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Simulating hydrogen combustion in SI engines: can we do it better?

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Simulating hydrogen engines presents unique challenges due to the very different reactivity and diffusivity of hydrogen compared with conventional fuels, particularly where a hydrogen flame interacts with turbulence and engine walls. These properties introduce new complexities in areas such as ignition kernel formation and propagation, turbulent flame development, flame-wall interactions, and engine heat transfer. This presentation focuses on spark-ignition engines and provides an overview of the key challenges associated with hydrogen combustion in these engines. It reviews simulation studies conducted at the University of Melbourne [1-7], highlighting various combustion modes observed in hydrogen-fueled engines. The talk also examines the influence of heat transfer modelling on the accuracy of simulation results. Finally, it concludes with recommendations on how high-fidelity simulation tools such as Direct Numerical Simulation (DNS) can be carefully used to improve existing models, and how novel approaches to heat transfer modelling may contribute to the development of more efficient engine designs.

References

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