

# ELECTRIC MACHINES

Selection, Sizing, Installation,  
and Design with Examples



SECOND EDITION  
BY T. K. ALKEER

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# Electric Machines Steady State Transients And Design With MatlabR

**ION. TUTELEA BOLDEA (LUCIAN N.)**



## **Electric Machines Steady State Transients And Design With MatlabR:**

*Electric Machines* Ion Boldea, Lucian Nicolae Tutelea, 2009-11-24 Ubiquitous in daily life electric motors generators are used in a wide variety of applications from home appliances to internal combustion engines to hybrid electric cars They produce electric energy in all electric power plants as generators and motion control that is necessary in all industries to increase productivity save energy and reduce pollution With its comprehensive coverage of the state of the art *Electric Machines Steady State Transients and Design with MATLAB* addresses the modeling design testing and manufacture of electric machines to generate electricity or in constant or variable speed motors for motion control Organized into three stand alone sections Steady State Transients and FEM Analysis and Optimal Design the text provides complete treatment of electric machines It also Explores international units Contains solved and proposed numerical examples throughout Guides students from simple to more complex math models Offers a wealth of problems with hints The book contains numerous computer simulation programs in MATLAB and Simulink available on an accompanying CD ROM to help readers make a quantitative assessment of various parameters and performance indices of electric machines Skillfully unifying symbols throughout the book the authors present a great deal of invaluable practical laboratory work that has been classroom tested in progressively modified forms This textbook presents expressions of parameters modeling and characteristics that are directly and readily applicable for industrial R D in fields associated with electric machines industry for modern distributed power systems and industrial motion control via power electronics

**Electric Machines** Ion Boldea, Lucian Nicolae Tutelea, 2009-11-24 Ubiquitous in daily life electric motors generators are used in a wide variety of applications from home appliances to internal combustion engines to hybrid electric cars They produce electric energy in all electric power plants as generators and motion control that is necessary in all industries to increase productivity save energy and reduce pollution With its comprehensive coverage of the state of the art *Electric Machines Steady State Transients and Design with MATLAB* addresses the modeling design testing and manufacture of electric machines to generate electricity or in constant or variable speed motors for motion control Organized into three stand alone sections Steady State Transients and FEM Analysis and Optimal Design the text provides complete treatment of electric machines It also Explores international units Contains solved and proposed numerical examples throughout Guides students from simple to more complex math models Offers a wealth of problems with hints The book contains numerous computer simulation programs in MATLAB and Simulink available on an accompanying downloadable resources to help readers make a quantitative assessment of various parameters and performance indices of electric machines Skillfully unifying symbols throughout the book the authors present a great deal of invaluable practical laboratory work that has been classroom tested in progressively modified forms This textbook presents expressions of parameters modeling and characteristics that are directly and readily applicable for industrial R D in fields associated with electric machines industry for modern distributed power systems and industrial motion control via power

