Gasoline Direct Injection Engine Cold Start Improvement By

GLOVER MIDDLETON

Investigations on the Pollutant Emissions of Gasoline Direct Injection Engines During Cold-start Elsevier
As the CO2 emission standards around the world become more stringent, the turbocharged downsized gasoline direct injection (GDI) engine provides a mature platform to achieve better fuel economy. For this reason, it is expected that the GDI engine will capture increasing shares of the market during the coming years. The in-cylinder liquid injection, though advantageous in most engine operation regimes, creates emissions challenges during the cold crank-start and cold fast-idle phases. The engine cold-start is responsible for a disproportionate share of the hydrocarbons (HC), nitrogen oxides (NOx) and particulate matter (PM) emitted over the certification cycle. Understanding the sources of the pollutants during this stage is necessary for the further market penetration of GDI under the constraint of tighter emission standards. This work aims to examine the formation processes of the HC, NOx and PM emissions during the cold-start phase in a GDI engine, and the sensitivity of the pollutant emissions to different operation strategies. To this end, a detailed analysis of the crank-start was carried out, in which the first three engine cycles were individually examined. For the steady-state phase, the trade-off between low fast-idle emissions and high exhaust thermal enthalpy flow, necessary for fast catalyst warm-up, is investigated under several operation strategies. The pollutant formation processes are strongly dependent on the mixture formation and on the temperature and pressure history of the combustion process. The results show that unconventional valve timing strategies with large, symmetric, negative valve overlap and delayed combustion phasing are the most effective ways to reduce engine-out emissions during both crank-start and fast-idle phases.

