

Simulation of a Hydrogen Internal Combustion Engine with Cryogenic Mixture Formation



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Cuvillier Verlag Feb 2008, 2008. Taschenbuch. Condition: Neu. Neuware - It is generally accepted that the worldwide change of the climate is caused by the manmade emissions of the greenhouse gas CO₂. For this reason the development of new technologies for propulsion aims at the reduction of the CO₂-emissions. Using hydrogen as an energy carrier offers the possibility to produce the fuel for vehicles from renewable energy sources, thus avoiding the emission of CO₂ completely. The on-board storage of liquid hydrogen at very low(cryogenic) temperatures offers currently the best basis to achieve acceptable cruising ranges of hydrogen vehicles. The consistent utilisation of the cold hydrogen using cryogenic mixture formation offers unique opportunities for the optimisation of a combustion engine with regard to power and efficiency. To fully exploit the potential of this promising mixture formation strategy, the usage of modern simulation techniques is necessary. In the course of this thesis, 1D and 3D computational fluid dynamic simulation tools were brought to a serviceable state ready for the optimisation of a hydrogen engine with cryogenic mixture formation. The simulation of the mixing and the combustion with novel models, adapted for hydrogen engine simulations, was verified by comparison to engine test bench results and optical experiments. Careful model and mesh studies have been performed. The ability of a Turbulent Flame Speed Closure (TFC) combustion model to predict the combustion process for a large part of the engine operating map could be demonstrated. This is a significant progress compared to results achieved until now regarding hydrogen engine simulations. A crucial point of the cryogenic mixture formation is the formation of frost inside the intake port due to the low mixture temperature. For the simulation of this phenomenon, a novel approach to compute frost formation in combination with a 3D CFD simulation has been...



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