ELECTRICAL MACHINES AND CONVERTERS pdf

1: Electrical Protection for Machine shop in the woods

If you are searched for the book by H. Buyse Electrical Machines and Converters: Modelling and Simulation in pdf format, then you've come to loyal website.

Power and Energy Systems Electric Drive and Power Converter Controls Purdue has been highly active in the area of controls for electric machinery, electric drive systems, and power electronic converters, and even systems of power electronic converters. The first contributions of this were set forth in [] which offer a control based on the standard induction motor model. Later, improved versions of this strategy were set forth that address rotor resistance variation, magnetic saturation, and distributed circuit effects in the machine rotor []. Purdue researchers have also been highly involved in control development for permanent magnet synchronous machines. In [8], a feedback based approach to flux weakening is set forth which allows flux weakening to occur without knowledge of the machine model flux-weakening is a technique used to increase the speed range. In [9] an approach is set forth to reduce sensor requirements, thereby reducing the cost of the drive system. In [], the performance of permanent-magnet synchronous machines is set forth. Therein, the optimal current waveform in terms of loss and torque ripple is found, and a method to obtain this waveform is set forth. This control strategy addresses the problems of reducing loss and torque ripple which causes acoustic noise. The control which obtains the desired waveform is generalized in [14]. This can be used to inject desired harmonic content for example, to reduce cogging torque or to make sure that irregularities in a machine such as a slight imbalance do not introduce objectionable harmonics. The application of these concepts to the switched reluctance machine is described in []. For example, in [17] an inverter control strategy is set forth for 3-phase power regulation. The strategy is simple, effective, and offers essentially perfect bus voltage regulation. The control strategy for a power-electronics based distribution transformer is set forth in []. One common theme in power systems containing numerous power electronic converters is stability. Power electronic converters often appear as constant power loads to the system, and this class of load is destabilizing. A strategy to mitigate this effect is set forth in []. Topics of research interests are on development of pulsewidth modulation techniques, modeling, and control of multi-level and multi-module converters [22]-[29]. Purdue has had considerable efforts in power electronics based Marine and Aerospace Power Systems , and this interest has included the controls. In [30], a systematic means of semiautomatically designing system controls is set forth. Purdue has also been interested in exotic power systems. In MPC, control is determined at each sampling, through the solution of an optimal control problem. The optimal control formulation for switching systems is presented in [32]. In [33]-[36], the optimization is implemented within a Model Predictive Control framework for control of switching in a dc-dc boost converter. The primary focus of this research is on the real-time implementation of the control method, wherein the control problem is solved online in less than one switch period. A benefit of MPC control is that it achieves fast dynamic response over a wide range of operating points, even for systems with dynamic loads. Model Predictive Control of the boost converter left results in fast dynamic response ie. Winner of Manley Memorial Medal for best paper of the year in aerospace engines, their parts, and their accessories Originally accepted to the conference, the paper was then accepted for SAE Transactions.

2: Energy: Power Electronics & Drives: Introduction to Electric Machines and Drives

Modeling of Electric Machinery and Converters. Over the past two decades, Purdue researchers have been highly active in pushing the envelope in electric machinery modeling, particularly in regard to modeling machine-converter interaction.

