

Editorial

Advanced Research on Internal Combustion Engines and Engine Fuels

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Abstract: Internal combustion (IC) engines serve as power devices that are widely applied in the fields of transport, engineering machinery, stationary power generation, etc., and are evolving towards the goal of higher efficiency and lower environmental impacts. In this Editorial, the role of IC engines for future transport and energy systems is discussed, and research directions for advancing IC engine and fuel technologies are recommended. Finally, we introduce the 14 technical papers collected for this Special Issue, which cover a wide range of research topics, including diesel spray characteristics, combustion technologies for low- and zero-carbon fuels, advanced combustion mode, fuel additive effects, engine operation under extreme conditions and advanced materials and manufacturing processes.

Keywords: internal combustion engine; fuel; renewable energy; carbon neutral; Special Issue

1. Introduction

Internal combustion (IC) engines have driven the development of human civilization and global economic growth, serving as a power device that is widely applied in the fields of transport, engineering machinery, stationary power generation, etc. The current global stock of passenger cars is around 1.19 billion, and the number of commercial vehicles totals 249 million, of which almost 99% are powered by IC engines, accounting for 81.3% of the oil demand in the transport sector [1]. Following that, maritime and aviation vehicles, which are also primarily powered by combustion engines, account for 7.9% and 7.1% of the transport oil demand, respectively [1]. Overall, the transport sector, including road, railway, aviation and shipping vehicles, accounts for 25.5% of global energy consumption [2] and contributes 16.2% of total global greenhouse gas (GHG) emissions as the fourth-largest source of emissions following industry (29.4%), agriculture, forestry and land use (18.4%) and construction (17.5%) [3]. Therefore, IC engines are a leading source of GHG emissions, and significant effort is needed to reduce their carbon footprint.

2. Current Status and Trends in IC Engine and Fuel Technologies

2.1. Progress in IC Engine Technologies

Since its conception in the late-19th century, the IC engine has undergone a continuous and rapid evolution and is now a complex assembly of numerous advanced technologies. To meet the ever-stringent emission regulations, tremendous effort has been dedicated to research and development aiming at an improvement in combustion efficiency and reduction in pollution emissions. The main harmful emissions generated from IC engine exhaust include particulate matter (PM), nitrogen oxide (NO_x), carbon monoxide (CO) and unburnt hydrocarbon (UHC). Figure 1 presents the trends in the US federal emission limits on PM, NO_x and non-methane organic gas (NMOG) emissions for light-duty fleet vehicles [4], which have been tightened significantly since their adoption in 1994. Over the past 40 years, including in the pre-regulation age, the emission levels of these harmful pollutants from IC engines have been effectively reduced by 100–1000 times. Taking the



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Advanced Internal Combustion Engine Research

**United States. Congress. House.
Committee on Appropriations.
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Advanced Internal Combustion Engine Research:

Advanced Direct Injection Combustion Engine Technologies and Development H Zhao, 2014-01-23 Direct injection enables precise control of the fuel air mixture so that engines can be tuned for improved power and fuel economy but ongoing research challenges remain in improving the technology for commercial applications As fuel prices escalate DI engines are expected to gain in popularity for automotive applications This important book in two volumes reviews the science and technology of different types of DI combustion engines and their fuels Volume 1 deals with direct injection gasoline and CNG engines including history and essential principles approaches to improved fuel economy design optimisation optical techniques and their applications Reviews key technologies for enhancing direct injection DI gasoline engines Examines approaches to improved fuel economy and lower emissions Discusses DI compressed natural gas CNG engines and biofuels

Advanced Internal Combustion Engines K. Sudhakar, Anil Kumar, 2016-02 This book is the outcome of many years of teaching of Advanced IC Engine subject and it is intended to serve as a reference for researchers and engineers The subject matter is arranged sequentially and presented in a very simple and systematic manner A large number of worked out examples are provided in Testing of IC Engine Chapter

