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Harnessing Exascale Platforms to Predict Shock-Wave / Boundary-Layer Interaction[1] JONATHAN POGGIE, Purdue University — Separated shock-wave / boundary-layer interactions occur in a broad flight regime, from transonic commercial aircraft to hypersonic space-access vehicles. These interactions tend to be intensely unsteady, with frequency content from fine-grained turbulence to low-frequency (~ 10 Hz) separation bubble breathing. The presence of this unsteadiness can cause problems with flight control and structural fatigue on aircraft. Simulation of this important phenomenon is extremely challenging because of the need to capture such a broad range of scales. Identification of the physical mechanisms underlying the unsteadiness may help guide the development of simplified models that capture the essential features of the interactions. To this end, our research group has been investigating separated compression ramp flows, and studied their selective response to disturbances in the incoming turbulent boundary layer. In implicit large-eddy simulations, conditional averaging identified a perturbation velocity profile associated with separation motion, and forcing in the upstream boundary layer with this particular form was found to drive large-scale separation unsteadiness downstream.

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Jonathan Poggie
Purdue University

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