Motorcycle Fuel Injection Handbook Springer Nature
This book gathers a selection of peer-reviewed papers presented at the 2nd International Conference on Experimental and Computational Mechanics in Engineering (ICECME 2020), held as a virtual conference and organized by Universitas Syiah Kuala, Banda Aceh, Indonesia, on 13–14 October 2020. The contributions, prepared by international scientists and engineers, cover the latest advances in computational mechanics, metallurgy and material science, energy systems, manufacturing processing systems, industrial and system engineering, biomechanics, artificial intelligence, micro/nano-engineering, micro-electro-mechanical system, machine learning, mechatronics, and engineering design. The book is intended for academics, including graduate students and researchers, as well as industrial practitioners working in the areas of experimental and computational mechanics.
Proceedings of the 3rd VAE2020, Miskolc, Hungary Springer Science & Business Media
This book highlights recent findings in industrial, manufacturing and mechanical engineering, and provides an overview of the state of the art in these fields, mainly in Russia and Eastern Europe. A broad range of topics and issues in modern engineering are discussed, including the dynamics of machines and working processes, friction, wear and lubrication in machines, surface transport and technological machines, manufacturing engineering of industrial facilities, materials engineering, metallurgy, control systems and their industrial applications, industrial mechatronics, automation and robotics. The book gathers selected papers presented at the 6th International Conference on Industrial Engineering (ICIE), held in Sochi, Russia in May 2020. The authors are experts in various fields of engineering, and all papers have been carefully reviewed. Given its scope, the book will be of interest to a wide readership, including mechanical and production engineers, lecturers in engineering disciplines, and engineering graduates.
Gasoline Direct Injection Engine and Spark Ignition Performance Springer Nature
This book focuses on gasoline compression ignition (GCI) which offers the prospect of engines with high efficiency and low exhaust emissions at a lower cost. A GCI engine is a compression ignition (CI) engine which is run on gasoline-like fuels (even on low-octane gasoline), making it significantly easier to control particulates and NOx but with high efficiency. The state of the art development to make GCI combustion feasible on practical vehicles is highlighted, e.g., on overcoming problems on cold start, high-pressure rise rates at high loads, transients, and HC and CO emissions. This book will be a useful guide to those in academia and industry.
Numerical Modeling of Gasoline Direct Injection Spark Ignition Engines During Cold-start Springer Nature
Abstract : In this thesis, two different works related to cold start of a direct-injection (DI) gasoline engine are shown. First, effect of split injection is studied on engine exhaust temperature and hydrocarbon emissions for cold start conditions. Instead of single injection, two injections are done, one injection during the intake stroke and one injection during the compression stroke. Split injection is known to reduce jet wall wetting, thus reducing the hydrocarbon emissions from engine itself. Further, split injection reduces engine cycle-by-cycle variability with respect to the single injection case. Correlations between start of injection for the injection in the intake stroke (SOI), end of injection for the injection in the compression stroke (EOI) and Split Ratio (SR) with Exhaust Temperature (Texh) and engine hydrocarbon emissions are proposed with the help of design of experiments (DOE). These correlations could be used for controlling exhaust temperature during cold start. Second, because of repetitive marshalling of a vehicle, i.e. cold start the engine on the vehicle and drive it a few feet and then turn it off, spark plugs are observed to get fouled. A spark plug is considered to be fouled when the insulator nose becomes coated with a foreign substance including oil, fuel or carbon. This enables the ignition coil voltage to follow along the insulator nose and ground out rather than bridging gap and firing normally. A tool to measure quasi real-time spark plug fouling is proposed in this work, which uses in-cylinder ion data to measure offset voltage which is then used to calculate spark plug shunt resistance. Based on the spark plug shunt resistance, fouling level of the plug can be calculated, and the condition of the plug can be determined.
Proceedings of China SAE Congress 2018: Selected Papers ASTM International
Farm Machinery has long been the standard book on current theory and practice for both students and farmers. This fully revised 5th edition incorporates new text and photographs which reflect the many changes and developments that have taken place over the last decade. This new text has been added to complement earlier material concerning the working principles, operation and maintenance of vast array of the somewhat less sophisticated farm tractors and farm machines in use on British farms in the twenty-first century. There are chapters on tractors, cultivation and drilling machinery, crop treatment and harvest machinery. Further sections deal with farmyard and estate maintenance machinery, mechanical handlers, dairy equipment, irrigation, farm power and the farm workshop.
Fuels and Lubricants Handbook Springer Nature
This book presents the proceedings of the third Vehicle and Automotive Engineering conference, reflecting the outcomes of theoretical and practical studies and outlining future development trends in a broad field of automotive research. The conference's main themes included design, manufacturing, economic and educational topics.
Advanced Direct Injection Combustion Engine Technologies and Development BoD – Books on Demand
Gasoline consumption and pollutant emissions from transportation are costly and have serious, demonstrated environmental and health impacts. Downsized, turbocharged direct-injection spark ignition (DISI) gasoline engines consume less fuel and achieve superior performance compared with conventional port fuel injected spark ignition (PFI-SI) engines. Although more efficient, turbocharged DISI engines have new emissions challenges during cold start. DISI fuel injection delivers more liquid fuel into the combustion chamber, increasing the emissions of unburned hydrocarbons. The turbocharger slows down activation (warm-up) of the catalytic exhaust after-treatment system. The objective of this research is to find a control strategy that: 1. Accelerates warm-up of the catalyst, and 2. Maintains low emissions of unburned hydrocarbons (UBHCs) during the catalyst warm-up process. This research includes a broad experimental survey of engine behaviour and emission response for a modern turbocharged DISI engine. The study focuses on the idle period during cold-start for which DISI engine emissions are worst. Engine experiments and simulations show that late and slow combustion lead to high exhaust gas temperatures and mass flow rate for fast warm-up. However, late and slow combustion increase the risk of partial-burn misfire. At the misfire limit for

