

## ***Design Of Brushless Permanent Magnet Machines***

The importance of permanent magnet (PM) motor technology and its impact on electromechanical drives has grown exponentially since the publication of the bestselling second edition. The PM brushless motor market has grown considerably faster than the overall motion control market. This rapid growth makes it essential for electrical and electromechanical engineers and students to stay up-to-date on developments in modern electrical motors and drives, including their control, simulation, and CAD. Reflecting innovations in the development of PM motors for electromechanical drives, *Permanent Magnet Motor Technology: Design and Applications, Third Edition* demonstrates the construction of PM motor drives and supplies ready-to-implement solutions to common roadblocks along the way. This edition supplies fundamental equations and calculations for determining and evaluating system performance, efficiency, reliability, and cost. It explores modern computer-aided design of PM motors, including the finite element approach, and explains how to select PM motors to meet the specific requirements of electrical drives. The numerous examples, models, and diagrams provided in each chapter facilitate a lucid understanding of motor operations and

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characteristics. This 3rd edition of a bestselling reference has been thoroughly revised to include:

- Chapters on high speed motors and micromotors
- Advances in permanent magnet motor technology
- Additional numerical examples and illustrations
- An increased effort to bridge the gap between theory and industrial applications
- Modified research results

The growing global trend toward energy conservation makes it quite possible that the era of the PM brushless motor drive is just around the corner. This reference book will give engineers, researchers, and graduate-level students the comprehensive understanding required to develop the breakthroughs that will push this exciting technology to the forefront.

This dissertation, "Design, Analysis and Control of Multiphase Flux Regulated Permanent Magnet Brushless DC Motor Drives" by Jinyun, Gan, ???, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. DOI: 10.5353/th\_b3124530 Subjects: Electric motors, Permanent magnet - Design and construction  
Electric motors, Brushless - Design and construction

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Electric motors, Direct current - Electric motors, Direct current

In Finite Element Analysis of Electrical Machines the author covers two-dimensional analysis, emphasizing the use of finite elements to perform the most common calculations required of machine designers and analysts. The book explains what is inside a finite element program, and how the finite element method can be used to determine the behavior of electrical machines. The material is tutorial and includes several completely worked out examples. The main illustrative examples are synchronous and induction machines. The methods described have been used successfully in the design and analysis of most types of rotating and linear machines. Audience: A valuable reference source for academic researchers, practitioners and designers of electrical machinery.

Design Optimisation of Brushless Permanent Magnet Synchronous Motor for Electric Vehicles  
Permanent-magnet and Brushless DC Motors  
Design and Analysis

Permanent Magnet Synchronous Machines  
Magnetic Design, Performance, and Control of  
Brushless DC and Permanent Magnet Synchronous  
Motors

This dissertation, "Design, Analysis, Control and Application of Permanent-magnet Hybrid Brushless Machines" by Chunhua, Liu, [?][?][?], was obtained from The University of

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The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. DOI:

10.5353/th\_b4284166 Subjects: Permanent magnet motors  
Electric motors, Brushless - Design and construction  
Design of Brushless Permanent-magnet Machines

A presentation of the theory of brushless d.c. drives to help engineers appreciate the potential of such motors and apply them more widely, by taking into account developments in permanent-magnet materials, power semiconductors, electronic control and motor design.

Design Optimisation of a Slotless Brushless Permanent Magnet DC Motor with Helically-wound Laminations for Underwater Rim-driven Thrusters

Geometric Design Optimization of Brushless Permanent Magnet Motors

Energy Efficiency in Motor Driven Systems

Mastering MATLAB 5

Design and Applications, Third Edition

***A 2kw high-efficiency alternator system and its control board system are also designed, analyzed and fabricated applying to the truck auxiliary power unit (APU). The alternator system has two stages. The first stage is that the alternator three-phase outputs are connected to the three-phase active rectifier to get 48V DC. An advanced Sliding model control (SMO) is used to get an alternator position. The buck is used for the second***

