

Constantine D. Rakopoulos
Evangelos G. Giakoumis

Diesel Engine Transient Operation

Principles of Operation
and Simulation Analysis



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Diesel Engine Transient Operation Constantine D. Rakopoulos, Evangelos G. Giakoumis, 2009-03-10 Traditionally the study of internal combustion engines operation has focused on the steady state performance However the daily driving schedule of automotive and truck engines is inherently related to unsteady conditions In fact only a very small portion of a vehicle s operating pattern is true steady state e g when cruising on a motorway Moreover the most critical conditions encountered by industrial or marine engines are met during transients too Unfortunately the transient operation of turbocharged diesel engines has been associated with slow acceleration rate hence poor driveability and overshoot in particulate gaseous and noise emissions Despite the relatively large number of published papers this very important subject has been treated in the past scarcely and only segmentally as regards reference books Merely two chapters one in the book *Turbocharging the Internal Combustion Engine* by N Watson and M S Janota McMillan Press 1982 and another one written by D E Winterbone in the book *The Thermodynamics and Gas Dynamics of Internal Combustion Engines Vol II* edited by J H Horlock and D E Winterbone Clarendon Press 1986 are dedicated to transient operation Both books now out of print were published a long time ago Then it seems reasonable to try to expand on these pioneering works taking into account the recent technological advances and particularly the global concern about environmental pollution which has intensified the research on transient diesel engine operation typically through the Transient Cycles certification of new vehicles

Optimizing Diesel Engine Operation Strategy During Transient Operation Markus Hehn, *Measurement of Diesel Engine Emissions During Transient Operation*, 2007 **Simplified Models for Emission Formation in Diesel Engines**

During Transient Operation Anders Westlund, 2011 **Nanoparticles in medicine and environment** J.C. Marijnissen, Leon Gradon, 2009-12-01 A huge effort is put into the science of nanoparticles and their production In many cases it is unavoidable that nanoparticles are released into the environment either during the production processes or during the use of a product made from these particles It is also realized that combustion processes like traffic and power plants release nanoparticles into the atmosphere However it is not known how nanoparticles interact with the human body especially upon inhalation At the same time research activities are devoted to understand how nano sized medicine particles can be used to administer medicines via inhalation In any case it is absolutely necessary to know how the nanoparticles interfere with the inhalation system how they deposit and affect on the human system Three main themes are discussed Nanoparticle sources and production Nanoparticle inhalation and deposition Toxicological and medical consequences of nanoparticles Each theme is covered comprehensively starting at nano quantum effects up to technical and medical applications such as measuring equipment and inhalation instrumentation This book brings together all sub disciplines in the field related to aerosol nanoparticles Each chapter is written by a world expert giving the state of the art information and challenging open questions The last chapter summarizes in an interdisciplinary way what is already known and what still is

ahead of us Diesel Emissions and Their Control Magdi K Khair,W Addy Majewsky,2006-12-01 This book will assist readers in meeting today s tough challenges of improving diesel engine emissions diesel efficiency and public perception of the diesel engine It can be used as an introductory text while at the same time providing practical information that will be useful for experienced readers This comprehensive book is well illustrated with more than 560 figures and 80 tables Each main section is broken down into chapters that offer more specific and extensive information on current issues as well as answers to technical questions Modeling and Control of Engines and Drivelines Lars Eriksson,Lars Nielsen,2014-02-27

Modeling and Control of Engines and Drivelines Control systems have come to play an important role in the performance of modern vehicles with regards to meeting goals on low emissions and low fuel consumption To achieve these goals modeling simulation and analysis have become standard tools for the development of control systems in the automotive industry Modeling and Control of Engines and Drivelines provides an up to date treatment of the topic from a clear perspective of systems engineering and control systems which are at the core of vehicle design This book has three main goals The first is to provide a thorough understanding of component models as building blocks It has therefore been important to provide measurements from real processes to explain the underlying physics to describe the modeling considerations and to validate the resulting models experimentally Second the authors show how the models are used in the current design of control and diagnosis systems These system designs are never used in isolation so the third goal is to provide a complete setting for system integration and evaluation including complete vehicle models together with actual requirements and driving cycle analysis Key features Covers signals systems and control in modern vehicles Covers the basic dynamics of internal combustion engines and drivelines Provides a set of standard models and includes examples and case studies Covers turbo and super charging and automotive dependability and diagnosis Accompanied by a web site hosting example models and problems and solutions Modeling and Control of Engines and Drivelines is a comprehensive reference for graduate students and the authors close collaboration with the automotive industry ensures that the knowledge and skills that practicing engineers need when analysing and developing new powertrain systems are also covered **Review of Thermodynamic**

