
Dynamic Simulation of Electrical Machines and Drive Systems Using MATLAB GUI

Viliam Fedák, Tibor Balogh and Pavel Záskalický

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/248519>

1. Introduction

Since the first appearance, the fields of electrical machine and drive systems have been continuously enriched by introduction of many important topics. Progress in power electronics, microcontrollers, new materials and advances in numerical modeling have led to development of new types of electrical machines and in field of electrical drives to realization of complex control algorithms. Their verification is usually done by simulation during system design, thus the effort is concentrated to development of simulation models.

MATLAB offers almost infinite possibilities for easy development of system models. MATLAB GUI (Graphic User Interface) in connection with Simulink and specialized toolboxes present a suitable and easy programmable tool for development of purpose-oriented virtual model of any dynamical system. Easy and comfortable change of parameters by control elements in MATLAB GUIDE (GUI Development Environment), such as push- and radio- buttons, text boxes, and easy visualization of results, enable to develop virtual models without deep knowledge of their substance nor without a tedious programming and debugging the models.

Well-elaborated models of electrical drives and machines available on-line were developed by (Riaz, n.d.). (Saadat, 2012) presented application of MATLAB GUI for electrical engineering subjects, available online and MATLAB GUI was utilized in (Petropol-Serb et al, 2007) for development of virtual model of induction machine.

Our contribution aims to present methodology and results in development of unified series of virtual models for electrical machines and drive systems using MATLAB GUI. The organization of the contribution is as follows: after brief description of tasks at virtual models design in GUI MATLAB (chapter 2) in the third chapter we describe development of few typical GUI oriented models of (more complex) electrical machines starting from a

Dynamic Simulation Of Electrical Machines And Drive

**Paul C. Krause, Oleg Wasynczuk, Maher
Hasan, Timothy O'Connell**



Dynamic Simulation Of Electrical Machines And Drive:

Dynamic Simulation of Electrical Machines and Drive Systems Using MATLAB GUI. Viliam Fedák, Pavel Zásalický, Tibor Balogh, 2012 **Dynamic Simulation of Electric Machinery** Chee-Mun Ong, 1998 This book and its accompanying CD ROM offer a complete treatment from background theory and models to implementation and verification techniques for simulations and linear analysis of frequently studied machine systems Every chapter of Dynamic Simulation of Electric Machinery includes exercises and projects that can be explored using the accompanying software A full chapter is devoted to the use of MATLAB and SIMULINK and an appendix provides a convenient overview of key numerical methods used Dynamic Simulation of Electric Machinery provides professional engineers and students with a complete toolkit for modeling and analyzing power systems on their desktop computers Permanent Magnet Synchronous and Brushless DC Motor Drives Ramu Krishnan, 2017-12-19 Despite two decades of massive strides in research and development on control strategies and their subsequent implementation most books on permanent magnet motor drives still focus primarily on motor design providing only elementary coverage of control and converters Addressing that gap with information that has largely been disseminated only in journals and at conferences Permanent Magnet Synchronous and Brushless DC Motor Drives is a long awaited comprehensive overview of power electronic converters for permanent magnet synchronous machines and control strategies for variable speed operation It introduces machines power devices inverters and control and addresses modeling implementation control strategies and flux weakening operations as well as parameter sensitivity and rotor position sensorless control Suitable for both industrial and academic audiences this book also covers the simulation low cost inverter topologies and commutation torque ripple of PM brushless DC motor drives Simulation of the motor drives system is illustrated with MATLAB codes in the text This book is divided into three parts fundamentals of PM synchronous and brushless dc machines power devices inverters PM synchronous motor drives and brushless dc motor drives With regard to the power electronics associated with these drive systems the author Explores use of the standard three phase bridge inverter for driving the machine power factor correction and inverter control Introduces space vector modulation step by step and contrasts with PWM Details dead time effects in the inverter and its compensation Discusses new power converter topologies being considered for low cost drive systems in PM brushless DC motor drives This reference is dedicated exclusively to PM ac machines with a timely emphasis on control and standard and low cost converter topologies Widely used for teaching at the doctoral level and for industrial audiences both in the U S and abroad it will be a welcome addition to any engineer s library **Electrical Machine and Drive (Introduce to Advance Control)** Rajendra Aparnathi, Ved Vyas Dwivedi, 2013-09-27 This Book is a source for B E M E and research aspirants Working in the fields of inverters converters and Advance technique in Electrical and Electronics Engineering **LabVIEW for Electric Circuits, Machines, Drives, and Laboratories** Nesimi Ertugrul, 2002 Master electric circuits machines devices and power electronics hands on without

expensive equipment In LabVIEW for Electric Circuits Machines Drives and Laboratories Dr Nesimi Ertugrul uses custom written LabVIEW Virtual Instruments to illuminate the analysis and operation of a wide range of AC and DC circuits electrical machines and drives including high voltage current power applications covered in no other book Includes detailed background VI panels lab practices hardware information and self study questions everything you need to achieve true mastery

