# Application of the FGM Method to Spray A Conditions of the ECN database

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**Abstract**

Modeling turbulent diesel spray combustion which combines complex flow and transport phenomena with combustion event including a vast amount of species and reactions is a major challenge. The Flamelet Generated Manifold (FGM) method is a promising technique to model reacting flows using tabulated chemistry approach. The method is adopted for diesel spray combustion by tabulating chemistry as a function of the mixture fraction (Z) and a reaction progress variable ( $\mathcal{Y}$ ). In previous work, the method has been successfully applied to simulate Spray H cases as defined by the engine combustion network (ECN). Two different tabulation approaches (igniting counterflow diffusion flames (ICDF) and homogeneous reactors (HR)) were investigated and compared to the available experimental data of the ECN.

In this paper, the FGM method is applied to simulate Spray A conditions of the ECN. First, the sensitivity of the spray sub-models (atomization and breakup models) is studied for the non-reacting case of the Spray A setup. Later, the FGM approach is applied on the reacting case for FGM's generated with two different n-Dodecane reaction mechanisms, using two tabulation approaches, and with and without inclusion of a turbulent closure (PDF approach based on variance of Z). The 3D-RANS (Reynolds Averaged Navier-Stokes) simulations are performed with the commercial CFD code STAR-CD. The combustion results are analyzed by comparing the simulated and measured ignition delays and lift-off lengths. One mechanism results in ignition for all simulations, whereas the other mechanism does not. It was found that this can be attributed to the different sensitivity of the mechanisms to the strain rate. In general, HR tabulation predicts shorter ignition delay and lift-off length (LOL) than the ICDF in line with the observations from previous work. The atomization model does not show major effect on ignition delay however it affects the LOL significantly in both tabulation approaches. Inclusion of the turbulent closure does not affect ignition delay or LOL predictions. In general compared to the experiments, the ICDFs slightly over predict whereas the HRs systematically under-predicts.

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