Abstract

Ernst Mach recorded experimentally, in the late 1870s, two different shock-wave reflection configurations and laid the foundations for one of the most exciting and active research field in Shock Wave Reflection Phenomena. The first wave reflection, a two-shock wave configuration, is known nowadays as regular reflection, RR, and the second wave reflection, a three-shock wave configuration, was named after Ernst Mach and is called nowadays Mach reflection. Until early 1990s, the hysteresis where both RR and MR reflections are possible, was believed not to exist. In 1995 the possibility of hysteresis was demonstrated computationally by Ivanov and co-authors using new algorithms of parallelization of the direct simulation Monte Carlo method developed at ITAM and the advances in high-performance computing. Numerical experiments had no disturbances occurring in wind tunnel experiments and allowed a clearer understanding of the nature of transition. The computational studies of hysteresis paved the way for a later experimental confirmation of hysteresis in several wind tunnel setups.

In this talk the results of our recent numerical and experimental investigations of hysteresis-related phenomena in the shock wave reflection transition are presented. It is demonstrated that the existence of more than one stable configuration and the hysteresis seem to be a universal feature of the interaction of flow discontinuities. A wide range of problems is considered, including various aspects of shock wave reflection in supersonic gas flows, shock and detonation wave interaction in chemically reacting flows.

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