Modeling and High Performance Control of Electric Machines John Chiasson, 2005-05-13 Modeling and High Performance Control of Electric Machines introduces you to both the modeling and control of electric machines The direct current DC machine and the alternating current AC machines induction PM synchronous and BLDC are all covered in detail The author emphasizes control techniques used for high performance applications specifically ones that require both rapid and precise control of position speed or torque You ll discover how to derive mathematical models of the machines and how the resulting models can be used to design control algorithms that achieve high performance Graduate students studying power and control as well as practicing engineers in industry will find this a highly readable text on the operation modeling and control of electric machines An Instructor s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department Instructor Support materials are also available Email IAline@wiley.com

Power Quality in Power Systems, Electrical Machines, and Power-Electronic Drives Ewald F. Fuchs, Mohammad A. S. Masoum, 2023-02-13 Power Quality in Power Systems Electrical Machines and Power Electronic Drives uses current research and engineering practices guidelines standards and regulations for engineering professionals and students interested in solving power quality problems in a cost effective reliable and safe manner within the context of renewable energy systems The book contains chapters that address power quality across diverse facets of electric energy engineering including AC and DC transmission and distribution lines end user applications such as electric machines transformers inductors capacitors wind power and photovoltaic power plants and variable speed variable torque power electronic drives The book covers nonsinusoidal waveshapes voltage disturbances harmonic losses aging and lifetime reductions single time events such as voltage dips and the effects of variable speed drives controlled by PWM converters The book also reviews a corpus of techniques to mitigate power quality problems such as the optimal design of renewable energy storage devices including lithium ion batteries and fuel cells for automobiles serving as energy storage and the optimal design of nonlinear loads for simultaneous efficiency and power quality Provides theoretical and practical insights into power quality problems related to future smart grid renewable hybrid electric power systems electric machines and variable speed variable torque power electronic drives Contains a highly varied corpus of practical applications drawn from current international practice Designed as a self study tool with end of chapter problems and solutions designed to build understanding Includes very highly referenced chapters that enable readers to save time and money in the research discovery process for critical research articles regulatory standards and guidelines

PID and Predictive Control of Electrical Drives and Power Converters using

MATLAB / Simulink Liuping Wang,Shan Chai,Dae Yoo,Lu Gan,Ki Ng,2015-03-02 A timely introduction to current research on PID and predictive control by one of the leading authors on the subject PID and Predictive Control of Electric Drives and Power Supplies using MATLAB Simulink examines the classical control system strategies such as PID control feed forward control and cascade control which are widely used in current practice The authors share their experiences in actual design and implementation of the control systems on laboratory test beds taking the reader from the fundamentals through to more sophisticated design and analysis The book contains sections on closed loop performance analysis in both frequency domain and time domain presented to help the designer in selection of controller parameters and validation of the control system Continuous time model predictive control systems are designed for the drives and power supplies and operational constraints are imposed in the design Discrete time model predictive control systems are designed based on the discretization of the physical models which will appeal to readers who are more familiar with sampled data control system Soft sensors and observers will be discussed for low cost implementation Resonant control of the electric drives and power supply will be discussed to deal with the problems of bias in sensors and unbalanced three phase AC currents Brings together both classical control systems and predictive control systems in a logical style from introductory through to advanced levels Demonstrates how simulation and experimental results are used to support theoretical analysis and the proposed design algorithms MATLAB and Simulink tutorials are given in each chapter to show the readers how to take the theory to applications Includes MATLAB and Simulink software using xPC Target for teaching purposes A companion website is available Researchers and industrial engineers and graduate students on electrical engineering courses will find this a valuable resource **MATLAB** Vasilios Katsikis,2012-09-26 This is the first book in a three volume series deploying MATLAB based applications in almost every branch of science This volume presents interesting topics from different areas of engineering signal and image processing based on the MATLAB environment The book consists of 20 excellent insightful articles and the readers will find the results very useful to their work This collection of high quality articles refers to a large range of professional fields and may be used for scientific engineering and educational purposes **Automotive NVH Technology** Anton Fuchs,Eugenius Nijman,Hans-Herwig Pribsch,2015-10-31 This book presents seven chapters examining selected noise vibration and harshness NVH topics that are highly relevant for automotive vehicle development These include applications following the major trends toward increased passenger comfort vehicle electrification and lightweight design The authors of the seven chapters all of which are experts from the automotive industry and academia present the foremost challenges and potential solutions in this demanding field Among others applications for sound optimization in downsized engines noise optimization in electric powertrains weight reduction options for exhaust systems porous materials description and the vibro acoustic analysis of geared systems are discussed International Conference on Electrical Machines and Drives ,1997 *Dynamics and Control of Electrical Drives* Wach Piotr,2011-04-28 Dynamics is a science concerned with movement and changes In the