Research Staff Research on electrical energy systems focuses broadly on generation, transmission, conversion and control of electrical energy, including renewable energy. Six permanently employed lecturers form the division for Electrical Energy and, together with a relatively high number of postgraduate students, are involved in this research. Facilities comprise, amongst other things, three large, world-class laboratories for research on high-voltage power electronics and electrical machines. Tests can be done in these laboratories at power and voltage levels of up to 3 MW and kV respectively. The research on power systems includes work on wideband modelling and parameter estimation of power system components by application of system identification techniques. Instrumentation for system identification measurements and the measurement of wideband waveforms on high-voltage transmission systems form part of this research. As an example of what is done, a number of large generator units were recently tested for modelling and parameter identification purposes in conjunction with the Electricity Supply Commission Eskom of South Africa. The way electrical loads are modelled is cardinal to the analysis, operation and design of energy system networks, particularly in rural areas. Load modelling and load voltage sensitivity for energy system analysis therefore receives considerable attention in research on power systems. Evaluation of the performance of power-line insulators made of various materials in polluted environments forms an important part of the high voltage research. For example, cyclo-aliphatic insulators of different lengths have been energised at a coastal test station to evaluate their pollution performance. A pollution monitoring device has been developed and calibrated in this regard. Power electronic converters play a vital role in electrical energy conversion and control. The power electronic research focuses on the development and control of new power electronic converter technology and the application thereof. This includes research on multilevel converters, cost-effective AC-to-AC converters, single-to-three phase converters and matrix converters. Applications for these converters are active filters, voltage regulation devices, conversion of renewable energy and rural electrification. Research on electrical machines and drives focuses on the optimum design and control of permanent magnet, reluctance and induction machine drive and generator systems. Optimum design of these machines is achieved using finite-element analysis and optimisation algorithms. New permanent-magnet generators are designed and developed, for example, for direct-drive renewable energy applications such as wind, hydro and wave energy. A study on linear Stirling-engine generator power supply was launched recently. Another focus of the research is on drive systems for electrical transportation, such as in-wheel drives for electrical vehicles. A parallel hybrid electrical vehicle was recently developed and tested. Position sensorless control, as well as optimum efficiency control, also form an integral part of the research on electrical drives. For further information on the research focus areas in the Division for Electrical Energy, please visit the websites below. Postgraduate bursaries are available for Masters and PhD studies. Johan Vermeulen for more information on this research activity. Electrical Machines Laboratory US Electrical Machines Laboratory EMLab undertakes research, design and development of both conventional and special electrical machines, applied magnetics and power electronics. From the outset High Voltage Engineering was an important element of the Department. The early professors, Prof. Alan Heydorn and Prof Hanno Reuter both had a solid high voltage training in accordance with the German school. The undergraduate lectures are in Afrikaans, but postgraduate work and research is conducted in English. Power Electronics Group This lab does research mainly for industry and governmental organisations.

3: Associate Professorship in Power Electronic Converters, Electrical Machines and Drives ()

Note: Citations are based on reference standards. However, formatting rules can vary widely between applications and fields of interest or study. The specific requirements or preferences of your reviewing publisher, classroom teacher, institution or organization should be applied.

