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Soot parameter fields predictions in the flames via AI assisted optical diagnostics from data-driven models to PINNs models

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Abstract: Conventional optical diagnostics requires optical expertise, high cost and time-consuming on complicated optical preparation and post-processing, whlist machine learning-assisted optical diagnostics paves a more efficient, lower costing, and high-fidelity way for multi-parameters simultaneous diagnosis in combustion and reacting flows. In this report, we introduced machine learning assisted the flame luminosity measurement to predict the soot multi-parameters simultaneous diagnosis in flames, from the data-driven models in terms of BP neural network, U-Net Convolution neural network and Trident-net multi-tasking model to fundamental physical informed neural networks (PINNs). It is delightful to find that the prescribed data size requirements for model training were reduced along with subtle neural network design or fundamental physical information incorporated, even though the high prediction accuracy remains. Such characteristics are appreciated by the combustion diagnostics in the real power plants, since the limited optical window or experimental data are available that is frequently encountered.

Keywords: Soot parameter fields, BP neural network, CNN model, multi-tasking model, PINNs

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