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stage to get 14V DC output. The whole system efficiency is much higher than the traditional system using induction motor. This book reports the state of the art of energy-efficient electrical motor driven system technologies, which can be used now and in the near future to achieve significant and cost-effective energy savings. It includes the recent developments in advanced electrical motor end-use devices (pumps, fans and compressors) by some of the largest manufacturers. Policies and programs to promote the large scale penetration of energy-efficient technologies and the market transformation are featured in the book, describing the experiences carried out in different parts of the world. This extensive coverage includes contributions from relevant institutions in the Europe, North America, Latin America, Africa, Asia, Australia and New Zealand.

Axial Flux Permanent Magnet (AFPM) brushless machines are modern electrical machines with a lot of advantages over their conventional counterparts. This timeless and revised second edition deals with the analysis, construction, design, control and applications of AFPM machines. The authors present their own research results, as well as significant research contributions made by others.

Chung, M. J., Gweon, D.-G.: Optimal design and development of linear brushless permanent magnet motor

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***Design for Manufacture of Brushless Permanent Magnet Synchronous Servomotors***

***Design, Analysis and Control of Multiphase Flux Regulated Permanent Magnet Brushless DC Motor Drives***

***Design, Analysis, Control and Application of Permanent Magnet Brushless Dual-Memory Machines***

***Electromagnetic Linear Machines with Dual Halbach Array***

*Written for electrical, electronics, & mechanical engineers responsible for designing & specifying motors, the book provides details of brushless DC & synchronous motors, as well as both radial & axial motor topologies. Beginning with a discussion of the fundamentals of generic motor design, it logically progresses to a set of more advanced, yet easily understandable, concepts for designing brushless permanent-magnet motors. In addition, the author fully explains techniques for magnetic modeling & circuit analysis, shows how magnetic circuit analysis applies to motor design, describes all major aspects of motor operation & design in simple mathematical terms, develops rigorous design equations for radial flux & axial flux motors, & illustrates basic motor drive schemes. All common motor design terms are clearly defined & a wealth of charts, tables & equations are included.*

*An advanced introduction to the simulation and hardware implementation of BLDC motor drives A thorough reference on the simulation and hardware implementation of BLDC motor drives, this*

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*book covers recent advances in the control of BLDC motor drives, including intelligent control, sensorless control, torque ripple reduction and hardware implementation. With the guidance of the expert author team, readers will understand the principle, modelling, design and control of BLDC motor drives. The advanced control methods and new achievements of BLDC motor drives, of interest to more advanced readers, are also presented. Focuses on the control of PM brushless DC motors, giving readers the foundations to the topic that they can build on through more advanced reading Systematically guides readers through the subject, introducing basic operational principles before moving on to advanced control algorithms and implementations Covers special issues, such as sensorless control, intelligent control, torque ripple reduction and hardware implementation, which also have applications to other types of motors Includes presentation files with lecture notes and Matlab 7 coding on a companion website for the book In recent years, brushless DC motors and controllers have begun an unparalleled triumph in model construction and in all technical fields. This book is intended to show how a brushless motor works. The basic principle is discussed first, before all the key terms such as kV and rpm/V, operating voltage, load and idle current, torque, turns, electrical and mechanical power, losses, efficiency, etc. are explained. A brushless motor can't work without a brushless controller, it requires a three-phase AC voltage. To increase the speed properly, the controller*

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*must have information on the rotor position. This can be done by Hall sensors or directly via the motor windings. All that will be taken into account in the book.*

*Brushless Permanent-magnet Motor Design*

*Dynamics and Control of Electrical Drives*

*Design of Brushless Permanent-magnet Machines*

*Permanent Magnet Synchronous and Brushless DC Motor Drives*

*Axial Flux Permanent Magnet Brushless Machines*

A complete reference to all MATLAB functions and graphics, covering all features of Version 5. Over 100 MATLAB M-files demonstrate the use of MATLAB in performing real-world tasks.

