APPLICATION OF ZIMONT'S TURBULENT FLAME SPEED CLOSURE FOR COMBUSTION MODELING OF A SINGLE CYLINDER SPARK IGNITION ENGINE

J.K. Lishan Eranga

168039V

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Department of Mechanical Engineering

University of Moratuwa

Sri Lanka

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Dr. R.A.C.P. Ranasinghe,

University of Moratuwa

ABSTRACT

Increasing need to get the maximum power out from fuels while maintaining less amount of toxic emissions has created the requirement of making an optimum IC engine. Numerical simulations play a vital part in determining those design and operating parameters which make that idea of an optimum engine a reality. In the present work applicability of two well-known turbulent flame speed models: Namely Peters and Zimont in premixed charge gasoline spark ignition (SI) engines were evaluated. Their ability to predict the characteristics of premixed turbulent combustion process of an SI engine in the RANS context was first assessed and based on those results Zimont model was used to evaluate the applicability of Smagorinsky-Lilly Large eddy simulation (LES) model in engine simulations. Several simulations were done to identify and implement required modifications to get correct solutions from the LES model.

Combustion of the Ricardo E6 single cylinder test engine was modeled with the above two turbulent flame speed closure models implemented to a commercial computational fluid dynamics (CFD) code. Full cycle simulations, covering all four strokes including the valve motion, spark discharge, flame kernel development and fully developed combustion, were performed using different engine operating conditions. Engine was fueled with gasoline. Obtained results were compared with experimental values obtained using the same operating conditions of the E6 engine to evaluate the prediction ability of the different models. Accordingly, In-cylinder pressure variation and the combustion heat release rate versus crank angle were compared with measured values. In general, predictions, of both models were found to be in reasonable agreement with experiment values, but significant discrepancies could be observed in certain operating conditions.

Keywords: CFD; LES; premixed; RANS; SI engine; turbulent combustion.

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