each parameter, the following conclusions are drawn: 1. Late ignition timing is the most effective way to increase exhaust enthalpy flow rate for fast catalyst warm-up. 2. By creating a favourable spatial fuel-air mixture stratification, split fuel injection can simultaneously retard and stabilize combustion to improve emissions and prevent partial-burn misfire. 3. Excessive trapped residuals from long valve overlap limit the potential for valve timing to reduce cold-start emissions. 4. Despite their more challenging evaporation characteristics, fuel blends with high ethanol content showed reasonable emissions behaviour and greater tolerance to late combustion than neat gasoline. 5. Higher exhaust back-pressure leads to high exhaust temperature during the exhaust stroke, leading to significantly more post-flame oxidation. 6. Post-flame oxidation in the combustion chamber and exhaust system play a critical role in decreasing the quantity of catalyst-in emissions due to hydrocarbons that escape primary (flame) combustion. A cold start strategy combining late ignition, 15% excess air, and high exhaust backpressure yielded the lowest cumulative hydrocarbon emissions during cold start.

Proceedings of the 2nd International Conference on Experimental and Computational Mechanics in Engineering Springer Nature

This thorough how-to manual helps the off-road motorcycle enthusiast get the most out of their machine. This one-stop reference covers everything from basic maintenance to performance modifications, including: • Engine rebuilding• Transmission rebuilding• Clutch repair and rebuilding• Big-bore kits• Cam kits and valve timing and tuning• Tuning stock suspension• Suspension revalving and kits• Jetting and tuning carburetors• Tuning electronic fuel injection• Wheels, tires, and brakes• Chains and sprockets• Cooling systems • Electrical systems

Future Strategies for a Climate-Neutral Mobility Fox Chapel Publishing

This book presents the papers from the Internal Combustion Engines: Performance, fuel economy and emissions held in London, UK. This popular international conference from the Institution of Mechanical Engineers provides a forum for IC engine experts looking closely at developments for personal transport applications, though many of the drivers of change apply to light and heavy duty, on and off highway, transport and other sectors. These are exciting times to be working in the IC engine field. With the move towards downsizing, advances in FIE and alternative fuels, new engine architectures and the introduction of Euro 6 in 2014, there are plenty of challenges. The aim remains to reduce both CO2 emissions and the dependence on oil-derivate fossil fuels whilst meeting the future, more stringent constraints on gaseous and particulate material emissions as set by EU, North American and Japanese regulations. How will technology developments enhance performance and shape the next generation of designs? The book introduces compression and internal combustion engines' applications, followed by chapters on the challenges faced by alternative fuels and fuel delivery. The remaining chapters explore current improvements in combustion, pollution prevention strategies and data comparisons. presents the latest requirements and challenges for personal transport applications gives an insight into the technical advances and research going on in the IC Engines field provides the latest developments in compression and spark ignition engines for light and heavy-duty applications, automotive and other markets

Flow and Combustion in Reciprocating Engines Elsevier

This proceedings volume gathers outstanding papers submitted to the 2016 SAE-China Congress, the majority of which are from China, the biggest car maker as well as most dynamic car market in the world. The book includes insights into the current challenges that the whole industry is currently facing, and it offers possible solutions to problems such as emission controls, environmental pollution, the energy shortage, traffic congestion and sustainable development. It also presents the latest technical achievements in the automotive industry. Many of the approaches it presents can help technicians to solve the practical problems that most affect their daily work.

