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Analysis of Wall Models for Internal Combustion Engine Simulations Using High-speed Micro-PIV Measurements PETER MA, TIM EWAN, Stanford University, CHRISTOPHER JAINSKI, ANDREAS DREIZLER, Technische Universität Darmstadt, LOUISE LU, VOLKER SICK, University of Michigan, MATTHIAS IHME, Stanford University — The performance of internal combustion engines (IC-engine) is affected by the thermo-viscous boundary layer region. Computational models for the prediction of engine performance typically rely on wall functions to overcome the need for resolving the boundary layer structure. The objective of this contribution is to assess some of the assumptions on the wall functions under realistic operating conditions in a motored engine. Crank angle resolved high-resolution micro particle image velocimetry (μ-PIV) measurements were conducted previously in a spark-ignition direct-injection single cylinder engine. Data analysis is performed to assess the inner structure of the boundary layer. Using these measurements, the performance of a hierarchy of wall models, including the wall function model, which is commonly used in RANS and LES IC-engine simulations, and three hybrid RANS/LES wall models with increasing fidelity are investigated. It is shown that all four models provide adequate predictions if the first grid-point is located in the viscous sublayer; the wall function model has consistently underpredicted the shear velocity if the first grid-point is located outside the viscous sublayer, however the other three hybrid wall models all give reasonable results in this region.

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