

極超音速流れにおける凹面・凸面および平面形状前方での衝撃波不安定性とその制御

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Shock Instabilities and its Passive Control in front of Concave, Convex Hemispherical Shell and Flat Plate geometries at Mach 7 Hypersonic Flow

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The bow shock formed in front of positive curvature (convex) blunt noses in uniform supersonic and hypersonic flow field is steady and stable. Although, it is observed that for zero (flat) or negative curvature (concave) geometries, the bow shock becomes unstable. The experiments were performed at Kashiwa Hypersonic and High Enthalpy wind tunnel to characterize the oscillating bow shock in front of three basic geometries (Flat circular plate, convex hemispherical shell and concave hemispherical shell). Further, to control the bow-shock oscillations in front of concave hemispherical shell, passive control methods as spike in the cavity, breathing holes at the curved surface of hemispherical shell and cross-wire have also been studied. The force measurement and center pressure measurement were carried out for three basic geometries and concave hemispherical shell with passive control in hypersonic flow. The force measurement was done by using six-component force balance and center pressure measurement was conducted using Kulite XCL-152 pressure transducer. The shock oscillations were captured by using Schlieren method with Phantom Miro M310 high-speed camera with frame rate of 10,000 fps. The shock oscillation captured by high-speed camera has been shown in Figure 1.

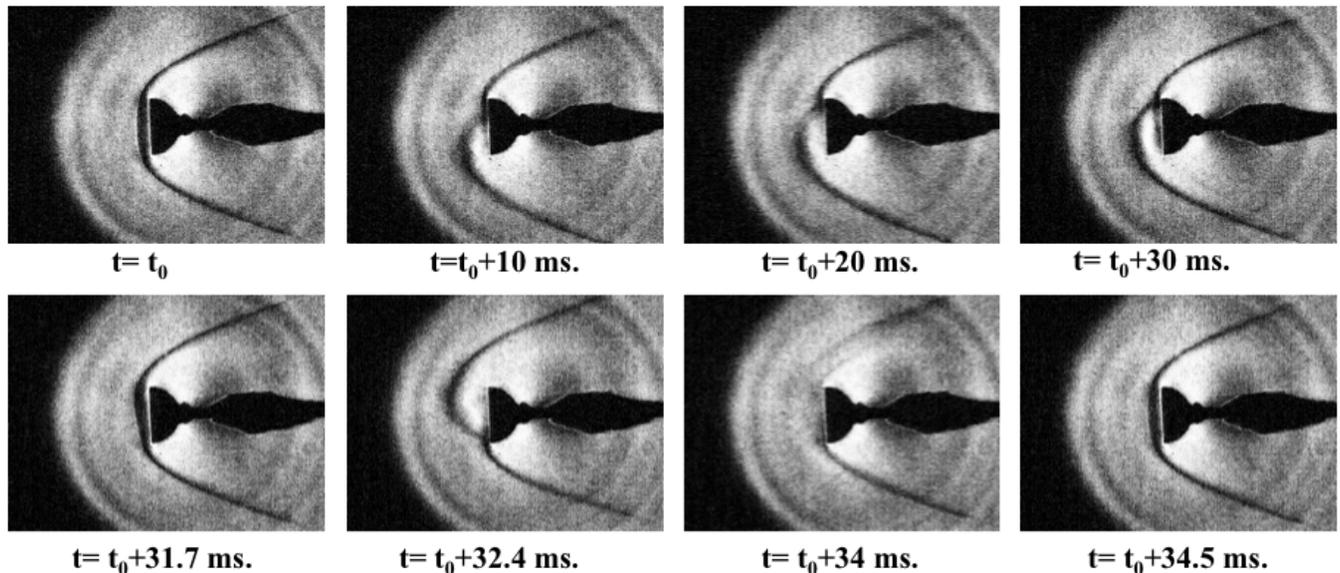


Figure 1: Shock Oscillation in front of Hemispherical Concave Shell captured by High-Speed Camera

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(1) Vashishtha A., Watanabe Y., Suzuki K., "Study of Shock Shapes in front of concave, convex and Flat Arc in Hypersonic Flow," Proceedings of 46th Fluid Dynamics Conference / 32nd Aerospace Numerical Simulation Symposium, JSASS, July 03-04, 2014.