

SPACE PROPULSION SYMPOSIUM (C4)  
Hypersonic and Combined Cycle Propulsion (5)

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FLOW PATTERN AND MIXING CHARACTERISTICS OF CROSS FUEL INJECTION IN A  
SUPERSONIC FLOW

**Abstract**

Using Nano-particle based laser scattering imaging technique, schlieren system and oil streamline-display technique, the flow patterns and mixing characteristics of fuel injection with tandem multi-orifices and parallel multi-orifices in a supersonic flow were investigated in this paper. The distance among the tandem multi-orifices and that among the parallel multi-orifices were varied. The experimental results showed that decreasing the distance among the tandem multi-orifices will reduce the dynamic pressure of the stream in front of the second injection, which results in the increase of the penetration height of the second injection. For the over-small distance among the parallel multi-orifice injection, the front shock waves before the injection jets connect together and the freestream is hard to enter into the gap among the injection jets and the mixing effect decrease. Over-large distance among the parallel multi-orifice injection decreases the interactions between the injection jets and the mixing effect decrease to some extent. For the mixing enhancement, there is a proper optimized distance for the parallel injection.