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Lenght and Time Scale Comparison in Different Transitional SBLIs

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The global organisation in terms of spatial and temporal dynamics of two transitional shock wave boundary layer interactions (TrSBLIs) are presented in this paper. The geometries under investigation are an incident-reflecting flat plate and a compression corner at Mach number of 1.65.

The two shock systems are studied numerically, and all computations are performed using ONERA's FLU3M solver with second-order accuracy both in time and space. We leverage Large-Eddy Simulations in order to carry out long-time computations such that several cycles of the low-frequency unsteadiness that affect the separated region are captured. The incoming perturbations are injected into the laminar boundary layer using a compressible variant of the Synthetic Eddy Method, and their amplitude and bandwidth are kept the same for both configurations.

The difference in spatial scales obtained either for a shock-reflection case or for a compression corner resulting in the same total pressure rise is analysed. Characteristic temporal scales were extracted through spectral decomposition of wall pressure fluctuations. The point of separation was associated with low-frequency unsteadiness of $St_L \simeq 0.05$, which agreed well with previous investigations.

A complete picture of the two flow configurations is discussed, and the breathing phenomenon is compared using coherence and phase spectral information. The mechanism of transition and the amplification rate of the boundary layer modes are also addressed.