

Nikolaos Xiros

# Robust Control of Diesel Ship Propulsion

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Xiros



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**Nikolaos Xiros**



## **Robust Control Of Diesel Ship Propulsion:**

**Robust Control of Diesel Ship Propulsion** Nikolaos Xiros, 2002-08-05 Based on the author's research and practical projects he presents a broad view of the needs and problems of the shipping industry in this area. The book covers several models and control types developing an integrated nonlinear state space model of the marine propulsion system. *Robust Control of Diesel Ship Propulsion* Nikolaos Xiros, 2012-12-06 This book covers a number of models and control types. An integrated nonlinear state space model of the marine propulsion system is developed. This is based upon physical principles that incorporate uncertainties arising from engine thermodynamics and disturbances arising from propeller hydrodynamics. The model employs artificial neural networks to depict the nonlinearities of the thermochemical processes of engine power torque generation and the engine turbocharger dynamical interaction. Neural nets combine the required mathematical flexibility and formalism with numerical training and calibration options using either thermodynamic engine models or measured data series. The neural state space model is decomposed appropriately to provide a linearised perturbation model suitable for controller synthesis. The proportional integral derivative control law is examined under the perspective of shaft speed regulation for enhanced disturbance rejection of the propeller load. The typical marine shafting system dynamics and configuration allow for a smart implementation of the D term on shaft torque feedback. Full state feedback control is examined for increased robustness of the compensated plant against parametric uncertainty and neglected dynamics. The H requirements on the closed loop transfer matrix are appropriately decomposed to similar ones on scalar transfer functions which give specifications that are easier to manipulate. In effect the methods are comparatively assessed and suggestions and practical applications are given. This synthetic approach to propulsion plant control and operational problems should prove useful for both theoreticians and practitioners and can be easily adopted for the control of other processes or systems outside the marine field as well. **Modeling and Control of EGR on Marine Two-Stroke Diesel Engines** Xavier

Llamas, 2018-01-30 The international marine shipping industry is responsible for the transport of around 90% of the total world trade. Low speed two stroke diesel engines usually propel the largest trading ships. This engine type choice is mainly motivated by its high fuel efficiency and the capacity to burn cheap low quality fuels. To reduce the marine freight impact on the environment the International Maritime Organization IMO has introduced stricter limits on the engine pollutant emissions. One of these new restrictions named Tier III sets the maximum NOx emissions permitted. New emission reduction technologies have to be developed to fulfill the Tier III limits on two stroke engines since adjusting the engine combustion alone is not sufficient. There are several promising technologies to achieve the required NOx reductions. Exhaust Gas Recirculation EGR is one of them. For automotive applications EGR is a mature technology and many of the research findings can be used directly in marine applications. However there are some differences in marine two stroke engines which require further development to apply and control EGR. The number of available engines for testing EGR controllers on ships and test

beds is low due to the recent introduction of EGR Hence engine simulation models are a good alternative for developing controllers and many different engine loading scenarios can be simulated without the high costs of running real engine tests The primary focus of this thesis is the development and validation of models for two stroke marine engines with EGR The modeling follows a Mean Value Engine Model MVEM approach which has a low computational complexity and permits faster than real time simulations suitable for controller testing A parameterization process that deals with the low measurement data availability compared to the available data on automotive engines is also investigated and described As a result the proposed model is parameterized to two different two stroke engines showing a good agreement with the measurements in both stationary and dynamic conditions Several engine components have been developed One of these is a new analytic in cylinder pressure model that captures the influence of the injection and exhaust valve timings without increasing the simulation time A new compressor model that can extrapolate to low speeds and pressure ratios in a physically sound way is also described This compressor model is a requirement to be able to simulate low engine loads Moreover a novel parameterization algorithm is shown to handle well the model nonlinearities and to obtain a good model agreement with a large number of tested compressor maps Furthermore the engine model is complemented with dynamic models for ship and propeller to be able to simulate transient sailing scenarios where good EGR controller performance is crucial The model is used to identify the low load area as the most challenging for the controller performance due to the slower engine air path dynamics Further low load simulations indicate that sensor bias can be problematic and lead to an undesired black smoke formation while errors in the parameters of the controller flow estimators are not as critical This result is valuable because for a newly built engine a proper sensor setup is more straightforward to verify than to get the right parameters for the flow estimators