Funded Research Power Electronics and Power Systems Power electronics is the engineering study of converting electrical power from one form to another. A lot of energy is wasted during this power conversion process due to low power conversion efficiency. It is estimated that the power wasted in desktop PCs sold in one year is equivalent to seventeen MW power plants! It is therefore very important to improve the efficiency of these power conversion systems. The findings could lead to early applications in the power industry, especially in power converters like medium voltage drives, solid state transformers and high voltage transmissions and circuit breakers. Learn more Electric Machines and Drives The electric machine is an electromechanical energy conversion device that processes and delivers power to the load. The same electric machine can operate as a motor to convert electrical power to mechanical power or operate as a generator to convert mechanical power to electrical power. The electric machine in conjunction with the power electronic converter and the associated controller makes the motor drive. The power electronic converter is made of solid state devices and handles the flow of bulk power from the source to the motor input terminals. The advances in the power semiconductor technology over the past several decades enabled the development of compact, efficient and reliable DC and AC electric motor drives. The controller is made of microcontroller or digital signal processor and associated small signal electronics. The function of the controller is to process the user commands and various sensor feedback signals to generate the gate switching signals for the power converter semiconductor switches following a motor control algorithm. The sensor signals include machine rotor position, phase currents, inverter bus voltage, and machine and inverter temperature outputs. Fault protection and diagnostics is also part of the motor controller algorithm. Research in the area of electric machines and drives is focused on design optimization using 2D and 3D finite element analysis, and drives design at the systems level considering operating requirements and control opportunities. The research is multifaceted seeking innovations in machine configurations, motor control concepts, parameter identifications, and noise and vibration analysis. Motor drives are designed to make the system more efficient, fault tolerant, smoother in operation, smaller and matched to the applications. Modeling and design tools are developed to aid the machine design and drive development efforts. Particular research emphasis is on permanent magnet and reluctance type machines and drives. Electric Vehicle Systems Within a single century, personal transportation has progressed from the horse and buggy to nearly a billion private automobiles. It is projected that the need for personal mobility will grow even faster, as large numbers of people are lifted out of poverty in developing countries and demand transportation. Emissions from oil-burning automobiles clog our air and contribute to global warming. For all of these reasons, finding an alternative to oil for private transportation is imperative. Although several alternatives can propel a car, only one is readily available today: With the introduction of electric propulsion, a completely new drivetrain is introduced in the vehicle requiring multidisciplinary research into system components. The Electric vehicle system is comprised of electric motor, power electronics converters, and energy storage devices such as batteries. In addition, the overall system must be optimized to maximize overall system efficiency. Finally, to reduce the overall transportation emissions, the vehicle energy storage device should be recharged at times when the grid power production is most efficient and non-polluting. NCSU research on electric vehicle systems focuses on extending the vehicle range by developing more efficient subsystems and including storage systems with higher energy and power densities. Another research topic focuses on development of fundamental and enabling technologies that will facilitate the electric power industry to actively manage and control large amount of plug-in vehicle charging. More info is at: Electrical engineers develop circuits and schematics, but what is eventually delivered to a customer are electro-physical circuits concurrently designed and combined into a hardware system. These hardware systems must meet metrics, such as power, weight, and size densities; government and industry standards; and reliability. Understandably, this research is broad-based and multidisciplinary with studies in electric, magnetic, thermal and mechanical components and circuits. The NCSU research focus is on high-frequency, high-density topologies that use ultrafast-switching power semiconductors, and the materials and fabrication processes to create such topologies. Applications are in new integrated power systems from chip to ship including land-based smart grid power systems; electric vehicle converters and drives; high performance power supplies for aerospace, telecom and DC distribution systems; and ultrafast fault protectors using the latest in SiC and GaN semiconductors. Those interested in this area would find it advantageous to have had primary study in power electronics and physics with strong interests in heat transfer, materials or structural mechanics. Power Electronics Power electronics is the technology associated with the efficient conversion, control and conditioning of electric power by static means from its available input form into the desired electrical output form. Power electronic converters can be found wherever there is a need to modify the electrical energy form i. Large scale power electronics are used to control hundreds of megawatt of power flow across our nation. Research in this area includes power electronics applications to control large scale power transmission and distribution as well as the integration of distributed and renewable energy sources into the grid. NCSU also has a strong program on the emerging applications of wide bandgap semiconductor devices that offer high oeprating temperatures, higher efficiency and higher power density. In addition, under-voltage or other fault conditions are monitored to prevent damage to the system. The soft-start feature reduces stress on power supply components and increase product reliability. Implementation is typically done using analog integrated circuits but there is a strong trend to move towards digital or mixed signal implementation. Power Semiconductor Devices Power semiconductor devices are semiconductor devices used as switches or rectifiers in power electronic circuits switch mode power supplies for example. They are also called power devices or when used in integrated circuits, called power ICs. A power diode or MOSFET, for example, operates on similar principles as its low-power counterpart, but is able to carry a larger amount of current and typically is able to support a larger reverse-bias voltage in the off-state. Research needs in this area include on one hand to increase the maximum power handling capability of the power devices, on the other hand include the need to increase the speed they can switch. Power semiconductor is also the key in determining the power conversion efficiency. Research projects are focused on the analysis of power device structures using numerical simulations and the development of analytical models based on semiconductor transport physics. Students are encouraged to validate the theoretical analysis using electrical characterization of commercially available devices and by the fabrication of novel device structures. The impact of improvements in power device characteristics on specific applications allows an understanding of trade-offs between on-state characteristics, reverse blocking capability, and switching performance. Power Systems Electric power systems are comprised of components that produce electrical energy and transmit this energy to consumers. A modern electric power system has mainly six main components: The production and transmission of electricity is relatively efficient and inexpensive, although unlike other forms of energy, electricity is not easily stored, and thus, must be produced based on the demand. NCSU research on electric power systems concentrates on the study of emerging technologies such as power electronics, energy storage, renewable and distributed energy sources on the electric power system operation, control and protection. The research is coordinated through two major centers: Future Renewable Electric Energy Delivery and Management Systems Center FREEDM focuses on development of a smart-grid that will enable anybody to integrate new renewable energy technologies into the power grid for a secure and sustainable future. Research involves development or adoption of new power electronics, communication, and control technologies to demonstrate and prototype such a system.

4: Power Electronics and Power Systems â€¢ Electrical and Computer Engineering

Electric Drive and Power Converter Controls. Purdue has been highly active in the area of controls for electric machinery, electric drive systems, and power electronic converters, and even systems of power electronic converters.

