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基于DES模型的超燃气动斜坡/燃气发生器方案仿真研究

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DES Computational Study of Aero-ramp Injectors Integrated with Gas-portfire in Supersonic Flow

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摘要 采用基于剪切应力输运(SST)*k-ω*两方程湍流模型的分离涡(DES)方法和雷诺时均Navier-Stokes(RANS)方法对超燃气动斜坡结合燃气发生器增进掺混方案进行数值仿真研究。通过对比DES仿真结果、RANS仿真结果与试验结果,发现DES仿真结果对流场内涡结构的捕捉和分辨能力强于RANS方法获得的结果。选取燃气发生器喷流形成的壁面涡流特征角为比较标准, DES仿真结果显示该角度为48°,RANS仿真结果为37°,而试验测得该角度为47°。可见DES仿真结果与试验结果更为接近,说明对于气动斜坡结合燃气发生器的超燃掺混方案,DES方法仿真结果是合理的。

关键词： 超声速掺混 DES模型 气动斜坡 燃气发生器 超燃冲压发动机

Abstract： Detached eddy simulation (DES) and Reynolds average Navier-Stokes (RANS) models based on shear stress transport (SST) *k-ω* two-equation model are used to simulate the flow field of aero-ramp injectors integrated with gas-portfire, which is a new method to enhance mixing in supersonic flow. Results show that the DES model is able to capture more detailed flow structures such as eddies and separation zones as compared with the RANS method. A characteristic degree is selected to evaluate the accuracy of DES and RANS results by comparing them with experimental results. The results show that the characteristic degree in DES, RANS and experiments are 48°, 37° and 47° respectively. The results obtained by the DES model agree much better with experimental results than the RANS method. Therefore, the DES model is considered more suitable to simulate an aero-ramp injectors integrated with a gas-portfire flow field.

Keywords： supersonic mixing DES model aero-ramp gas-portfire scramjet

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