Proceedings of the 15th International Marine Design Conference Austin A. Kana, 2024-08-22 The 15th International Marine Design Conference IMDC 2024 was organized by the Department of Maritime and Transport Technology Delft University of Technology and was hosted by the Netherlands Defence Materiel Organisation at the Marine Etablissement Amsterdam MEA The aim of the IMDC is to promote all aspects of marine design as an engineering discipline The focus of IMDC 2024 is on the key design challenges and opportunities in the maritime field with special emphasis on the following themes Ship design methodology issues such as design spiral systems engineering set based design design optimisation concurrent design modular design configuration based design or fuzzy design aspects Novel marine design concepts such as hull form design transport ships service vessels naval vessels yachts and cruise ships or specialized and complex vessels Offshore design methodology such as applications to offshore wind turbines semi submersibles floating fish farms or floating cities Influence of energy transition on maritime design including both zero emission and high power and energy systems Influence of unmanned and autonomous transition on maritime design Influence of digital transition on maritime design such as digital shadows and twins model based systems engineering AI ML and big data Influence of

regulations on maritime design Maritime design education      *Robust Autonomous Guidance* Alberto Isidori, Lorenzo Marconi, Andrea Serrani, 2012-12-06 Plant control systems are subject to the undesirable influence of exogenous commands and disturbances To track and reject these the authors have designed a feedback control system based on embedding a model of them within the controller itself the internal model From a review of the principles of internal model based feedback control design this book moves on to expound recent enhancements to such designs and then to their implementation in systems operating under conditions of great uncertainty The case studies presented involve control systems coping with a high degree of nonlinear behaviour The key issues addressed in each are the design of an adaptive internal model for the specific tracking task and of stabilizing control capable of steering the tracking error to zero while keeping all internal states bounded for any arbitrarily large but bounded envelope of initial data and uncertain parameters Nested saturated controls form the basis of novel tools for asymptotic analysis and design      *Diesel Engine System Design* Qianfan Xin, 2011-05-26 Diesel Engine System Design links everything diesel engineers need to know about engine performance and system design in order for them to master all the essential topics quickly and to solve practical design problems Based on the author's unique experience in the field it enables engineers to come up with an appropriate specification at an early stage in the product development cycle Links everything diesel engineers need to know about engine performance and system design featuring essential topics and techniques to solve practical design problems Focuses on engine performance and system integration including important approaches for modelling and analysis Explores fundamental concepts and generic techniques in diesel engine system design incorporating durability reliability and optimization theories      **Ship Motion Control** Tristan Perez, 2006-03-30 engineers into a single volume whilst concentrating on two important research control design problems autopilots with rudder roll stabilization and fin and combined rudder fin stabilization He has been guided by some of the leading marine control academics in particular Mogens Blanke and Thor Fossen indeed Chapters 3 and 4 on kinematics and kinetics of ship motion are jointly authored with Professor Fossen There are some 240 cited references an invaluable resource for interested readers The volume is likely to appeal to a wide range of readers who will each be able to extract something different from the various parts of the monograph Part I has some four chapters on the modelling fundamentals including kinematics dynamics and actuators Part II is a very useful survey of the ship roll stabilization problem and how ship roll performance is measured and assessed This clearly motivates the human necessity for roll reduction and roll stabilization Parts III and IV move on to the control systems aspects of the various stabilization designs Valuable material here includes a study of system performance limitations as caused by the presence of non minimum phase characteristics and actuator saturation Chapter 10 has an interesting historical review of these marine control problems stretching back some thirty years into the 1970s      *Control of Ships and Underwater Vehicles* Khac Duc Do, Jie Pan, 2009-08-09 Most ocean vessels are underactuated but control of their motion in the real ocean environment is essential Starting with a review of the background

on ocean vessel dynamics and nonlinear control theory the authors systematic approach is based on various nontrivial coordinate transformations coupled with advanced nonlinear control design methods This strategy is then used for the development and analysis of a number of ocean vessel control systems with the aim of achieving advanced motion control tasks including stabilization trajectory tracking path tracking and path following Control of Ships and Underwater Vehicles offers the reader new results in the nonlinear control of underactuated ocean vessels efficient designs for the implementation of controllers on underactuated ocean vessels numerical simulations and real time implementations of the control systems designed on a scale model ship for each controller developed to illustrate their effectiveness and afford practical guidance

**Optimal Control of Wind Energy Systems** Iulian Munteanu, Antoneta Iuliana Bratcu, Nicolaos-Antonio Cutululis, Emil Ceanga, 2008-02-05 Optimal Control of Wind Energy Systems is a thorough review of the main control issues in wind power generation covering many industrial application problems A series of control techniques are analyzed and compared starting with the classical ones like PI control and gain scheduling techniques and continuing with some modern ones sliding mode techniques feedback linearization control and robust control Discussion is directed at identifying the benefits of a global dynamic optimization approach to wind power systems The main results are presented and illustrated by case studies and MATLAB Simulink simulation The corresponding programmes and block diagrams can be downloaded from the book s page at [springer.com](http://springer.com) For some of the case studies presented real time simulation results are available Control engineers researchers and graduate students interested in learning and applying systematic optimization procedures to wind power systems will find this a most useful guide to the field

**Process Control** Jie Bao, Peter L. Lee, 2007-06-14 Passivity and associated stability conditions form one of the cornerstones in control theory and have begun to be applied in process control In this book passivity based developments in all areas of control theory are addressed systematically for the first time The emphasis is placed on real results that add insight Case studies illustrate applications in all the main chapters MATLAB routines and a library of functions that implement the methods developed in the book can be downloaded from [springer.com](http://springer.com)

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