electronics     Linear Electric Machines, Drives, and MAGLEVs Handbook Ion Boldea, 2017-12-19 Based on author Ion Boldea's 40 years of experience and the latest research Linear Electric Machines Drives and Maglevs Handbook provides a practical and comprehensive resource on the steady improvement in this field The book presents in depth reviews of basic concepts and detailed explorations of complex subjects including classifications and practical topologies with sample results based on an up to date survey of the field Packed with case studies this state of the art handbook covers topics such as modeling steady state and transients as well as control design and testing of linear machines and drives It includes discussion of types and applications from small compressors for refrigerators to MAGLEV transportation of linear electric machines Additional topics include low and high speed linear induction or synchronous motors with and without PMs with progressive or oscillatory linear motion from topologies through modeling design dynamics and control With a breadth and depth of coverage not found in currently available references this book includes formulas and methods that make it an authoritative and comprehensive resource for use in R D and testing of innovative solutions to new industrial challenges in linear electric motion energy automatic control     **Electrical Machines** Jacek F. Gieras, 2016-10-14 This book endeavors to break the stereotype that basic electrical machine courses are limited only to transformers DC brush machines induction machines and wound field synchronous machines It is intended to serve as a textbook for basic courses on Electrical Machines covering the fundamentals of the electromechanical energy conversion transformers classical electrical machines i e DC brush machines induction machines wound field rotor synchronous machines and modern electrical machines i e switched reluctance machines SRM and permanent magnet PM brushless machines In addition to academic research and teaching the author has worked for over 18 years in US high technology corporate businesses providing solutions to problems such as design simulation manufacturing and laboratory testing of large variety of electrical machines for electric traction energy generation marine propulsion and aerospace electric systems     **Induction Machines Handbook** Ion Boldea, 2020-05-19 Induction Machines Handbook Transients Control Principles Design and Testing presents a practical up to date treatment of intricate issues with induction machines IM required for design and testing in both rather constant and variable speed with power electronics drives It contains ready to use industrial design and testing knowledge with numerous case studies to facilitate a thorough assimilation of new knowledge Individual Chapters 1 through 14 discuss in detail the following Three and multiphase IM transients Single phase source IM transients Super high frequency models and behavior of IM Motor specifications and design principles IM design below 100 kW and constant  $V_1$  and  $f_1$  IM design above 100 kW and constant  $V_1$  and  $f_1$  IM design principles for variable speed Optimization design Single phase IM design Three phase IM generators Single phase IM generators Linear induction motors Testing of three phase IMs Single phase IM testing Fully revised and amply updated to add the new knowledge of the last decade this third edition includes special sections on Multiphase IM models for transients Doubly fed IMs models for transients Cage rotor synchronized reluctance motors Cage

rotor PM synchronous motor Transient operation of self excited induction generator Brushless doubly fed induction motor generators Doubly fed induction generators with D C output Linear induction motor control with end effect Recent trends in IM testing with power electronics Cage PM rotor line start IM testing Linear induction motor LIM testing This up to date book discusses in detail the transients control principles and design and testing of various IMs for line start and variable speed applications in various topologies with numerous case studies It will be of direct assistance to academia and industry in conceiving designing fabricating and testing IMs for the future of various industries from home appliances through robotics e transport and renewable energy conversion

**Reluctance Electric Machines** Ion Boldea, Lucian

Tutelea, 2018-07-20 Electric energy is arguably a key agent for our material prosperity With the notable exception of photovoltaic generators electric generators are exclusively used to produce electric energy from mechanical energy More than 60% of all electric energy is used in electric motors for useful mechanical work in various industries This book presents the modeling performance design and control of reluctance synchronous and flux modulation machines developed for higher efficiency and lower cost It covers one and three phase reluctance synchronous motors in line start applications and various reluctance flux modulation motors in pulse width modulation converter fed variable speed drives FEATURES Presents basic and up to date knowledge about the topologies modeling performance design and control of reluctance synchronous machines Includes information on recently introduced reluctance flux modulation electric machines switched flux flux reversal Vernier transverse flux claw pole magnetic geared dual rotor brushless doubly fed etc Features numerous examples and case studies throughout Provides a comprehensive overview of all reluctance electric machines

**Modern Permanent Magnet Electric Machines** Jacek F. Gieras, Jian-Xin Shen, 2022-12-05

The late 1980s saw the beginning of the PM brushless machine era with the invention of high energy density permanent magnets PM and the development of power electronics Although induction motors are now the most popular electric motors the impact of PM brushless machines on electromechanical drives is significant Today PM machines come second to induction machines Replacement of electromagnetic field excitation systems by PMs brings the following benefits No electrical energy is absorbed by the field excitation system and thus there are no excitation losses causing substantial increase in efficiency Higher power density kW/kg and or torque density Nm/kg than electromagnetic excitation Better dynamic performance than motors with electromagnetic excitation higher magnetic flux density in the air gap Simplification of construction and maintenance Less expensive for some types of machines Modern Permanent Magnet Electric Machines Theory and Control serves as a textbook for undergraduate power engineering students who want to supplement and expand their knowledge in the fundamentals of magnetism soft magnetic materials permanent magnets PMs calculation of magnetic circuits with PMs modern PM brushed DC machines and their controls modern PM brushless DC motors and drive control and modern PM generators The book can help students learn more about electrical machines and can serve as a prescribed text for teaching elective undergraduate

courses such as modern permanent magnet electrical machines Since the book is written in a simple scientific language and without redundant mathematics it can also be used by practicing engineers and managers employed in electrical machinery or electromagnetic device industries

