Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

A novel deep learning framework for efficient parameterization of high-dimensional flamelet manifolds OPEOLUWA OWOYELE, PRITHWISH KUNDU, PINAKI PAL, Argonne National Laboratory — Tabulated flamelet models are limited by the curse of dimensionality, wherein the computational memory required to store multidimensional flamelet lookup tables grows exponentially as the number of independent variables increases. In addition, it requires a vast increase in code complexity to perform interpolations in higher dimensions. One promising technique is to train an ANN *apriori* based on the flamelet table, and use the trained model during run-time to obtain the species mass fractions as functions of the independent variables. Results from a previous study showed that training accuracy and inference speed can be improved if the multidimensional data set is bifurcated and separate ANNs are used for different regions. In this work, an *apriori* study is performed using a physically meaningful divide-and-conquer approach, where an ensemble of deep neural networks is trained to represent the relevant physics in different regions of the flamelet manifold, as supervised by a gating network. The method is applied to 4-dimensional and 5-dimensional flamelet tables representing spray combustion in a constant volume chamber (ECN spray A) and a compression-ignition engine, respectively. The technique is demonstrated to result in a further decrease in the computational cost for a given accuracy. Moreover, the physical meaning of the obtained partitions is also discussed.

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Date submitted: 01 Aug 2019 Electronic form version 1.4