Simulation exaflopique de la combustion de sprays

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Abstract

Large Eddy Simulation (LES) has emerged as a powerful computational tool for the design and analysis of spray burners, offering the ability to capture the complex interactions between turbulent flow, combustion, and spray dynamics with high fidelity. However, the high accuracy of LES comes at a significant computational cost. The simulation of these systems often requires the use of large meshes in order to resolve fine-scale turbulence and sharp flame front as well as the handling of numerous species and chemical reactions. These demands pose substantial challenges in terms of the required computational resources and the time required for the simulation process, which can hinder the practical application of LES in industrial design processes. This thesis addresses the computational challenges associated with LES of spray burners by exploring and developing numerical approaches aimed at reducing the computational burden without compromising the accuracy of the simulations. Three primary strategies are investigated: Euler-Lagrange load balancing, Adaptive Mesh Refinement, and Dynamic Cell Clustering.