Advances in Internal Combustion Engine Research Dhananjay Kumar Srivastava, Avinash Kumar Agarwal, Amitava Datta, Rakesh Kumar Maurya, 2017-11-29 This book discusses all aspects of advanced engine technologies and describes the role of alternative fuels and solution based modeling studies in meeting the increasingly higher standards of the automotive industry By promoting research into more efficient and environment friendly combustion technologies it helps enable researchers to develop higher power engines with lower fuel consumption emissions and noise levels Over the course of 12 chapters it covers research in areas such as homogeneous charge compression ignition HCCI combustion and control strategies the use of alternative fuels and additives in combination with new combustion technology and novel approaches to recover the pumping loss in the spark ignition engine The book will serve as a valuable resource for academic researchers and professional automotive engineers alike

Advanced Internal Combustion Engines B. Freeman, S. Knoke, EPRI solutions, Energy International, Inc, Electric Power Research Institute, 2001

Advanced Research on Internal Combustion Engines and Engine Fuels Zongyu Yue, Haifeng Liu, 2024-03-05 Internal combustion IC engines are the power devices most used in the fields of transport engineering machinery stationary power generation etc They have been evolving continuously over the past few decades and still have great potential to further improve to reach the ultimate goal of zero emissions This Special Issue on the subject of Advanced Research on Internal Combustion Engines and Engine Fuels is dedicated to sharing recent progress and findings from the engine research community covering the entirety of the wide scope of engine and fuel related research i e diesel spray characteristics combustion technologies for low and zero carbon fuels advanced combustion modes the additive effects of fuel engine operation under extreme conditions advanced materials and manufacturing

Artificial Intelligence and Data Driven

Optimization of Internal Combustion Engines Jihad Badra, Pinaki Pal, Yuanjiang Pei, Sibendu Som, 2022-01-05 Artificial Intelligence and Data Driven Optimization of Internal Combustion Engines summarizes recent developments in Artificial Intelligence AI Machine Learning ML and data driven optimization and calibration techniques for internal combustion engines The book covers AI ML and data driven methods to optimize fuel formulations and engine combustion systems predict cycle to cycle variations and optimize after treatment systems and experimental engine calibration It contains all the details of the latest optimization techniques along with their application to ICE making it ideal for automotive engineers mechanical engineers OEMs and R D centers involved in engine design Provides AI ML and data driven optimization techniques in combination with Computational Fluid Dynamics CFD to optimize engine combustion systems Features a comprehensive overview of how AI ML techniques are used in conjunction with simulations and experiments Discusses data driven optimization techniques for fuel formulations and vehicle control calibration

Proceedings of the FISITA 2012 World Automotive Congress SAE-China, FISITA, 2012-11-02 Proceedings of the FISITA 2012 World Automotive Congress are selected from nearly 2 000 papers submitted to the 34th FISITA World Automotive Congress which is held by Society of Automotive Engineers of China SAE China and the International Federation of Automotive Engineering Societies FISITA This proceedings focus on solutions for sustainable mobility in all areas of passenger car truck and bus transportation Volume 2 Advanced Internal Combustion Engines II focuses on Flow and Combustion Diagnosis Engine Design and Simulation Heat Transfer and Waste Heat Reutilization Emission Standard and International Regulations Above all researchers professional engineers and graduates in fields of automotive engineering mechanical engineering and electronic engineering will benefit from this book SAE China is a national academic organization composed of enterprises and professionals who focus on research design and education in the fields of automotive and related industries FISITA is the umbrella organization for the national automotive societies in 37 countries around the world It was founded in Paris in 1948 with the purpose of bringing engineers from around the world together in a spirit of cooperation to share ideas and advance the technological development of the automobile

