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NUMERICAL STUDY ON MIXING OF A PASSIVE SCALAR IN SUPERSONIC MIXING LAYERS USING A HYBRID RANS/LES APPROACH

Abstract

In order to improve the mixing efficiency of air and flammable gas in a dual-combustor ramjet (DCR), the mixing process of a passive scalar in a turbulent supersonic mixing layer was studied using a Hybrid RANS/LES method. The supersonic bi-component mixing flow field with the convective Mach number 0.25 was simulated, whose results are validated against the experimentally velocity and concentration data. The fully-developed flow is analyzed to give mixture fraction and turbulence statistics. The probability density function (PDF) of the mixture fraction is obtained. The mixing efficiency of the mixture fraction is calculated by integrating the scalar PDFs. Furthermore, the effect of the velocity ratio, compressibility and Reynolds number on the mixing efficiency is analyzed. The scalar PDFs shows the marching style across the layer. The mixing efficiency is very sensitive to the velocity ratio, while the compressibility and Reynolds number have a little effect on the mixing efficiency. These findings on the supersonic mixing layer can provide more insight into the scalar mixing mechanism.