Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Reynolds number dependency on Lagrangian Coherent Structures (LCS) over supersonic turbulent boundary layers[1] GERMAN SALTAR RIVERA, GUILLERMO ARAYA, HPCVLab, Dept. of Mechanical Eng., U. of Puerto Rico-Mayaguez — Lagrangian coherent structures (LCS) have received a lot of attention recently due to its advantages over Eulerian coherent structure identification schemes. Transport barriers revealed by LCS have the capability to enhance mixing for many engineering applications. This study utilizes a high-fidelity Direct Numerical Simulation database of spatially-developing turbulent boundary layers (SDTBL) at the supersonic regime ($M_\infty = 2.5$) to evaluate the effects of Reynolds number on LCS. The analysis is performed by prescribing realistic turbulent information at the computational domain inflow for SDTBL simulations. The methodology is based on the Dynamic Multiscale Approach by Araya et al. (JFM, Vol. 670, pp. 581-605, 2011) adapted to compressible flow. Furthermore, identification of LCS structures is performed by computing the Finite-Time Lyapunov Exponent (FTLE). Preliminary results reveal that zones with large FTLE values, after performing a backward time integration of particle trajectories (attraction material lines), can be linked to the local presence of hairpin vortex packets. At the larger Reynolds number, coherent motions exhibit a finer structure, more isotropic but less organized structures. Behavior at low Reynolds numbers depicts a more organized pattern.

[1]NASA PR Space Grant Fellowship (Grant #NNX15AI11H), NSF-CAREER #1847241

German Saltar Rivera
HPCVLab, Dept. of Mechanical Eng., U. of Puerto Rico-Mayaguez

Date submitted: 03 Aug 2020 Electronic form version 1.4