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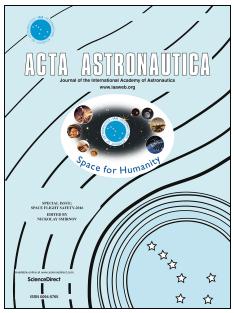

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Periodic Forcing of a Shock Train in a Scramjet Inlet-Isolator at Overspeed Condition

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Abstract: Unsteady viscous numerical simulations are performed to explore the response of a shock train to downstream backpressure forcing in a scramjet inlet-isolator at the overspeed condition. A sinusoidal dynamic backpressure is applied at the exit of the isolator, thus leading a forced shock train oscillation. The results show that the shock train travels along a different path for the upstream and downstream movements. There is a clear hysteresis loop during the shock train oscillation. Under the low forcing frequency, the shock train travels in a clockwise loop. While it travels in a counter-clockwise loop under the high forcing frequency. Moreover, there is a lag between the shock train oscillation and the fluctuating backpressure. Especially for the high forcing frequency, the phase of the shock train oscillation is opposite to the fluctuating backpressure. The effects of the amplitude and frequency of the periodic fluctuating backpressure on the oscillation range of the shock train are also investigated. With the amplitude of the fluctuating backpressure increasing, the oscillation range of the shock train increases. With the frequency of the fluctuating backpressure increasing, the oscillation range of the shock train increases first and then decreases under high frequency.

Keywords: scramjet, shock train, forced oscillation, overspeed condition, hysteresis

Nomenclature

A	dimensionless amplitude of backpressure ratio
c	speed of sound
C_p	specific heat
D	diameter of parabolic reflector
f	frequency of fluctuating backpressure
k	order of accuracy of numerical scheme

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