most general approach it relates to life processes as well as behavior in nature in rest It governs small particles technical objects conversion of matter and materials but also concerns people groups of people in their individual and in particular social dimension In dynamics we always have to do with causes or stimuli for motion the rules of reaction or behavior and its result in the form of trajectory of changes This book is devoted to dynamics of a wide class of specific but very important objects such as electromechanical systems This is a very rigorous discipline and has a long tradition as its theoretical bases were formulated in the first half of the XIX century by d Alembert Lagrange Hamilton Maxwell and other prominent scientists but their crucial results were based on previous pioneering research of others such as Copernicus Galileo Newton This book in its theoretical foundations is based on the principle of least action which governs classical as well as relativistic mechanics and electromagnetism and leads to Lagrange s equations which are applied in the book as universal method to construct equations of motion of electromechanical systems It gives common and coherent grounds to formulate mathematical models for all lumped parameters electromechanical systems which are vital in our contemporary industry and civilized everyday life From these remarks it seems that the book is general and theoretical but in fact it is a very practical one concerning modern electrical drives in a broad sense including electromechanical energy conversion induction motor drives brushless DC drives with a permanent magnet excitation and switched reluctance machines SRM And of course their control which means shaping of their trajectories of motion using modern tools their designed autonomy in keeping a track according to our programmed expectations The problems presented in the book are widely illustrated by characteristics trajectories dynamic courses all computed by use of developed simulation models throughout the book There are some classical subjects and the history of the discipline is discussed but finally all modern tools and means are presented and applied More detailed descriptions follow in abstracts for the particular chapters The author hopes kind readers will enjoy and profit from reading this book *Modeling Power Electronics and Interfacing Energy Conversion Systems* M. Godoy Simoes, Felix A.

Farret, 2016-10-24 Discusses the application of mathematical and engineering tools for modeling simulation and control oriented for energy systems power electronics and renewable energy This book builds on the background knowledge of electrical circuits control of dc dc converters and inverters energy conversion and power electronics The book shows readers how to apply computational methods for multi domain simulation of energy systems and power electronics engineering problems Each chapter has a brief introduction on the theoretical background a description of the problems to be solved and objectives to be achieved Block diagrams electrical circuits mathematical analysis or computer code are covered Each chapter concludes with discussions on what should be learned suggestions for further studies and even some experimental work Discusses the mathematical formulation of system equations for energy systems and power electronics aiming state space and circuit oriented simulations Studies the interactions between MATLAB and Simulink models and functions with real world implementation using microprocessors and microcontrollers Presents numerical integration techniques transfer

function modeling harmonic analysis and power quality performance assessment Examines existing software such as MATLAB Simulink Power Systems Toolbox and PSIM to simulate power electronic circuits including the use of renewable energy sources such as wind and solar sources The simulation files are available for readers who register with the Google Group power electronics interfacing energy conversion systems googlegroups com After your registration you will receive information in how to access the simulation files the Google Group can also be used to communicate with other registered readers of this book

E-Learning Boyka Gradinarova,2015-10-21 In this book we can read about new technologies that enhance training and performance discover new exciting ways to design and deliver content and have access to proven strategies practices and solutions shared by experts The authors of this book come from all over the world their ideas studies findings and experiences are beneficial contributions to enhance our knowledge in the field of e learning The book is divided into three sections and their respective chapters refer to three macro areas The first section of the book covers Instructional Design of E learning considering methodology and tools for designing e learning environments and courseware Also there are examples of effective ways of gaming and educating The second section is about Organizational Strategy and Management The last section deals with the new Developments in E learning Technology emphasizing subjects like knowledge building by mobile e learning systems cloud computing and new proposals for virtual learning environments platforms

