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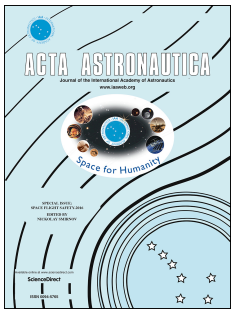

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Effects of injection nozzle exit width on rotating detonation engine

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Abstract: A series of numerical simulations of RDE modeling real injection nozzles with different exit widths are performed in this paper. The effects of nozzle exit width on chamber inlet state, plenum flowfield and detonation propagation are analyzed. The results are compared with that using an ideal injection model. Although the ideal injection model is a good approximation method to model RDE inlet, the two-dimensional effects of real nozzles are ignored in the ideal injection model so that some complicated phenomena such as the reflected waves caused by the nozzle walls and the reversed flow into the nozzles can not be modeled accurately. Additionally, the ideal injection model overpredicts the block ratio. In all the cases that stabilize at one-wave mode, the block ratio increases as the nozzle exit width gets smaller. The dual-wave mode case also has a relatively high block ratio. A pressure oscillation in the plenum with the same main frequency with the rotating detonation wave is observed. A parameter σ is applied to describe the non-uniformity in the plenum. σ increases as the nozzle exit width gets larger. Under some condition, the heat release on the interface of fresh premixed gas layer and detonation products can be strong enough to induce a new detonation wave. A spontaneous mode-transition process is observed for the smallest exit width case. Due to the detonation products existing in the premixed gas layer before the detonation wave, the detonation wave will propagate through reactants and products alternately, and therefore its strength will vary with time, especially near the chamber inlet. This tendency gets weaker as the injection nozzle exit width increases.

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