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Effect of isothermal wall condition on the inter-scale kinetic energy transfer in hypersonic boundary layer. DEHAO XU, College of Engineering, Peking University, JIANCHUN WANG, MINPING WAN, Department of Mechanics and Aerospace Engineering, Southern University of Science and Technology, CHANGPIN YU, XINLIANG LI, Institute of Mechanics, Chinese Academy of Sciences, SHIYI CHEN, Department of Mechanics and Aerospace Engineering, Southern University of Science and Technology — Effect of isothermal wall condition on the inter-scale transfer of kinetic energy in hypersonic boundary layer is studied by direct numerical simulation (DNS) using both hot wall and cold wall conditions with the high freestream Mach number $M_\infty = 8$. The streamwise-spanwise average of the large-scale spatial convection and viscous dissipation are prominent in the near wall region and decrease rapidly away from wall, while the crest location of SGS flux is in the buffer layer. The cold wall condition enhances the local reverse transfer of kinetic energy in expansion regions and the wall inhibits the efficiency of inter-scale kinetic energy transfer. Helmholtz decomposition is introduced to analyze the compressibility effect on the solenoidal and compressible components of SGS kinetic energy flux. Strong fluctuating solenoidal kinetic energy transfer appears in the buffer layer, while intense fluctuating compressible kinetic energy transfer exists in the near wall region. The cold wall condition significantly increases the compressibility effect in the near wall region.

Dehao Xu
College of Engineering, Peking University

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