An introductory text primarily written for those who select or buy power supplies. Treatment is primarily descriptive. Liang, Power Electronics and Motor Control, 2nd ed. Cambridge University Press, c This clear and concise advanced textbook is a comprehensive introduction to power electronics. It considers the topics of analogue electronics, electric motor control and adjustable speed electrical drives, both a. In recent years, great changes have taken place in the types of semiconductor devices used as power switches in engineering applications. In this second edition of a popular text, a further completely new chapter has been added, dealing with the application of PWM techniques in induction motor speed control. The chapters dealing with electronic switching devices and with adjustable speed drives have been entirely rewritten, to ensure the text is completely up-to-date. With numerous worked examples, exercises, and the many diagrams, advanced undergraduates and postgraduates will find this a readable and immensely useful introduction to the subject of power electronics. Jayant Baliga, Cryogenic operation of silicon power devices, Boston: Kluwer Academic Publishers, c Presents the different characteristics of power devices operated below C K , down to 77 K including commercial devices. CRC Press, c Provides a comprehensive coverage of the power electronics field. Van Nostrand Reinhold Kluwer , c This guide helps engineers solve design problems related to the new high frequency standard in electronics. It takes the mystery out of how to make necessary measurements, interpret results, and engineer solutions to specific noise problems. The relationship between high frequency noise to final product reliability and Electromagnetic Inference EMI performance is fully clarified, and guidelines to writing meaningful specifications on noise performance are provided. Users also gain an understanding of the transition between the time and frequency domains. Available from Intertec Communications Inc. A collection of papers dedicated to Smart Power Integrated Circuits. Topics include the big picture; reliability; devices, materials and processing; testing and packaging; analysis, modeling and simulation. Application categories include models for motor control, power supplies, automotive, and other. Written primarily for the circuit designer and power processing system designer who want to design their own magnetics. Topics include low frequency power transformers, optimization, power reactors, nonlinear magnetics, current transformers, pulse transformers, field gradient control, heat transfer, and materials and fabrication methods. Some derivations require knowledge of calculus but only algebraic formulas are used for design. Designing electronic hardware to withstand severe thermal environments. Explains the fundamentals underlying the operation of magnetic amplifiers and illustrates principle uses. Topics include magnetics, magnetic amplifiers, components, and application. Primarily descriptive with algebraic equations. Popular undergraduate text in electrical measurement. Topics include electrical units, experimental and statistical analysis, computation aides, measurement using various measuring techniques and instruments of resistance, capacitance, mutual inductance, voltage, current, and power. Mathematical treatment is algebra, complex algebra, trigonometry, and simple statistics. This text for undergraduate students focuses on the physical principles and behavior of the thyristor family of power converters. Conversion, Inverters, and Index. Presents the fundamentals of switched-mode power supplies. Topics include switched-mode power converters, calculator-aided analysis and design, design of magnetic components, stability considerations, input-filter interactions, and performance measurement and evaluation. The several appendices include one on state-space-averaging and one on SPICE models for computer simulation. Contains an extensive bibliography. Mathematical treatment through state-variables. A collection of papers relevant to high frequency resonant power conversion. The invited introductory paper is written by Dr. This book is an introduction to the physical principles of semiconductor devices and their fabrication technology. It is intended as a textbook for undergraduate students in applied physics, electrical engineering, and materials science; it can also be used as a reference for practicing engineers and scientists who need an update on device and technology developments. Topics include energy bands and carrier concentrations, carrier transport phenomena, p-n junction, bipolar devices, unipolar devices, microwave devices, photonic devices, crystal growth and epitaxy, oxidation and film deposition, diffusion and ion implantation, lithography and etching, and integrated devices.

5: Electric machine - Wikipedia

of machines and power electronics in subjects such as electrical services and lighting, power systems, electrical energy converters and drives, control systems, robotics and mechatronics.

