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Structure of hypersonic turbulent spot evolution.[1] HEMANTH GOPARAJU, DATTA GAITONDE, Ohio State Univ - Columbus — Boundary layer transition subjects hypersonic flight vehicles to strong localized increases in skin friction, wall heat transfer and fatigue due to acoustic loading. These effects are more pronounced in the late stages of transition, which are characterized by turbulent spots. The underlying physics of these spots is different from those in low Mach number regimes due to the existence of acoustic instabilities. To understand the role of these instabilities, high-fidelity simulations are performed with an isolated turbulent spot triggered on a flat plate at Mach 6. Momentum potential theory is used to examine the interplay of vortical, entropic and acoustic components during the spot evolution. The vortical component is found to be predominant in the lift-up structures and in the calmed region. In the turbulent core, the entropic component reveals cell-like structures around the critical layer along with a radiating acoustic component; while closer to the wall, the latter component exhibits roller-like structures, a signature of Mack modes. The role of these additional mechanisms may provide clues on potentially adapting control strategies developed for lower-speed flows.

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Hemanth Goparaju
Ohio State Univ - Columbus

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