Improving the prediction of heat transfer in internal combustion engines

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Abstract

The objective is to improve the prediction of heat transfer in simulations of internal combustion engines (ICEs) as part of a national effort to reduce pollution generated by cars and trucks. In the global effort to reduce emissions, the automotive industry relies on computational fluid mechanics (CFD) to optimize combustion efficiency and pollutant emissions by simulating the flow, thermodynamics and chemistry inside a piston engine. To remain tractable, i.e. low computational cost to enable the study of many different configurations, such simulations require models, one of which is the modeling of heat transfer at the wall. Models, owing to their inherent approximations and assumptions, introduce uncertainties in the solution that are often difficult to quantify.

Our research focuses on heat transfer modeling. In the CFD code KIVA, an industry standard for the simulation of ICEs developed by Los Alamos National Labs, heat transfer modeling assumes that the local heat flux in a piston engine behaves similarly as the heat flux in a steady flow over a flat plate. We use high-fidelity simulations to study the uncertainty associated with such an assumption, by comparing the heat flux in a reciprocal turbulent flow with KIVA's models. Using the database produced by our in-house code, we will also study new approaches in heat transfer modeling and test them in KIVA.