Electric Machines and Drives Shaahin Filizadeh,2013-02-20 Electric machines have a ubiquitous presence in our modern daily lives from the generators that supply electricity to motors of all sizes that power countless applications Providing a balanced treatment of the subject Electric Machines and Drives Principles Control Modeling and Simulation takes a ground up approach that emphasizes fundamental principles The author carefully deploys physical insight mathematical rigor and computer simulation to clearly and effectively present electric machines and drive systems Detailing the fundamental principles that govern electric machines and drives systems this book Describes the laws of induction and interaction and demonstrates their fundamental roles with numerous examples Explores dc machines and their principles of operation Discusses a simple dynamic model used to develop speed and torque control strategies Presents modeling steady state based drives and high performance drives for induction machines highlighting the underlying physics of the machine Includes coverage of modeling and high performance control of permanent magnet synchronous machines Highlights the elements of power electronics used in electric drive systems Examines simulation based optimal design and numerical simulation of dynamical systems Suitable for a one semester class at the senior undergraduate or a graduate level the text supplies simulation cases that can be used as a base and can be supplemented through simulation assignments and small projects It includes end of chapter problems designed to pick up on the points presented in chapters and develop them further or introduce additional aspects The book provides an understanding of the fundamental laws of physics upon which electric machines operate allowing students to master the mathematical skills that their modeling and analysis requires

Linear Electric Machines, Drives, and MAGLEVs Handbook Ion Boldea, 2023-07-31 Linear motion is richly present in various industries from direct electric propulsion in urban and interurban people movers on wheels or on magnetic cushions MAGLEVs to indoor transport of goods conveyors etc through plunger solenoids to open hotel doors and as electromagnetic power switches to compressor drives by linear oscillatory permanent magnet PM motors smart phones integrated microphone and loudspeakers and controlled vehicles suspension etc Besides the traditional rotary motor drives with mechanical transmissions which mean friction limitations weather dependent in traction heavy vehicles more losses positioning errors backlash in the process and higher maintenance costs to handle them linear motion in industry by direct electromagnetic forces is free of friction limitations for traction free of mechanical transmission and thus more efficient with less maintenance cost and fewer positioning errors backlash This explains why they are used in so many applications already since the dramatic advancement of power electronics and digital control in the last four decades Modeling performance design control and testing of linear electric machines LEMs show notable differences with respect to rotary electric motor drives which warrant a dedicated treatment of these aspects The Second Edition First Edition 2013 concentrates on the above technical aspects of various types of LEMs in close relationship with specific applications via numerical examples of modeling design control and testing with ample representative results from literature industry and some of the author's contributions such as Technical field and circuit modeling of linear induction motors in flat configurations for low and high speeds with and without dynamic end effects and in tubular configurations short travel design control and testing Linear synchronous motor LSM drives in dc excited homopolar reluctance and superconducting excitation configurations for urban and interurban high speed vehicles propulsion and integrated propulsion and levitation in MAGLEVs modeling design and control with full scale numerical examples with emphasis on lower KWh passenger Km at high speeds Flat and tubular linear permanent magnet PM synchronous motors L PMSMs mainly destined to industrial indoor transport for automation at high efficiency in clean rooms Linear flux modulation motors new breed suitable for very low speed applications due to higher thrust density Plunger solenoids in various applications including new valve PM actuators with millisecond response time Linear resonant PM oscillatory motors design control and testing mainly destined to compressors for higher efficiency in compact drives Attraction and repulsive force suspension levitation systems for MAGLEVs Active and passive guideway MAGLEVs in urban and superhigh speed interurban transport at lower Kwh per passenger km in lighter vehicles without wheels The numerous numerical design and control examples with practical specifications throughout the 23 chapters of the book allow the reader deep and fast access to a practical but thorough unitary good for comparisons methodology in designing and controlling LEMs for various applications