FUNDAMENTALS OF INTERNAL COMBUSTION ENGINES, THIRD EDITION GUPTA, H. N., 2025-08-16 The book covers analysis of processes thermodynamic combustion fluid flow heat transfer friction and lubrication relevant to design performance efficiency fuel and emission requirements of internal combustion engines Besides it also includes special topics such as reactive systems fuel line hydraulics side thrust on the cylinder walls etc and modern developments such as electronic fuel injection systems electronic ignition systems electronic indicators exhaust emission requirements etc Most importantly the third edition introduces two new chapters on Advanced Combustion Engines and Electrical Vehicles The first chapter includes advanced low temperature combustion modes such as HCCI PCCI and RCCI models It also includes Flexible Fuel Vehicle and GDCI Engine whereas the latter chapter on Electric Vehicles discusses BEV HEV and Fuel Cell Vehicle KEY FEATURES Explains basic principles and applications in a clear concise and easy to read

manner Richly illustrated to promote a fuller understanding of the subject SI units are used throughout Example problems illustrate applications of theory End of chapter review questions and problems help students reinforce and apply key concepts Provides answers to all numerical problems TARGET AUDIENCE Providing a comprehensive introduction to the basics of Internal Combustion Engines this book is suitable for B Tech in mechanical engineering aeronautical engineering and automobile engineering M Tech Thermal Engineering in mechanical engineering A M I E Section B courses in mechanical engineering Competitive examinations such as Civil Services Engineering Services GATE etc In addition the book can be used for refresher courses for professionals in automobile industries

Alternative Fuels and Advanced Combustion Techniques as Sustainable Solutions for Internal Combustion Engines Akhilendra Pratap

Singh,Dhananjay Kumar,Avinash Kumar Agarwal,2021-05-15 This monograph covers different aspects related to utilization of alternative fuels in internal combustion IC engines with a focus on biodiesel dimethyl ether alcohols biogas etc The focal point of this book is to present engine combustion performance and emission characteristics of IC engines fueled by these alternative fuels A section of this book also covers the potential strategies of utilization of these alternative fuels in an energy efficient manner to reduce the harmful pollutants emitted from IC engines It presents the comparative analysis of different alternative fuels in a variety of engines to show the appropriate alternative fuel for specific types of engines This book will prove useful for both researchers as well as energy experts and policy makers

Advanced Direct Injection Combustion Engine Technologies and Development H Zhao,2009-12-18 Volume 2 of the two volume set Advanced direct injection combustion engine technologies and development investigates diesel DI combustion engines which despite their commercial success are facing ever more stringent emission legislation worldwide Direct injection diesel engines are generally more efficient and cleaner than indirect injection engines and as fuel prices continue to rise DI engines are expected to gain in popularity for automotive applications Two exclusive sections examine light duty and heavy duty diesel engines Fuel injection systems and after treatment systems for DI diesel engines are discussed The final section addresses exhaust emission control strategies including combustion diagnostics and modelling drawing on reputable diesel combustion system research and development Investigates how HSDI and DI engines can meet ever more stringent emission legislation Examines technologies for both light duty and heavy duty diesel engines Discusses exhaust emission control strategies combustion diagnostics and modelling

Advanced Manufacturing in Biological, Petroleum, and Nanotechnology Processing Augustine O. Ayeni,Olagoke Oladokun,Oyinkepreye David Orodu,2022-05-03 This book covers advanced manufacturing in biological petroleum and nanotechnology processing for the development of novel products and systems that incorporate enhanced pollution control and waste management for environmental remediation The book is divided into three parts The first section looks at the design and application of process systems the second section focuses largely on pollution control and management and the final section discusses areas related to process modeling and simulation Coverage highlights the

integration of smart tools and solutions and looks at current advances in monitoring industrial and environmental processes that can assist in making significant progress in process design for the effective control of pollution and waste management

An Introduction to Thermodynamic Cycle Simulations for Internal Combustion Engines Jerald A.

Caton, 2015-10-16 This book provides an introduction to basic thermodynamic engine cycle simulations and provides a substantial set of results. Key features include comprehensive and detailed documentation of the mathematical foundations and solutions required for thermodynamic engine cycle simulations. The book includes a thorough presentation of results based on the second law of thermodynamics as well as results for advanced high efficiency engines. Case studies that illustrate the use of engine cycle simulations are also provided.

Energy and Water Development Appropriations for 2006: Dept. of the Army, Corps of Engineers United States. Congress. House. Committee on Appropriations.

