Hindawi Publishing Corporation
Advances in Mechanical Engineering
Volume 2014, Article ID 765315, 2 pages
http://dx.doi.org/10.1155/2014/765315

*Editorial*

# Numerical Study on Super/Hypersonic Flow, Mixing, and Combustion Phenomena

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Received 24 March 2014; Accepted 24 March 2014; Published 29 April 2014



Super/hypersonic flow, mixing, and combustion processes are ubiquitous in next-generation aircraft and propulsion devices, for example, in the hypersonic aircraft and scramjet. Knowledge on physical mechanisms of high-speed compressible flow, mixing, and combustion has both important academic meaning and engineering value for developing effective flow control approaches, predicting accurately aerodynamic force and heat of aircraft, enhancing propulsion efficiency, and so forth. Experimental studies related to high-speed flows are very expensive and take time. Therefore, along with the development of computation technology, not only the computer hardware but also the calculation algorithm and software, numerical simulations play important roles in the study of super/hypersonic flow, mixing, and combustion processes. Numerical simulations can reduce research costs and provide the convenience in addition to discovering new flow phenomena, recognizing flow details, extending research topics, and so forth. In recent years, remarkable advances have been achieved in studies of transition prediction of super/hypersonic flow, supersonic mixing, heat transfer in high-speed flows, two-phase flows, and supersonic turbulent combustion by using the numerical simulation technology. In this special issue, we have invited some papers that address such issues.

Two papers of this issue address the flow stability and transition taking boundary layer flows as examples. One of the papers does the stability analysis of hypersonic boundary layer over a cone at small angle of attack, results of which show that the boundary layer stability was greatly influenced by small angles of attack. The maximum growth rate of the most unstable wave on the leeward is larger than that on the windward, which gives a reasonable explanation for the transition leeside-forward and wind side-aft for smooth cones at small angle of attack. The other paper performs a large eddy simulation of supersonic boundary layer transition over a flat-plate based on the spatial mode with free stream Mach number 4.5 and depicts onset and development of large-scale coherent structures through the transition process.

Other two papers present aerodynamics characteristics related to the aircraft in high-speed compressible flows. One of the papers performs the numerical research of aerodynamic characteristic effects of base jet on supersonic rocket using the SST $k$-$\omega$ turbulence model and the other conducts the investigation of the three-dimensional hinge moment characteristics generated by the ONERA-M6 wing with an aileron. A paper then focuses on the comparison study on different compressibility modifications of turbulence model in supersonic combustion simulation and presents that a combination of the three correction models of dilatational compressibility, structural compressibility, and shock unsteadiness compressibility gives the most remarkable correction effect in most situations and may improve the prediction accuracy of supersonic combustion phenomena.

Four other papers mainly discuss the mixing and mixing enhancements in supersonic flows. One of the papers presents the LES results on passive mixing in supersonic shear layer flows considering effects of baffle configuration, finding that the baffle with cavities can induce large scale vortexes, promote the mixing layer to lose its stability easily, and then lead to the mixing efficiency enhancement. Another paper finds that the mixing efficiency is also enhanced by increasing the density difference of two streams, when it conducts the numerical study on effects of density stratification on mixing enhancement by shock wave in supersonic shear layer flows. Another paper performs the large eddy simulation results of improvements of mixing and flame holding in combustor through transverse injection into supersonic flow after rearward-facing step and gives validations by the NPLS and PIV experimental measurements. Another paper then analyzes the mixing enhancement induced by the Richtmyer-Meshkov instability in the scramjet combustor with a central strut.

A paper presents effects of inflow Mach number and step height on supersonic flows over a backward-facing step. Another paper then discusses the influence of injection scheme on the ethylene supersonic combustion by means of numerical investigations. Another one presents numerical analysis of supersonic film cooling in supersonic flow in hypersonic inlet with isolator.

Four other papers discuss the models of ignition and two-phase flow. One of the papers presents the research of macroscopic regularities of heat and mass transfer at the ignition condition of a liquid high-energy material by an immersed source with a limited energy capacity and another paper then depicts the transient heat and mass transfer of liquid droplet ignition at the spreading over the heated substrate. Another paper shows a parallel Monte Carlo simulation of aerosol dynamics. A paper discusses a fast numerical solution procedure of gas-particle two-phase plumes, in which comparisons of different drag coefficients show that Loth's drag formula can calculate exactly particle initial acceleration process for high $Re_r$ and $M_r$ two-phase flows for high-speed plumes.

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