Recent Investigation on the Formation of Steady Oblique Detonation Wave in Hypersonic Flow

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Detonation is a promising combustion organization mechanism for high-speed airbreathing propulsion. Oblique detonation engine (ODE) works with steady oblique detonation waves (ODW) which is more applicable for flights at high flight Mach numbers. ODE was proposed more than eight decades back, and becomes a hot topic again in recent years.

One of the main challenges in experimental studies on ODE combustion is the lack of high-temperature large-scale testing facilities. The detonation-driven shock tunnel (JF-12) [1], which was put into use in 2012, can provide large-scale high-temperature test flows for the test of ODE. In this paper, the performance of JF-12 is reviewed to explain why it is qualified for the test of large-scale non-premixed detonation. Some recent experimental and computational studies on the formation of ODW are summarized. For the numerical simulation of two-phase detonation, a Eulerian-Lagrangian approach based on OpenFOAM V7 [2] is used. The mechanisms for the onset of stable ODWs in two-phase air-fuel mixtures, i.e., the forced-initiation-trip (FIT) and transverse jet (TRJ), are studied and compared. TRJ technique can also contribute to thermal protection through the cooling film along the combustion chamber wall as shown in Fig. 1.

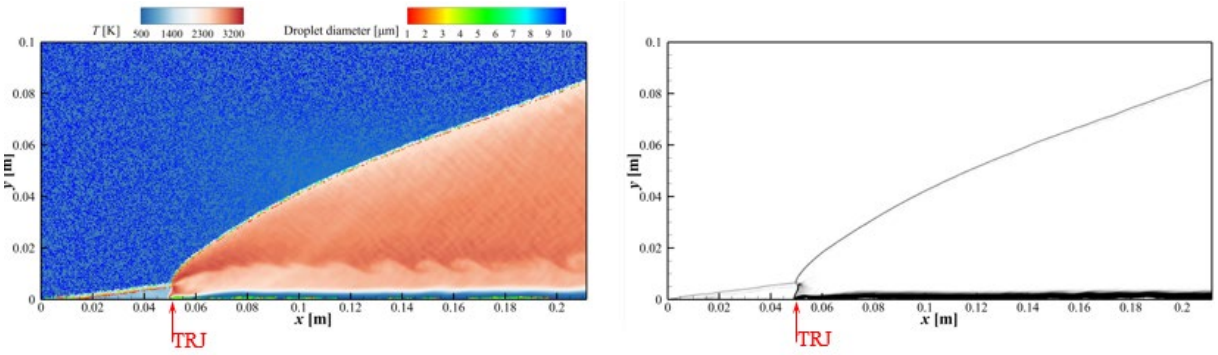

Figure 1: Computation of steady oblique detonation wave of liquid fuel induced by transverse jet (TRJ).

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References

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