Subcommittee on Energy and Water Development, 2005 Proceedings of the FISITA 2012 World Automotive Congress SAE-China, FISITA, 2012-11-02 Proceedings of the FISITA 2012 World Automotive Congress are selected from nearly 2 000 papers submitted to the 34th FISITA World Automotive Congress which is held by Society of Automotive Engineers of China SAE China and the International Federation of Automotive Engineering Societies FISITA. This proceedings focus on solutions for sustainable mobility in all areas of passenger car truck and bus transportation. Volume 1 Advanced Internal Combustion Engines I focuses on New Gasoline Direct Injection GDI Spark Ignition SI Compression Ignition CI Engines and Components Fuel Injection and Sprays Fuel and Lubricants After Treatment and Emission Control. Above all researchers professional engineers and graduates in fields of automotive engineering mechanical engineering and electronic engineering will benefit from this book. SAE China is a national academic organization composed of enterprises and professionals who focus on research design and education in the fields of automotive and related industries. FISITA is the umbrella organization for the national automotive societies in 37 countries around the world. It was founded in Paris in 1948 with the purpose of bringing engineers from around the world together in a spirit of cooperation to share ideas and advance the technological development of the automobile.

FY2011 Annual Progress Report for Advanced Combustion Engine Research and Development, 2011 Annual Progress Report for the Advanced Combustion Engine Research and Development R D subprogram supporting the mission of the Vehicle Technologies Program by removing the critical technical barriers to commercialization of advanced internal combustion engines ICEs for passenger and commercial vehicles that meet future federal emissions regulations.

Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance Richard Folkson, 2014-03-19 Most vehicles run on fossil fuels and this presents a major emissions problem as demand for fuel continues to increase. Alternative Fuels and Advanced Vehicle Technologies gives an overview of key developments in advanced fuels and vehicle technologies to improve the energy efficiency and environmental impact of the automotive sector. Part I considers the role of alternative fuels such as electricity alcohol and hydrogen fuel cells as well as

advanced additives and oils in environmentally sustainable transport Part II explores methods of revising engine and vehicle design to improve environmental performance and fuel economy It contains chapters on improvements in design aerodynamics combustion and transmission Finally Part III outlines developments in electric and hybrid vehicle technologies and provides an overview of the benefits and limitations of these vehicles in terms of their environmental impact safety cost and design practicalities **Alternative Fuels and Advanced Vehicle Technologies** is a standard reference for professionals engineers and researchers in the automotive sector as well as vehicle manufacturers fuel system developers and academics with an interest in this field Provides a broad ranging review of recent research into advanced fuels and vehicle technologies that will be instrumental in improving the energy efficiency and environmental impact of the automotive sector Reviews the development of alternative fuels more efficient engines and powertrain technologies as well as hybrid and electric vehicle technologies

The Testing of High Speed Internal Combustion Engines Arthur William Judge,1924 *FY2009 Annual Progress Report for Advanced Combustion Engine Research and Development* ,2009 Fiscal Year 2009 Annual Progress Report for the Advanced Combustion Engine Research and Development R D subprogram The Advanced Combustion Engine R D subprogram supports the mission of the VTP program by removing the critical technical barriers to commercialization of advanced internal combustion engines ICEs for passenger and commercial vehicles that meet future Federal emissions regulations Dramatically improving the efficiency of ICEs and enabling their introduction in conventional as well as hybrid electric vehicles is the most promising and cost effective approach to increasing vehicle fuel economy over the next 30 years **Advanced Direct Injection Combustion Engine Technologies and Development** H. Zhao,2010-02-01 Volume 2 of the two volume set Advanced direct injection combustion engine technologies and development investigates diesel DI combustion engines which despite their commercial success are facing ever more stringent emission legislation worldwide Direct injection diesel engines are generally more efficient and cleaner than indirect injection engines and as fuel prices continue to rise DI engines are expected to gain in popularity for automotive applications Two exclusive sections examine light duty and heavy duty diesel engines Fuel injection systems and after treatment systems for DI diesel engines are discussed The final section addresses exhaust emission control strategies including combustion diagnostics and modelling drawing on reputable diesel combustion system research and development **Annual Catalogue** Massachusetts Institute of Technology,1929

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