Power Quality in Power Systems and Electrical Machines
Ewald F. Fuchs, Mohammad A. S. Masoum, 2015-07-14 The second edition of this must have reference covers power quality issues in four parts including new discussions related to renewable energy systems The first part of the book provides

background on causes effects standards and measurements of power quality and harmonics Once the basics are established the authors move on to harmonic modeling of power systems including components and apparatus electric machines The final part of the book is devoted to power quality mitigation approaches and devices and the fourth part extends the analysis to power quality solutions for renewable energy systems Throughout the book worked examples and exercises provide practical applications and tables charts and graphs offer useful data for the modeling and analysis of power quality issues Provides theoretical and practical insight into power quality problems of electric machines and systems 134 practical application example problems with solutions 125 problems at the end of chapters dealing with practical applications 924 references mostly journal articles and conference papers as well as national and international standards and guidelines

Hybrid Electric Vehicles Chris Mi, M. Abul Masrur, 2025-12-22 Introduction to all types of hybrid electric vehicles HEVs with coverage of fundamentals applications and the latest industry technologies Hybrid Electric Vehicles Principles and Applications with Practical Perspectives provides an introduction to hybrid vehicles from hybrid electric hybrid hydraulic and plug in hybrid electric vehicles to fuel cell vehicles and off road hybrid vehicular systems The book focuses on the propulsion systems for these vehicles including issues related to power and energy management Other topics covered include hybrid vs pure electric hybrid electric vehicle HEV system architecture including plug in charging control and hydraulic safety and EMC storage technologies vehicular power and energy management diagnostics and prognostics and electromechanical vibration issues This Third Edition has been updated to address the latest industry trends and technologies impacting HEVs such as more detailed discussions on planetary gear synchronous reluctance motors fast charging methods for batteries and matters pertaining to cybersecurity in vehicles The latest HEV industry data and examples highlighting automakers current HEV models are featured throughout the book Topics discussed in Hybrid Electric Vehicles Principles and Applications with Practical Perspectives include Specific state of the art HEVs including the Toyota Prius the Honda Civic and the Ford Escape with additional coverage of two mode hybrid vehicles HEV fundamentals covering performance powertrain component sizing gradability requirements and selection of gear ratios Cold start emissions reduction and cold hot weather performance enhancement Electric and hybrid ships aircraft and locomotives with discussion on industrial utilization of other types of vehicles Military applications of HEVs covering ruggedness issues dismounted soldier applications and electromagnetic launchers Fast charging of batteries in electrified vehicles Cybersecurity issues in electrified vehicles Hybrid Electric Vehicles Principles and Applications with Practical Perspectives is an essential up to date reference on the subject for engineers working in the automotive industry including at automakers vehicle OEMs and component suppliers as well as students and instructors in upper level undergraduate or graduate courses related to HEVs and electric propulsion *Fault Detection, Supervision and Safety of Technical Processes 2003 (SAFEPROCESS 2003)* Marcel Staroswiecki, Eva Wu, 2004-02-27 A three volume work bringing together papers presented at SAFEPROCESS 2003 including four plenary

papers on statistical physical model based and logical model based approaches to fault detection and diagnosis as well as 178 regular papers **Offshore Wind Energy Generation** Olimpo Anaya-Lara, David Campos-Gaona, Edgar

Moreno-Goytia, Grain Adam, 2014-03-26 The offshore wind sector's trend towards larger turbines bigger wind farm projects and greater distance to shore has a critical impact on grid connection requirements for offshore wind power plants This important reference sets out the fundamentals and latest innovations in electrical systems and control strategies deployed in offshore electricity grids for wind power integration Includes All current and emerging technologies for offshore wind integration and trends in energy storage systems fault limiters superconducting cables and gas insulated transformers Protection of offshore wind farms illustrating numerous system integration and protection challenges through case studies Modelling of doubly fed induction generators DFIG and full converter wind turbines structures together with an explanation of the smart grid concept in the context of wind farms Comprehensive material on power electronic equipment employed in wind turbines with emphasis on enabling technologies HVDC STATCOM to facilitate the connection and compensation of large scale onshore and offshore wind farms Worked examples and case studies to help understand the dynamic interaction between HVDC links and offshore wind generation Concise description of the voltage source converter topologies control and operation for offshore wind farm applications Companion website containing simulation models of the cases discussed throughout Equipping electrical engineers for the engineering challenges in utility scale offshore wind farms this is an essential resource for power system and connection code designers and practitioners dealing with integration of wind generation and the modelling and control of wind turbines It will also provide high level support to academic researchers and advanced students in power and renewable energy as well as technical and research staff in transmission and distribution system operators and in wind turbine and electrical equipment manufacturers

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