Brushless permanent magnet (PM) motors can be divided into the PM synchronous AC motor (PMSM) and PM brushless DC motor (PMBDCM). The former has sinusoidal airgap flux and the back EMF, thus has to be supplied with sinusoidal current to produce constant torque. The PMBDCM has the trapezoidal back EMF, so the rectangular current waveform in its armature winding is required to obtain the low torque ripple. Generally, the magnets with parallel magnetization are used in the PMSM while the magnets with radial magnetization are suitable for the BDCM. The interior PM (IPM) synchronous machine is being studied as a promising candidate for high-power starter/alternator in future internal combustion engine vehicles. The other many popular applications of IPM machine are traction, machine tool, spindle drives, air conditioning compressors and electrical vehicles. Torque ripple minimization in PM motors is conventionally obtained by either good motor design or appropriate control strategies. In design optimization programs, a reliable and detailed analysis of the torque and

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back-EMF of the machine should be performed.

This book extends the conventional two-dimensional (2D) magnet arrangement into 3D pattern for permanent magnet linear machines for the first time, and proposes a novel dual Halbach array. It can not only effectively increase the radial component of magnetic flux density and output force of tubular linear machines, but also significantly reduce the axial flux density, radial force and thus system vibrations and noises. The book is also the first to address the fundamentals and provide a summary of conventional arrays, as well as novel concepts for PM pole design in electric linear machines. It covers theoretical study, numerical simulation, design optimization and experimental works systematically. The design concept and analytical approaches can be implemented to other linear and rotary machines with similar structures. The book will be of interest to academics, researchers, R&D engineers and graduate students in electronic engineering and mechanical engineering who wish to learn the core principles, methods, and applications of linear and rotary machines.

Electric Vehicle Machines and Drives

Brushless Motors and Controllers

Permanent Magnet Motor Technology

DESIGN ANALYSIS & CONTROL OF F

Brushless Permanent-magnet and Reluctance Motor Drives

**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**

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**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.**

**This dissertation, "A New Phase Decoupling Permanent Magnet Brushless DC Motor and Its Control" by [redacted], Wei, Xia, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons:**

**Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. DOI: 10.5353/th\_b3123542 Subjects: Electric motors, Permanent magnet - Design and construction Electric motors, Brushless - Design and construction**

**Brushless Motors: Magnetic Design, Performance and Control is an outgrowth of the author's two previous books on this subject. This book contains significant additional material covering further aspects of magnetic design, performance, and electrical control. The primary goal of this book is to meet the needs of working engineers who have little or no experience in electric motor design and control. The book starts with basic concepts, provides intuitive reasoning for them, and gradually builds a set of understandable concepts that foster the development of usable knowledge. This book strives to provide a basis of knowledge that non-experts can use to develop practical expertise, making them more productive in**

**their work and allowing them to productively explore other approaches to motor design, performance, and electrical control.**

**Brushless Permanent Magnet Motor Design**

**Design of Brushless Permanent-magnet Motors**

**NEW PHASE DECOUPLING PERMANENT**

**Permanent Magnet Brushless DC Motor Drives and Controls**

**Interior Permanent-Magnet Synchronous Motors**

*Rapid increases in energy consumption and emphasis on environmental protection have posed challenges for the motor industry, as has the design and manufacture of highly efficient, reliable, cost-effective, energy-saving, quiet, precisely controlled, and long-lasting electric motors. Suitable for motor designers, engineers, and manufacturers, as well Interest in permanent magnet synchronous machines (PMSMs) is continuously increasing worldwide, especially with the increased use of renewable energy and the electrification of transports. This book contains the successful submissions of fifteen papers to a Special Issue of Energies on the subject area of “Permanent Magnet Synchronous Machines”. The focus is on permanent magnet synchronous machines and the electrical systems they are connected to. The presented work represents a wide range of areas. Studies of control systems, both for permanent magnet synchronous machines and for brushless DC motors, are presented and experimentally verified. Design studies of generators for wind power, wave power and hydro power are presented. Finite element method simulations and analytical design methods are used. The presented studies represent several of the different research fields on permanent magnet machines and electric drives.*