Power and Energy Systems Modeling of Electric Machinery and Converters Over the past two decades, Purdue researchers have been highly active in pushing the envelope in electric machinery modeling, particularly in regard to modeling machine-converter interaction. Areas of interest have included synchronous machines, induction machines, permanent magnet synchronous machines, and switched reluctance machines. Perhaps one of the most fundamental early contributions was set forth by P. Krause who organized reference frame theory and made its application systematic through the introduction of the arbitrary reference frame [1]. In the area of synchronous machines, Purdue has been active in extending the standard qd model to include saturation, leakage saturation, and distributed rotor effects in a systematic way [], as well as finding effective means to experimentally identify parameters of this advanced model [4]. Related to this work is an model of synchronous machine models that incorporate hysteresis and multiple rectifier modes []. Together [] form the basis of probably the most accurate ODE based synchronous machine model in existence. Permanent Magnet Synchronous Machine Under Test in Energy Conversion Research Laboratory Purdue researchers have also been highly interested in the problem of synchronous machine â€” line commutated converter interaction. In [7], Purdue researchers were the first to identify the true value of commutating reactance of a synchronous machine, which is critical to modeling of generator-rectifier sets. This methodology was extended in [] to form a comprehensive analysis of this class of systems. Purdue researchers have also been very active in the modeling of induction machines. The works set forth in [] put forth a model which includes saturation, leakage saturation, and distributed rotor effects in a comprehensive fashion. These effects are critical if the performance in the understanding of the current and torque ripple and related acoustic noise in induction motor based drive systems. A means of experimentally identifying parameters is set forth in [13]. Purdue researchers have also created advanced induction machine models using magnetic equivalent circuit MEC analysis in order to help understand the implications of issues such as broken rotor bars [14]. Single-phase induction machines actually two-phase machines suitably connected to a single-phase source are particularly difficult to model. Purdue has had a long standing interest in permanent magnet synchronous machine drives. The range from older studies considering the operating modes possible with o voltage source converters [] to more recent studies which considering wide-bandwidth machine models designed to accurately predict current ripple levels [20] or in which the machine back emf has an arbitrary waveshapes [21]. The area of switched reluctance machine modeling is particularly challenging because of the high degree of magnetic saturation and highly non-sinusoidal inductance variation. Despite this Purdue researchers have developed relatively straightforward models [] and even models in which state variables are constant in the steady state [24]. Purdue researchers have even modeled rather exotic variations of this device, including a switched capacitive machine [25]. Krause, Analysis of Electric Machinery [2] D.

6: EPub Free Electric Machines And Drives Principles Control Modeling And Simulation Reader Converter

â€¢ Design and prototyping of power converters and controllers for electrical machines â€¢ Design and manufacture of power electronic systems for the energy efficiency market â€¢ Analysis and design of wireless power transfer and inductive charging.

Electromagnetic-rotor machines[edit] Electromagnetic-rotor machines are machines having some kind of electric current in the rotor which creates a magnetic field which interacts with the stator windings. The rotor current can be the internal current in a permanent magnet PM machine , a current supplied to the rotor through brushes Brushed machine or a current set up in closed rotor windings by a varying magnetic field Induction machine. Permanent magnet machines[edit] PM machines have permanent magnets in the rotor which set up a magnetic field. The magnetomotive force in a PM caused by orbiting electrons with aligned spin is generally much higher than what is possible in a copper coil. The copper coil can, however, be filled with a ferromagnetic material, which gives the coil much lower magnetic reluctance. This may change with introduction of superconductors in rotor. Since the permanent magnets in a PM machine already introduce considerable magnetic reluctance, then the reluctance in the air gap and coils are less important. This gives considerable freedom when designing PM machines. It is usually possible to overload electric machines for a short time until the current in the coils heats parts of the machine to a temperature which cause damage. PM machines can in less degree be subjected to such overload because too high current in the coils can create a magnetic field strong enough to demagnetise the magnets. Brushed machines[edit] Brushed machines are machines where the rotor coil is supplied with current through brushes in much the same way as current is supplied to the car in an electric slot car track. More durable brushes can be made of graphite or liquid metal. It is even possible to eliminate the brushes in a "brushed machine" by using a part of rotor and stator as a transformer which transfer current without creating torque. Brushes must not be confused with a commutator. The difference is that the brushes only transfer electric current to a moving rotor while a commutator also provide switching of the current direction. There is iron usually laminated steel cores made of sheet metal between the rotor coils and teeth of iron between the stator coils in addition to black iron behind the stator coils. The gap between rotor and stator is also made as small as possible. All this is done to minimize magnetic reluctance of the magnetic circuit which the magnetic field created by the rotor coils travels through, something which is important for optimizing these machines. Large brushed machines which are run with DC to the stator windings at synchronous speed are the most common generator in power plants , because they also supply reactive power to the grid, because they can be started by the turbine and because the machine in this system can generate power at constant speed without a controller. This type of machine is often referred to in the literature as a synchronous machine. This machine can also be run by connecting the stator coils to the grid, and supplying the rotor coils with AC from an inverter. The advantage is that it is possible to control rotating speed of the machine with a fractionally rated inverter. When run this way the machine is known as a brushed double feed "induction" machine. Induction machines[edit] Induction machines have short circuited rotor coils where a current is set up and maintained by induction. This requires that the rotor rotates at other than synchronous speed, so that the rotor coils are subjected to a varying magnetic field created by the stator coils. An induction machine is an asynchronous machine. Induction eliminates the need for brushes which is usually a weak part in an electric machine. It also allows designs which make it very easy to manufacture the rotor. A metal cylinder will work as rotor, but to improve efficiency a "squirrel cage" rotor or a rotor with closed windings is usually used. The speed of asynchronous induction machines will decrease with increased load because a larger speed difference between stator and rotor is necessary to set up sufficient rotor current and rotor magnetic field. Asynchronous induction machines can be made so they start and run without any means of control if connected to an AC grid, but the starting torque is low. A special case would be an induction machine with superconductors in the rotor. The current in the superconductors will be set up by induction, but the rotor will run at synchronous speed because there will be no need for a speed difference between the magnetic field in stator and speed of rotor to maintain the rotor current. Another special case would be the brushless double fed induction machine , which has a double set of coils in the stator. Since it has two moving magnetic fields in the stator, it gives no meaning to talk about synchronous or asynchronous speed. Reluctance machines[edit] Reluctance machines have no windings in rotor, only a ferromagnetic material shaped so that "electromagnets" in stator can "grab" the teeth in rotor and move it a little. The electromagnets are then turned off, while another set of electromagnets is turned on to move stator further. Another name is step motor, and it is suited for low speed and accurate position control. Reluctance machines can be supplied with PMs in stator to improve performance. Electrostatic machines[edit] In electrostatic machines , torque is created by attraction or repulsion of electric charge in rotor and stator. Electrostatic generators generate electricity by building up electric charge. Early types were friction machines, later ones were influence machines that worked by electrostatic induction. The Van de Graaff generator is an electrostatic generator still used in research today. Homopolar machines[edit] Homopolar machines are true DC machines where current is supplied to a spinning wheel through brushes. The wheel is inserted in a magnetic field, and torque is created as the current travels from the edge to the centre of the wheel through the magnetic field. Handbook of Transformer Design and Applications, Chap.

