STUDY OF PCCI COMBUSTION MODELLING WITH THE FGM APPROACH

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Premixed Charge Compression Ignition (PCCI) is a viable approach for part load operation in diesel combustion engines. The idea of PCCI combustion is linked to advanced injection timing and operation with a highly lean mixture, such that ignition occurs after the injection event. Therefore, very low soot and nitric oxides (NO_x) emission levels can be achieved simultaneously.
The development of numerical tools has utmost importance to shorten the expensive and time-consuming prototype testing of diesel engines. Turbulent spray combustion in diesel engines combines complex flow and transport phenomena with the combustion event, which is a non-linear process including a vast amount of species and reactions. From a numerical point of view, it is a major challenge. Tabulation methods are commonly used to reduce the computational effort. The Flamelet Generated Manifold (FGM) approach is a promising technique in engine combustion modeling to include tabulated chemistry. The method is based on pre-tabulating chemistry as a function of two controlling variables. The mixture fraction and a reaction progress variable are used to characterize the evolution of mixing and combustion events, respectively.
In previous studies [1], the FGM approach is implemented successfully for conventional diesel operation. The objective of this study is to extend this method to PCCI conditions. As PCCI combustion is mainly governed by auto-ignition chemistry and not by flame propagation, the flamelet assumption may no longer be valid. However, it is believed that the combustion event can be viewed as a collection of homogeneous reactors (HR). Therefore in the proposed method for PCCI conditions, the database is generated using HR simulations instead of counter flow diffusion flames.

References

[1] Bekdemir, C., Somers, L.M.T., de Goey, L.P.H., “Modeling diesel engine combustion using pressure dependent Flamelet Generated Manifolds”, *Proc. Comb. Inst.*, 33: 2887–2894 (2010).