the flow inside, around and through complicated nozzles, and results are validated against experimental measurements. High-fidelity simulations utilizing as many as one million processors simultaneously will be discussed, allowing for a detailed description of interactions between turbulence, shocks, and acoustics. This includes observations of the phenomenon of "crackle" noise in heated supersonic jets. We will briefly discuss challenges met and overcome along this frontier of com putational science, and describe how information extracted from the high-fidelity simulations can be used to construct accurate reduced-order models useful for aeroacoustic design.

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