Numerical Simulation of Shock Wave; Turbulent Boundary Layer Interaction

Dr. M. K. Shukla, Dr. Mohammad Miyan*

Department of Mathematics, Shia P. G. College, Lucknow
*Corresponding Author

Email: miyanmohd@redffmail.com

Abstract

An analysis of the results shows an honest agreement with reference experiment in terms of mean quantities and turbulence structure. The machine knowledge makes sure theoretical and experimental results on fluctuation-amplification across the interaction region. Within the wake of the most shock a shedding of shocklets is discovered. The temporal behavior of the coupled shock-separation system agrees well with experimental knowledge. The simulation knowledge gives indications for a large-scale shock motion. In the present paper, it's discovered that the structural changes within the downstream separated flow are paying homage to bound global linear instability modes according within the literature, suggesting that an inherent instability of the separated flow may be the driving mechanism for the unsteadiness.

Keywords: Shock wave, Turbulent boundary, Boundary layer.

References

1. Anderson, J. D. Jr., 2001, Fundamentals of Aerodynamics (3rd ed.), McGraw-Hill, Science/Engineering/Math, ISBN 0-07-237335-0.
2. Hickel, S., Adams, N. A. and Domaradzki, J. A., 2006, An adaptive local deconvolution method for implicit LES. Journal of Computational Physics, 213:413–436.
3. Hickel, S., Egerer, C. P. and Larsson, J., 2014, Subgrid-scale modeling for implicit large eddy simulation of compressible flows and shock-turbulence interaction. Physics of Fluids, 26:106101.
4. Krehl, Peter O. K., 2011, "Shock wave physics and detonation physics — a stimulus for the emergence of numerous new branches in science and engineering", European Physical Journal H, 36: 85. doi:10.1140/epjh/e2011-10037-x.
5. On Boundary Layers: Laminar, Turbulent and Skin Friction, 2016, AERODYNAMICS, GENERAL AEROSPACE. http://aerospaceengineeringblog.com/boundary-layers/
6. Örley, F., Pasquariello, V., Hickel, S. and Adams, N. A., 2015, Cut-element based immersed boundary method for moving geometries in compressible liquid flows with cavitation. Journal of Computational Physics, 283:1–22.
7. Pasquariello, V., Hammerl, G., Örley, F., Hickel, S., Danowski, C., Popp, A., Wall, W. A. and Adams, N. A., 2015, A cut-cell Finite Volume – Finite Element coupling approach for fluid-structure interaction in compressible flow. Journal of Computational Physics (in review).
8. Pasquariello, V., Hickel, S. and Adams, N. A., 2015, Coupled simulation of shock-wave/turbulent boundary-layer interaction over a flexible panel. http://elib.dlr.de/97850/1/Pasquariello_2015_EUCASS.pdf
9. Priebe, S. and Martin, M. P., 2009, Direct Numerical Simulation of Shockwave and Turbulent Boundary Layer Interactions. http://croccolab.umd.edu/publications/conf-docs/AIAA_2009_0589.pdf
10. Robert, W. F. and McDonald, A. T., 2003, Introduction to Fluid Mechanics Fourth Edition, ISBN 0-471-54852-9.
11. Shock wave, 2017, From Wikipedia, the free encyclopedia. https://en.wikipedia.org/wiki/Shock_wave
12. Settles, G. S. (2006), High-speed Imaging of Shock Wave, Explosions and Gunshots, 94 (1), American Scientist, pp. 22–31.
13. Shang, J. S., Hankey, W. L. Jr. and Law, C., 1976, "Numerical Simulation of Shock Wave - Turbulent Boundary-Layer Interaction", AIAA Journal, Vol. 14, No. 10, pp. 1451-1457.