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Numerical investigation of kinetic energy dynamics during autoignition of n-heptane/air mixture PAULO LUCENA KREPPEL PAES, JAMES BRASSEUR, YUAN XUAN, The Pennsylvania State University — Many engineering applications involve complex turbulent reacting flows, where nonlinear, multi-scale turbulence-combustion couplings are important. Direct representation of turbulent reacting flow dynamics is associated with prohibitive computational costs, which makes it necessary to employ turbulent combustion models to account for the effects of unresolved scales on resolved scales. Classical turbulence models are extensively employed in reacting flow simulations. However, they rely on assumptions about the energy cascade, which are valid for incompressible, isothermal homogeneous isotropic turbulence. A better understanding of the turbulence-combustion interactions is required for the development of more accurate, physics-based subgrid-scale models for turbulent reacting flows. In order to investigate the effects of reaction-induced density, viscosity, and pressure variations on the turbulent kinetic energy, Direct Numerical Simulation (DNS) of autoignition of partially-premixed, lean n-heptane/air mixture in three-dimensional homogeneous isotropic turbulence has been performed. This configuration represents standard operating conditions of Homogeneous-Charge Compression-Ignition (HCCI) engines. The differences in the turbulent kinetic energy balance between the present turbulent reacting flow and incompressible, isothermal homogeneous isotropic turbulence are highlighted at different stages during the autoignition process.

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