ELECTRICAL MACHINES AND CONVERTERS pdf

7: USA1 - Converter for electrical machines - Google Patents

Electrical Protection for Machine shop in the woods This is a question for myself and a buddy in a similar situation. I searched the forums but did not come up with much.

It considers components, systems, technologies and materials related to the power production processes from traditional sources or renewable sources also in distributed generation systems with cogeneration, storage systems, etc. It further includes all the methodologies related to the electrical engineering and power electronics dealing with the static and dynamic regime of the components of the electrical systems, besides those of the control systems, of the automation processes, of mechatronics, informatics and of the communications. The research includes problems of electromagnetic compatibility, integration of the components in the systems, and management of the process of the conversion in industrial energy systems, in the transportation and in the service sector; it further, comprises methodological aspects related to reliability, the quality, safety and savings. More specifically, the research and teaching activities focus on converters, machines and electric drives. This may regard the analysis, design, technological development, characterization, application, and integration of the electric machines, of sensors and electric actuators, the electronic power components and converters, the electric drives, the electrical and electronic materials. Those deal with basic and application problems of the electronic and electro-mechanic conversion enabling an energy efficient exploitation of energy sources both traditional and renewable. The peculiar constraint for electric power is that of making it available in the form, extent, and quality needed for different industrial applications automation processes, treatment and processing of materials, handling, etc. About the Faculty of Science and Technology We are a young and fast growing faculty with a strong multidisciplinary and multinational dimension. In our staffwe have nationally and internationally recognized experts. We have a solid network of international collaborations and high-end research facilities, are expanding in many directions and open for new ideas. New challenges are our daily routine and therefore people who like innovation and strive for top scientific goals are a good match with our culture. Our main areas of interest are industrial engineering and automation, energy resources and energy efficiency, fundamental sciences for innovative applications, agricultural production and food technologies and dynamics and management of mountain ecosystems. We teach two bachelor courses, five master courses andtwo PhD study programs, and the number of courses is going to expand. Both our students and professors are provided with the support of the Language Centre of the University. It helps them in finding the right method for the study of the language of interest and in achieving the desired level of language proficiency through its courses and language counseling. Finally, it offers a preparation for internationally recognized language certificates. We further encourage our academics to improve their language skills by incentivizing financially those with B2 and C1 certificates in the second or third language. Currently, we are participating in 95 research projects witha fundingbudget of about 17 million Euros. Our work is visible all over the province of Bolzano, as our interdisciplinary and hands-on approach resulted in many fruitful collaborations, with a strong support from the local community. In this context, ideas can be transformed into projects in a matter of months. We firmly believe that our researchers are our greatest asset and a competitive advantage on a market thirsty for innovation:

8: Energy: Power Electronics & Drives: Hybrid and Electric Vehicle Boot Camp

In modern industries, electrical energy conversion systems consist of two main parts: electrical machines and power electronic converters. With global electricity use at an all-time high, uninterrupted operation of electrical power converters is essential.

