Aalto University
School of Engineering

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Alternative Fuels for Climate-Neutrality and Decarbonization in Off-Road and Heavy-Duty Vehicles

Title of the dissertation	Experimental Studies on Fuel Effects in Dual-Fuel Combustion.
Contents of the dissertation	Current efforts to mitigate the global warming and reduce the level of local harmful emissions from transportation sector have urged the restrictions on the use of fossil fuels. Internal combustion engines (ICEs) are not itself the cause of the global warming, it is, in fact, the fossil fuels that they have been operated with. Using carbon-free, carbon-neutral, and even using low-carbon fuels can significantly help reduce greenhouse gas (GHG) emissions from transportation and other energy sectors. However, a reliable and effective utilization of alternative fuels in ICEs is often associated with a range of challenges. Dual-fuel (DF) combustion – advanced combustion concept can accommodate various alternative fuel; however, the DF operations are typically limited by misfire or high pressure-rise rates that require further investigations. An improved engine efficiency is the key aspect to improve fuel economy and reduce global fuel demand. This dissertation focuses on scientific support of the industry and accelerate the commercialization of alternative motor fuels that can substitute fossil fuels. Additionally, it facilitates the better understanding of the utilization of various alternative fuels including renewable diesel, methane, ethane, hydrogen, and methanol in the current and future fleet of heavy-duty vehicles, off-road machines, and marine ships. The targeted goals include broadening the knowledge about fuel properties and the way how they impact fuel's energy conversion processes in a compression ignition (CI) engine especially using DF combustion technology. The results discuss underlying fundamental mechanisms of the DF combustion progression and demonstrate a significant reduction of harmful emissions using fuel modifications and engine control strategies. In this dissertation, on average a thermal efficiency of ~50% is demonstrated, while with methanol it reached 55% with ultra-low NO_x and soot emissions at wide range of operating loads.
Field of the dissertation	Energy Technology, Internal Combustion Engines and Thermodynamics
Doctoral candidate	Zeeshan Ahmad, M.Sc., born in 1989 in Lahore, Pakistan
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Place of the defence	Aalto University School of Engineering, Department of Mechanical Engineering, Auditorium 216, Otakaari 4, 02150 Espoo, Finland. Defence can also to followed remotely at https://aalto.zoom.us/j/65892987795
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