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*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*

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*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.*

*The Design of AC Brushless Permanent Magnet Motors for Electric Vehicle Traction Applications*

*A Comprehensive Tutorial and Reference*

*Control of Permanent Magnet Synchronous Motors  
Brushless Motors*

***A timely comprehensive reference consolidates the research and development of electric vehicle machines and drives for electric and hybrid propulsions • Focuses on electric vehicle machines and drives • Covers the major technologies in the area including fundamental concepts and applications • Emphasis the design criteria, performance analyses and application examples or potentials of various motor drives and machine systems •***

***Accompanying website includes the simulation models and outcomes as supplementary material  
Co-authored by a world-renowned expert in the field, Permanent Magnet Motor Technology: Design and Applications, Second Edition demonstrates the construction of PM motor drives and supplies ready-to-implement solutions for common roadblocks. The author***

***presents fundamental equations and calculations to determine and evaluate system performance, efficiency, and reliability; explores modern computer-aided design of PM motors, including the finite element approach; and covers how to select PM motors to meet the specific requirements of electrical drives. The numerous examples, models, and diagrams provided in each chapter give the reader a clear understanding of motor operations and characteristics.***

***This dissertation, "Design, Analysis and Control of Flux-mnemonic Permanent Magnet Brushless Machines" by Chuang, Yu, ??, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. DOI: 10.5353/th\_b4476902 Subjects: Electric motors, Permanent magnet - Design and construction Electric motors, Brushless - Design and construction Design and Applications, Second Edition, Design and Analysis of Short-stroke Brushless Permanent Magnet Linear Oscillating Actuators***

***paper review for IEEE transactions on industry applications***

***Mechanical Design of Electric Motors***

***Analysis and Design of Permanent Magnet***

***Brushless Dc Motor for Automotive Applications***

*Brushless permanent-magnet motors provide simple, low maintenance, and easily controlled mechanical power. Written by two leading experts on the subject, this book offers the most comprehensive guide to the design and performance of brushless permanent-magnetic motors ever written. Topics range from electrical and magnetic design to materials and control. Throughout, the authors stress both practical and theoretical aspects of the subject, and relate the material to modern software-based techniques for design and analysis. As new magnetic materials and digital power control techniques continue to widen the scope of the applicability of such motors, the need for an authoritative overview of the subject becomes ever more urgent. Design of Brushless Permanent-Magnet Motors fits the bill and will be read by students and researchers in electric and electronic engineering.*

*This dissertation, "Design, Analysis, Control and Application of Permanent Magnet Brushless Dual-memory Machines" by Fuhua, Li, 李福华, was obtained from The University of Hong Kong (Pokfulam, Hong Kong) and is being sold pursuant to Creative Commons: Attribution 3.0 Hong Kong License. The content of this*

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*dissertation has not been altered in any way. We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation. All rights not granted by the above license are retained by the author. Abstract: Conventional PM machines have fixed PM excitation and can only perform flux-weakening by controlling the d-axis current. This current incurs the power dissipation and reduces the efficiency during flux-weakening operations. Memory machines change this situation by introducing the memory function, namely magnetizing or reversely magnetizing Al-Ni-Co PMs to change the air-gap flux density. This provides another new way to realizing flux-weakening. And the elimination of the flux-weakening d-axis current improves the overall efficiency. But the single-memory machines have lower power density due to the low-energy Al-Ni-Co PMs. By incorporating the memory concept and with the intention of improving the power density, the DC-excited PMBL dual-memory machines have been proposed and implemented, based on two kinds of PMs which are high-coercivity Nd-Fe-B PMs and low-coercivity Al-Ni-Co PMs. The Nd-Fe-B PMs provide a strong magnetic field to excite high air-gap flux density; while the Al-Ni-Co PMs can be forward magnetized to strengthen the magnetic field produced by Nd-Fe-B PMs or can be reversely magnetized to cancel that field. Consequently the air-gap flux density can be controlled within a wide range. A series of*