**Smart Technologies in Urban Engineering** Olga Arsenyeva, Tatiana Romanova, Maria Sukhonos, Yevgen Tsegelnyk, 2022-11-29 This book offers a comprehensive review of smart technologies and perspectives on their application in urban engineering It covers a wide range of applications from transport and energy management to digital manufacturing smart city environment and sustainable development providing readers with new ideas for future research and collaborations This book presents select papers from the International Conference on Smart Technologies in Urban Engineering STUE 2022 held to commemorate the 100th anniversary of the O M Beketov National University of Urban Economy in Kharkiv Ukraine on June 9 11 2022 All the contributions offer plenty of valuable information and would be of great benefit to the experience exchange among scientists in urban engineering

**International Conference on Reliable Systems Engineering (ICoRSE) - 2022** Daniela Doina Cioboata, 2022-08-25 This book provides both researchers in the academia students and industrial experts the chance to exchange new ideas build relations and find virtual partners It is a scientific event whose proceedings have set a very high standard ICoRSE's distinctive feature is represented by its breadth of topics mechatronics integronics and adaptronics reliable systems engineering cyber physical systems optics theoretical and applied mechanics robotics modelling and simulation smart integrated control systems computer imaging processing smart bio medical and bio mechatronic systems MEMS and NEMS new materials sensors and transducers nano chemistry physical chemistry of biological systems micro and nanotechnology system optimization communications renewable energy and environmental engineering They all come together to deliver a clear picture of the state of the art reached in these areas so far

**BLDC (Brushless Direct Current) Motors** Ishwar Singh, 2024-06-09 In today's dynamic and interconnected world technological advancements are shaping the way we live work and interact with our environment Among the myriad innovations driving this transformation BLDC Brushless Direct Current motors stand out as versatile and indispensable components powering a wide range of applications across various industries This book aims to provide a comprehensive and accessible resource for individuals seeking to deepen their understanding of BLDC motors and leverage their capabilities in practical applications Drawing upon years of collective expertise and experience we have endeavored to distill complex concepts into clear explanations making this book suitable for both beginners and seasoned professionals alike

**MATLAB** Kelly Bennett, 2014-09-08 MATLAB is an indispensable asset for scientists researchers and engineers The richness of the MATLAB computational environment combined with an integrated development environment IDE and straightforward interface toolkits and simulation and modeling capabilities creates a research and development tool that has no equal From quick code prototyping to full blown deployable applications MATLAB stands as a de facto development language and environment serving the technical needs of a wide range of users As a collection of diverse

applications each book chapter presents a novel application and use of MATLAB for a specific result

**Electric Machines** Ion Boldea, Lucian N. Tutelea, 2021-10-07 With its comprehensive coverage of the state of the art this Second Edition introduces basic types of transformers and electric machines Classifications and characterization modeling and performance of power electric transformers single and multiphase motors and generators commercial machines dc brush induction dc excited synchronous PM synchronous reluctance synchronous and some new ones multiphase ac machines switched reluctance machines with great potential for industry with rotary or linear motion are all treated in the book The book covers in detail circuit modeling characteristics and performance characteristics under steady state testing techniques and preliminary electromagnetic thermic dimensioning with lots of solved numerical examples and special cases to illustrate new electric machines with strong industrialization potential All formulae used to characterize parameters and performance may be safely used in industry for preliminary designs and have been applied in the book through numerical solved examples of industrial interest Numerous computer simulation programs in MATLAB and Simulink that illustrate performance characteristics present in the chapters are included and many be used as homework to facilitate a deeper understanding of fundamental issues This book is intended for a first semester course covering electric transformers rotary and linear machines steady state modeling and performance computation preliminary dimensioning and testing standardized and innovative techniques The textbook may be used by R D engineers in industry as all machine parameters and characteristics are calculated by ready to use industrial design mathematical expressions