Farm Machinery expert verlag

Abstract : The in-cylinder trapped air, residual gas, and temperature are important dynamic parameters in Gasoline Direct Injection (GDI) Spark Ignition (SI) engines for fuel and combustion control. However, their real-time prediction for transient engine operations is complicated, especially when concerning variable valve timing. A dynamic cycle-by-cycle control-oriented discrete nonlinear model is proposed and developed in this thesis to estimate the in-cylinder mixture temperature and the mass of trapped air, and residual gas at the point of Intake Valve Closing (IVC). The developed model uses in-cylinder, intake, and exhaust pressures as the primary inputs. The exhaust gas backflow into the cylinder is estimated using a compressible ideal gas model that is designed for engines equipped with Variable Valve Timing (VVT). The designed model is integrated into a rapid-prototype control system for real-time operation. The model's dynamic behavior is validated using an engine dynamometer transient test cycle under real-time conditions. The cold crank-start phase significantly contributes to total engine-out emissions during the US Federal Test Procedure (FTP). The first three engine cycles of the cold crank-start for a Gasoline Direct Injection (GDI) engine in Hybrid Electric Vehicle (HEV) elevated cranking speed is investigated at 20°C. To this end, the impact of the operating strategy on the individual-cylinder engine-out emissions is analyzed quantitatively. For this purpose, a new dynamic method was developed to translate the engine-out emissions concentration measured at the exhaust manifold outlet to mass per cycle per cylinder. The HEV elevated cranking speed provides valve timing control, throttling, and increased fuel injection pressure from the first firings. This study concentrates on analyzing the cranking speed, spark timing, valve timing, and fuel injection strategy, and parameter effects on engine-out emissions. Design of Experiment (DOE) method is used to create a two-step multi-level fractional-factorial test plan with a minimum number of test points to evaluate the significant parameters affecting engine-out emissions during cold crank-start. The split injection parameters, including the Start of the first Injection (SOI), End of the second injection (EOI), and split ratio, in addition to the first cycle additive fuel factor, are investigated. Results show that using the high cranking speed with stabilized low intake Manifold Absolute Pressure (MAP), highly-retarded spark timing, high valve overlap, late intake first injection, 30 CAD bTDC firing EOI, and low first cycle fuel factor reduces the average first three cycles HC emission by 94\%.

Particulate Emissions from Vehicles Motorbooks

Developing a profound understanding of the combustion characteristics of the cold-start phase of a Direct Injection Spark Ignition (DISI) engine is critical to meeting the increasingly stringent emissions regulations. Computational Fluid Dynamics (CFD) modeling of gasoline DISI combustion under normal operating conditions has been discussed in detail using both the detailed chemistry approach and flamelet models (e.g., the G-

Equation). However, there has been little discussion regarding the capability of the existing models to capture DISI combustion under cold-start conditions. Accurate predictions of cold-start behavior involves the efficient use of multiple models - spray modeling to capture the split injection strategies, models to capture the wall-film interactions, ignition modeling to capture the effects of retarded spark timings, combustion modeling to accurately capture the flame front propagation, and turbulence modeling to capture the effects of decaying turbulent kinetic energy. The retarded spark timing helps to generate high heat flux in the exhaust for a rapid catalyst light-off of the after-treatment system during cold-start. However, the adverse effect is a reduced turbulent flame speed due to decaying turbulent kinetic energy. Accordingly, developing an understanding of the turbulence-chemistry interactions is imperative for accurate modeling of combustion under cold-start conditions.This study introduces a modified version of the G-Equation combustion model called the GLR model (G-Equation for Lower Reynolds number regimes) that exhibits improved performance under cold-start conditions. The model attempts to estimate the turbulent flame speed based on the local conditions of fuel concentration and turbulence intensity. The local conditions and the associated turbulent-chemistry interactions are studied by tracking the flame front on the Borghi-Peters regime diagram. To accurately model the DISI combustion process, it is important to account for the effects of the spark energy discharge process. In this work, an ignition model is presented that is compatible with the G-Equation combustion model, and which accounts for the effects of plasma expansion and local mixture properties such as turbulence and the equivalence ratio on the early flame kernel growth. The model is referred to as the Plasma Velocity on G-Surface (PVG) model, and it uses the G-surface to capture the kernel growth. The model derives its theory from the DPIK model and applies its concepts onto an Eulerian framework, thereby removing the need for Lagrangian particles to track the kernel growth. Finally, a methodology of using machine learning (ML) techniques in combination with 3D CFD modeling to optimize the cold-start fast-idle phase of a DISI engine is presented. The optimization process implies the identification of the range of operating parameters, that will ensure the following criteria under cold-start conditions: (1) a fixed IMEP of 2 bar (BMEP of 0 bar), (2) a stoichiometric exhaust equivalence ratio (based on carbon-to-oxygen atoms) to ensure the efficient operation of the after-treatment system, (3) enough exhaust heat flux to ensure a rapid light-off of the after-treatment system, and (4) acceptable NOx and HC emissions. Gaussian Process Regression (GPR)-based ML models are employed to make predictions about DISI cold-start behavior with acceptable accuracy and a substantially reduced computational time.

