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Unsteady flamelet modelling of spray flames using deep artificial neural networks OPEOLUWA OWOYELE, North Carolina State University, PRITHWISH KUNDU, MUHSIN AMEEN, Argonne National Laboratory, TAREK ECHEKKI, North Carolina State University, SIBENDU SOM, Argonne National Laboratory — We investigate the applicability of the tabulated, multidimensional unsteady flamelet model and artificial neural networks (TFM-ANN) to lifted diesel spray flame simulations. The tabulated flamelet model (TFM), based on the widely known flamelet assumption, eliminates the use of a progress variable and has been shown to successfully model global diesel spray flame characteristics in previous studies. While the TFM has shown speed-up compared to other models and predictive capabilities across a range of ambient conditions, it involves the storage of multidimensional tables, requiring large memory and multidimensional interpolation schemes. This work discusses the implementation of deep artificial neural networks (ANN) to replace the use of large tables and multidimensional interpolation. The proposed framework is validated by applying it to an n-dodecane spray flame (ECN Spray A) at different conditions using a 4 dimensional flamelet library. The validations are then extended for the simulations using a 5-dimensional flamelet table applied to the combustion of methyl decanoate in a compression ignition engine. Different ANN topologies, optimization algorithms and speed-up techniques are explored and details of computational resources required for TFM-ANN and the TFM are also presented. The overall tools and algorithms used in this study can be directly extended to other multidimensional tabulated models.

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