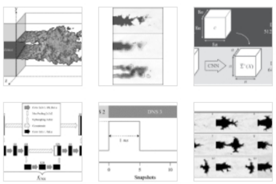
Outline

Figures (11)



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Combustion and Flame

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Training convolutional neural networks to estimate turbulent sub-grid scale reaction rates

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Abstract

This work presents a new approach for premixed turbulent combustion modeling based on convolutional neural networks (CNN).[1] We first propose a framework to reformulate the problem of subgrid flame surface density estimation as a machine learning task. Data needed to train the CNN is produced by direct numerical simulations (DNS) of a premixed turbulent flame stabilized in a slot-burner configuration. A CNN inspired from a U-Net architecture is designed and trained on the DNS fields to estimate subgrid-scale wrinkling. It is then tested on an unsteady turbulent flame where the mean inlet velocity is increased for a short time and the flame must react to a varying turbulent incoming flow. The CNN is found to efficiently extract the topological nature of the flame and predict subgrid-scale wrinkling, outperforming classical algebraic models.

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Keywords

Turbulent combustion; Deep learning; Flame surface density; Direct numerical simulation

[1] Code and data for the deep learning in this work is available at https://gitlab.com/cerfacs/code-for-papers/2018/arXiv_1810.03691.

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