Design and Development of an Electronically Controlled, Air Assisted, Fuel Injection System for Reducing Cold Start Emissions from a Methanol and Gasoline Fueled Spark Ignition Engine Springer

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.

Automotive Spark-Ignited Direct-Injection Gasoline Engines CarTech Inc

This book focuses on natural gas and synthetic methane as contemporary and future energy sources. Following a historical overview, physical and chemical properties, occurrence, extraction, transportation and storage of natural gas are discussed. Sustainable production of natural gas and methane as well as production and storage of synthetic methane are scrutinized next. A substantial part of the book addresses construction of vehicles for natural and synthetic methane as well as large engines for industrial and maritime use. The last chapters present some perspectives on further uses of renewable liquid fuels as well as natural gas for industrial engines and gas power plants.

Hcci and Cai Engines for the Automotive Industry ScholarlyEditions

Looks at the combustion basics of fuel injection engines and offers information on such topics as VE equation, airflow estimation, setups and calibration, creating timing maps, and auxiliary output controls.

How to Tune and Modify Bosch Fuel Injection Springer Nature

Providing thorough coverage of both fundamental electrical concepts and current automotive electronic systems, COMPUTERIZED ENGINE CONTROLS, Tenth Edition, equips readers with the essential knowledge they need to successfully diagnose and repair modern automotive systems. Reflecting the latest technological advances from the field, the Tenth Edition offers updated and expanded coverage of diagnostic concepts, equipment, and approaches used by today's professionals. The author also provides in-depth insights into cutting-edge topics such as hybrid and fuel cell vehicles, automotive multiplexing systems, and automotive electronic systems that interact with the engine control system. In addition, key concepts are reinforced with ASE-style end-of-chapter questions to help prepare readers for certification and career success. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Fuel Injection Pressure Effects on the Cold Start Performance of a GDI Engine Woodhead Publishing

With the signing of the Paris Agreement in December 2015 the United Nations explained their willingness to limit the GHG Emissions and contribute to the measures against the global warming effect. In 2019 the European Commission proposed the Green Deal and as a consequence the target to be climate neutral in 2050. In consequence the fossil based energy system has to transform into a climate-neutral energy system with renewable and sustainable energy carriers. Research on and development of alternative fuels and new production processes are ongoing to provide the technical solution. Political actions are needed to provide the economic framework for the introduction of such alternative fuel solutions. The fulfilment of the European CO2 reduction targets until 2050 needs realistic technical solutions including backwards compatible approaches for existing vehicle fleets. An economic and sustainable development towards climate neutral mobility requires a holistic view based on life cycle assessments for the different mobility approaches including the economic impacts as well as financing options. A synergetic discussion of solutions for future fuels and powertrain technologies is needed to develop an economic pathway to a sustainable and affordable mobility of

tomorrow. The challenging goal for mobility can only be achieved through an international cooperation of universities, the automobile industry, energy producers, the oil industry and the legislative bodies of the member states. The international colloquium aims to contribute to the development of a climate-neutral mobility by exchanging views on and discussing all aspects connected with the "powertrain/fuel/environment" system, including the necessary political regulations.

Handbook of Thermal Management of Engines Springer

Investigations on the Pollutant Emissions of Gasoline Direct Injection Engines During Cold-start ScholarlyBrief Springer Nature

Optimization of combustion processes in automotive engines is a key factor in reducing fuel consumption. This book, written by eminent university and industry researchers, investigates and describes flow and combustion processes in diesel and gasoline engines.

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