**Induction Motors** Rui Esteves Araújo, 2012-11-14 Motivated by the need of energy efficiency improvements process optimization soft start capability and numerous other environmental benefits it may be desirable to operate induction motors for many applications at continuously adjustable speeds The induction motor drives can provide high productivity with energy efficiency in different industrial applications and are the basis for modern automation This book provides an account of this developing subject through such topics as modelling noise control techniques used for high performance applications and diagnostics Compiled from contributions by international researchers this is not a textbook but the result is an interesting exploration of this technology that provides a combination of theory implementation issues and practical examples

**Electric Machines** ION. TUTELEA BOLDEA (LUCIAN N.), 2021-10-08 With its comprehensive coverage of the state of the art this second edition of the book introduces the basic types of transformers and electric machines and also discusses advanced subjects in electric machines starting from principles to applications and case studies with ample graphical results The first volume Electric Machines Steady State Performance with MATLAB R covers circuit modeling characteristics and performance characteristics under steady state testing techniques and preliminary electromagnetic thermic dimensioning This book is intended for first semester course treating electric transformers rotary and linear machines steady state modeling and performance computation preliminary dimensioning and testing standardized and innovative techniques The second volume Electric

Machines Transients Control Principles Finite Element Analysis and Optimal Design with MATLAB R is intended for second and third semester course treating topics such as modeling of transients control principles electromagnetic and thermal finite element Analysis and optimal design dimensioning Notable recent knowledge with strong industrialization potential has been added to this edition such as orthogonal models of multiphase A C machines thermal finite element analysis of FEA electric machines and FEA based only optimal design of a PM motor case study Both the volumes include numerical examples and case studies and numerous computer simulation programs in MATLAB and Simulink R are also available online that illustrate performance characteristics present in the chapters      **Electric Machines** Ion Boldea, Lucian N.

Tutelea, 2021-10-08 This Second Edition extensively covers advanced issues subjects in electric machines starting from principles to applications and case studies with ample graphical numerical results This textbook is intended for second and third semester courses covering topics such as modeling of transients control principles electromagnetic and thermal finite element analysis and optimal design dimensioning Notable recent knowledge with strong industrialization potential has been added to this edition such as Orthogonal models of multiphase a c machines Thermal Finite Element Analysis of FEA electric machines FEA based only optimal design of a PM motor case study Line start synchronizing premium efficiency PM induction machines Induction machines three and single phase synchronous machines with DC excitation with PM excitation and with magnetically salient rotor and a linear Pm oscillatory motor are all investigated in terms of transients electromagnetic FEM analysis and control principles Case studies numerical examples and lots of discussion of FEM results for PMSM and IM are included throughout the book The optimal design is treated in detail using Hooke Jeeves and GA algorithms with case comparison studies in dedicated chapters for IM and PMSM Numerous computer simulation programs in MATLAB and Simulink are available online that illustrate performance characteristics present in the chapters and the FEM and optimal design case studies and codes may be used as homework to facilitate a deeper understanding of fundamental issues

**Electric Machines**, 1990      **Теоретические основы и принципы применения защитного обесточивания рудничных электротехнических комплексов** Константин Маренич, 2022-05-15      Einfluss des

Zwischenkreis-Umrichters auf das Betriebsverhalten des Energieumwandlungsstrangs von Windkraftanlagen Lukas

