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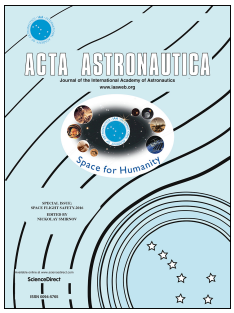

Nonlinear process in the mode transition in typical strut-based and cavity-strut based scramjet combustors

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Nonlinear process in the mode transition in typical strut-based and cavity-strut based scramjet combustors

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Abstract: The analysis of nonlinear characteristics and control of mode transition process is the crucial issue to enhance the stability and reliability of the dual-mode scramjet engine. In the current study, the mode transition processes in both strut-based combustor and cavity-strut based combustor are numerically studied, and the influence of the cavity on the transition process is analyzed in detail. The simulations are conducted by means of the Reynolds averaged Navier-Stokes (RANS) equations coupled with the renormalization group (RNG) k-ε turbulence model and the single-step chemical reaction mechanism, and this numerical approach is proved to be valid by comparing the predicted results with the available experimental shadowgraphs in the open literature. During the mode transition process, an obvious nonlinear property is observed, namely the unevenly variations of pressure along the combustor. The hysteresis phenomenon is more obvious upstream of the flow field. For the cavity-strut configuration, the whole flow field is more inclined to the supersonic state during the transition process, and it is uneasy to convert to the ramjet mode. In the scram-to-ram transition process, the process would be more stable, and the hysteresis effect would be reduced in the ram-to-scram transition process.

Keywords: Scramjet; mode transition; strut; cavity; nonlinear character; hysteresis phenomenon

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