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design principles on such kind of dual-memory machine are devised for guidance. The key design principles involve how to determine the number of salient poles on the stator and rotor, how to choose the surface areas and thicknesses of the two kind of PM pieces and how to size the rotor dimension. Generally, increase on the proportion of Nd-Fe-B PMs will raise the base field and the load capacity. On the other hand, increment on the proportion of Al-Ni-Co PMs will extend the controllable flux range. Analysis is also carried out on the equivalent magnetic circuit to formulate the magnetizing force exerted on Al-Ni-Co PMs. The machine model is analyzed by using time-stepping FEM (TS-FEM) and co-simulation of FEM software and Matlab Simulink. The dynamic reverse magnetizing processes are simulated and presented in details under different magnetizing current. In addition the effect of adding iron bridges between the two kinds PMs is also evaluated by simulations. Furthermore, the control methods are evaluate by simulations and experiments. The direct torque control (DTC) scheme is adapted to this doubly-salient dual-memory machine and a torque estimator is proposed to facilitate the DTC method. Both of the simulation results and the experimental results confirm the validity of the proposed design principles and the effectiveness of the control methods. Eventually, this dual-memory machine is proposed as a pole-changing wind power

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*generator and a pole-changing EV machine. Simulation and experimental results have verified the validity of the pole-changing scheme and the pole-protection scheme. DOI: 10.5353/th\_b5387979 Subjects: Electric motors, Brushless - Design and construction Permanent magnet motors*

*Small electric motors are crucial to the manufacture of industrial robots, numerically controlled machines, and computer peripherals such as disk drives and printers. In this handbook, Dr. Kenjo considers two of the most important small motors, permanent-magnet and brushless DC motors, explaining how to select the most suitable motor for the the intended application and how to design the drive circuitry. The book provides clear descriptions of the basic machine structure, the constructional relationships between conventional and brushless DC machines, and the drive and control circuitry. Generously illustrated and easy-to-follow.*

*Design, Analysis, Control and Application of Permanent-Magnet Hybrid Brushless Machines paper review for IEEE power engineering review and IEEE transactions on energy conversion*

*Finite Element Analysis of Electrical Machines*

*Design, Analysis and Application*

*Design of High Efficiency Brushless Permanent-magnet Machines and Driver System*

*Axial Flux Permanent Magnet (AFPM) brushless machines are modern electrical machines with a lot of*

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advantageous merits over their conventional counterparts. They are increasingly used in power generation, domestic appliances, industrial drives, electric vehicles, and marine propulsion drives and many other applications. This book deals with the analysis, construction, design, optimisation, control and applications of AFPM machines. The authors present their own research results, as well as significant research contributions made by others. This monograph will be of interest to electrical engineers and other engineers involved in the design and application of AFPM brushless machine drives. It will be an important resource for researchers and graduate students in the field of electrical machine and drives.

Permanent magnet synchronous (PMS) motors stand at the forefront of electric motor development due to their energy saving capabilities and performance potential. The motors have been developed in response to mounting environmental crises and growing electricity prices, and they have enabled the emergence of motor drive applications like those found in electric and hybrid vehicles, fly by wire, and drones. Control of Permanent Magnet Synchronous Motors is a timely advancement along that path as the first comprehensive, self-contained, and thoroughly up-to-date book devoted solely to the control of PMS motors. It offers a deep and extended analysis, design, implementation, and performance evaluation of major motor control methods, including Vector, Direct Torque, Predictive, Deadbeat, and Combined Control, in a systematic and coherent manner. All major Sensorless Control and Parameter Estimation methods are also studied. The book places

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great emphasis on energy saving control schemes.  
Design and Parameter Estimation of an Electric Power Steering Brushless Permanent Magnet Motor