Jansen, 2015-12-01 In den letzten Jahrzehnten ist die Nennleistung neu installierter Windenergiekonverter kontinuierlich gestiegen dabei dominierte die Bestrebung das Betriebsverhalten und den Wirkungsgrad des Energieumwandlungsstrangs zu verbessern Bei Windenergieanlagen der Multimegawattklasse werden die Anforderungen an die eingesetzte Technik immer anspruchsvoller dabei ger t die Identifikation eines geeigneten Generatorsystems in den Fokus der Betrachtung Ein erprobtes System aus der konventionellen Kraftwerkstechnik ist die fremderregte Synchronmaschine die sich durch ihr Betriebsverhalten und ihre gro e Leistungsdichte auszeichnet Die Wechselwirkungen der unterschiedlichen Teilsysteme sind von besonderer Bedeutung f r das dynamische Betriebsverhalten des Energieumwandlungssystems wobei der Einfluss des



Zwischenkreisumrichters exponiert ist Die eingesetzte Schaltungstopologie und die verwendeten Ansteuerverfahren wirken entscheidend auf das Betriebsverhalten der Synchronmaschine und somit auf den gesamten Energieumwandlungsstrang ein Zu diesem Zweck wird innerhalb dieser Arbeit ein Modell der fremderregten Synchronmaschine erarbeitet und das Maschinenverhalten untersucht Die Masterarbeit beginnt mit der Erläuterung der Synchronmaschine und ihrem stationären Verhalten dabei werden die Unterschiede zwischen den beiden grundlegenden fremderregten Maschinentypen herausgearbeitet Als Nächstes folgt die Herleitung der Grundgleichungen und der Notwendigkeit diese in  $dq0$  Koordinaten aufzustellen Um einen passenden Ansatz zur Simulation des mathematischen Modells in Matlab zu finden wurden im Rahmen der Literaturrecherche verschiedene Modellansätze gegenübergerstellt Als Ergebnis wird in der vorliegenden Arbeit der Ansatz hergeleitet der die Anforderungen bezüglich Anpassungsfähigkeit Modulationstiefe Detailgenauigkeit und Parametrierbarkeit am besten erfüllt Das Modell wird daraufhin so aufgestellt dass die Spannungen die Eingangsgrößen und die Ströme die Ausgangsgrößen sind Die Berechnungen finden in  $dq0$  rotorfesten Koordinaten statt Das Maschinenmodell wird im Folgenden mit Simulationsuntersuchungen validiert und so angepasst dass es zusammen mit dem Windkonvertermodell verwendet werden kann Dazu wird in dieser Arbeit ein Modell einer Windkraftanlage eingeführt Die Grundlagen aller an der Energiekonvertierung beteiligten Komponenten und deren Regelungen werden erläutert und die Implementierung in Matlab erklärt

Electric Drives Ion Boldea, 2025-09-10 Electric Drives now in its fourth edition provides a practical guide in understanding the fundamental principles and recent new knowledge of electric motion in motoring and electric energy flow in generating digital control via power electronics for energy savings and increased productivity in practically all industries from intelligent watches and phones to robots electric transport industrial processes and modern distributed electric power systems with ever more renewable energy penetration Every proposition number figure and reference has been revisited to bring necessary changes with new references to key recent knowledge trends to reflect the present state of the art The book has been restructured with a few chapters combined and one chapter on rectifier d c brush motor drives removed new introductory paragraphs in most chapters many as inspiring case studies and brand new chapters on flux modulation machine drives Chapter 8 and predictive control of a c drives Chapter 15 reflecting this updating effort The large number of new case studies complements the large number of worked numerical examples and the 10 user friendly MATLABR and SimulinkR programs that remain available online Although inevitably the math is intensive and intended to be directly usable the book mainly intended for senior undergraduate and graduate students and engineers in research and development in industry is a practical easy to assimilate and up to date synthesis of basic and advanced power electronics variable speed electric motor generator drives needed in all industries in which electric energy flow wise mainly digitally intelligent control is paramount

**Ninth International Conference on Electrical Machines and Drives** ,1999

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




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