Diesel Engine Simulations Under Transient Operating Conditions Constantine D. Rakopoulos,Evangelos G. Giakoumis,2006 Study and modeling of transient operation is an important scientific objective This is due to the fact that the majority of daily vehicle driving conditions involve transient operation with non linear situations experienced during engine transients Thus proper interconnection is needed between engine governor fuel pump turbocharger and load This paper surveys the publications available in the open literature concerning diesel engine simulations under transient operating conditions Only those models that include both full engine thermodynamic calculations and dynamic powertrain modeling are taken into account excluding those that focus on control design and optimization Most of the attention is concentrated to the simulations that follow the filling and emptying modeling approach A historical overview is given covering in more detail

research groups with continuous and consistent study of transient operation One of the main purposes of this paper is to summarize basic equations and modeling aspects concerning in cylinder calculations friction turbocharger engine dynamics governor fuel pump operation and exhaust emissions during transients The various limitations of the models are discussed together with the main aspects of transient operation e g turbocharger lag combustion and friction deterioration which diversify it from the steady state Some of the most important findings in the field during the last 30 years are presented and discussed The survey extends to special cases of transient diesel engine simulation such as second law analysis response when the turbocharger compressor experiences surge and whole vehicle performance Several methods of improving transient response are also mentioned based on the various simulations An easy to read tabulation of all research groups dealing with the subject that includes details about each model developed and engines parameters studied is also provided at the end of the paper SAE website [Design and Control of Diesel and Natural Gas Engines for Industrial and Rail Transportation Applications](#) American Society of Mechanical Engineers. Internal Combustion Engine Division, American Society of Mechanical Engineers. Internal Combustion Engine Division. Technical Conference, 2003 *Transient Diesel Emissions: Analysis of Engine Operation During a Tip-In* Jonathan R. Hagena, 2006 **Commerce Business Daily**, 1998-10

[Experimental Investigation of Transient Operation and Low Temperature Combustion in a Light Duty Diesel Engine](#), 2012 Detailed and highly time resolved experimental measurements were used to characterize the effects of transient operation on the performance of a light duty diesel engine and to identify the physical processes responsible for transient specific combustion behavior The engine response to transient events varied with the size and type of transition and the combustion strategy used but the underlying processes were similar in all cases Differences in the response rate of the fuel and air systems caused large variations in the equivalence ratio of the combustion charge during transient events For moderate to low load conditions this was primarily due to the discrepancy between the instantaneous intake air flow rate and the composition of the intake charge caused by storage of exhaust gas in the EGR system This effect was particularly significant for early injection LTC operation due to higher EGR rates and greater dependence of combustion phasing on intake charge composition Individual combustion cycles during transient events were compared to steady state operation at the same speed and load to quantify the differences in physical conditions The greatest effect on combustion and emissions was due to differences in intake charge composition which varied significantly between transient and steady state operation The response time of the common rail pressure also contributed to transient behavior in situations where the target pressure varied with changes in speed or load During larger load transitions thermal inertia of the engine system had a significant effect on emissions particularly UHC but did not influence the combustion phasing or heat release rate The characteristic rates of change of the charge gas fluid and physical component temperatures in response to speed or load transitions were much slower than those of other variables such as pressures or flow rates and were consistent with concurrent variations in

engine out emissions levels Numerous mechanisms by which thermal inertia could affect emissions formation were identified including variation of the intake manifold charge gas temperature in cylinder heat transfer and changing physical properties of the fuel

Experimental Investigation of Transient Operation and Low Temperature Combustion in a Light Duty Diesel Engine ,2012 Detailed and highly time resolved experimental measurements were used to characterize the effects of transient operation on the performance of a light duty diesel engine and to identify the physical processes responsible for transient specific combustion behavior The engine response to transient events varied with the size and type of transition and the combustion strategy used but the underlying processes were similar in all cases Differences in the response rate of the fuel and air systems caused large variations in the equivalence ratio of the combustion charge during transient events For moderate to low load conditions this was primarily due to the discrepancy between the instantaneous intake air flow rate and the composition of the intake charge caused by storage of exhaust gas in the EGR system This effect was particularly significant for early injection LTC operation due to higher EGR rates and greater dependence of combustion phasing on intake charge composition Individual combustion cycles during transient events were compared to steady state operation at the same speed and load to quantify the differences in physical conditions The greatest effect on combustion and emissions was due to differences in intake charge composition which varied significantly between transient and steady state operation The response time of the common rail pressure also contributed to transient behavior in situations where the target pressure varied with changes in speed or load During larger load transitions thermal inertia of the engine system had a significant effect on emissions particularly UHC but did not influence the combustion phasing or heat release rate The characteristic rates of change of the charge gas fluid and physical component temperatures in response to speed or load transitions were much slower than those of other variables such as pressures or flow rates and were consistent with concurrent variations in engine out emissions levels Numerous mechanisms by which thermal inertia could affect emissions formation were identified including variation of the intake manifold charge gas temperature in cylinder heat transfer and changing physical properties of the fuel

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