Prediction method for ignition delay time of liquid spray combustion in constant volume chamber

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Publication date:
2020

Document Version
Peer reviewed version

Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Prediction method for ignition delay time of liquid spray combustion in constant volume chamber[1] JIUN CAI ONG, Technical University of Denmark, KAR MUN PANG, MAN Energy Solutions, JENS HONORE WALTHER, Technical University of Denmark — A prediction method, known as the Coupled Time Scale (CTS) method, is proposed in the current work to estimate the ignition delay time (IDT) of liquid spray combustion by performing an inert spray simulation and a zero-dimensional (0-D) homogeneous reactor (HR) simulation. The method builds upon the assumption that if the majority of the vapor regions in a spray has composition close to the most reactive mixture fraction, then these regions will have a high probability to undergo high-temperature ignition and ultimately leading to autoignition in spray. The proposed method is applied to estimate high-temperature IDT of n-dodecane sprays at three ambient temperatures (T_{am}) of 800, 900, and 1000K, as well as for two nozzle diameters (D_{noz}) of 90 and 186μm. The fidelity of the proposed CTS method is verified by comparing the predicted IDT against CFD simulated IDT and measured IDT. Comparison of the estimated IDT from the CTS method to measured IDT yields a maximum relative difference of 24%. Meanwhile, a maximum relative difference of 33% is obtained between the IDT computed from the CTS method and the computed IDT from the large eddy simulations of the associated reacting sprays across the different T_{am} and D_{noz}

[1]The authors gratefully acknowledge the financial support from the Independent Research Fund Denmark (DFF) and MAN Energy Solutions under the grant number 8022-00143B.

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Date submitted: 03 Aug 2020 Electronic form version 1.4