A version of the converter that is simple from a production standpoint and is highly economical in terms of space is obtained by providing that the capacitor 15 is embodied as a foil capacitor surrounding the machine, to the electrodes 16, 17 of which the bridge circuits 1, 2, 3, n are connected, distributed over the circumference of the machine. Description PRIOR ART The present invention relates to a converter for electric machines, in particular for starters or starter-generators in motor vehicles, in which the converter comprises a plurality of bridge circuits connected to phase windings of the machine, of which circuits each has a plurality of electrically controllable switches and one buffer memory, embodied as a capacitor. With a converter, used for instance to adjust the rpm of an electric machine, a periodic activation and deactivation of the individual phase windings of the machine is generated via a pulse width modulated triggering of the switches in the bridge circuits connected to the phase windings. As a result of these switching events, relatively high interference voltage peaks occur, which are smoothed by means of a buffer memory embodied as a capacitor. Because of the very high interference voltage peaks, the capacitors of the bridge circuits must have a relatively high capacitance. For the buffer memory, an electrolyte capacitor is therefore used as a rule, since electrolyte capacitors have an especially high capacitance. However, electrolyte capacitors have a relatively large volume, and at high temperatures they tend to fail early. In order to be capable of dispensing with such capacitors of very high capacitance, in DE 47 A1 an otherwise three-phase machine is operated with many phases that is, more than three phases. To that end, the converter has not merely three bridge circuits as in a three-phase machine but rather many bridge circuits, which are triggered at staggered times relative to one another. Each of these bridge circuits is connected to one phase winding of the machine. In this many-phase arrangement, the clock frequency of the pulse width modulated triggering of the switches of the individual bridge circuits is increased. Since the requisite capacitance of the capacitors belonging to the individual bridge circuits depends on the clock frequency of the pulse width modulation, at a higher clock frequency the requisite capacitance is reduced compared to an only three-phase system. A multi-phase operation of the machine accordingly makes it possible to use capacitors of lesser capacitance for the bridge circuits, and therefore a changeover can be made from the electrolyte capacitors typically used to other capacitor principles. Simple foil capacitors, whose capacitance is comparatively low and which can be produced less expensively, can therefore be used. Moreover, foil capacitors do not heat up as much and are therefore also suited for use at high ambient temperatures, of the kind that occur in motor vehicles, for instance. The individual bridge modules comprise at least one high-side switch and at least one low-side switch and one capacitor, spanning the two switches, embodied as a concentrated component. The high-side switch connects the phase winding of the machine that is connected to the respective bridge circuit to a positive potential of a supply voltage, and the low-side switch makes the connection of the phase winding with a negative potential of the supply voltage. Thus the concentrated capacitors used in each bridge circuit in the prior art are dispensed with and are replaced with a space-saving foil capacitor that is simple to produce and that serves as the capacitance, forming the buffer memory, for all the bridge circuits that are present. The foil capacitor and the switches of the bridge circuits can be fixed side by side on the cylindrical surface of the heat sink. However, the foil capacitor can also be fixed on the cylindrical surface of the heat sink, and the switches of the bridge circuits can also be fixed on an end face, oriented perpendicular to the cylindrical surface, of the heat sink. In the same way, the foil capacitor and the switches of the bridge circuits can be disposed in two planes one above the other on the cylindrical surface of the heat sink. The heat-generating switches should be located in the plane closest to the heat sink. This converter comprises n bridge circuits [] 1, 2, 3,. The number n of bridge circuits depends on the number k of chronologically staggered pulses with which the phase windings of the electric machine are to be triggered. Each of the bridge circuits [] 1, 2, 3,. The bridge circuit 1 has the switches 11, 12; the bridge circuit 2 has the switches 21, 22; the bridge circuit 3 has the switches 31, 32; and the bridge circuit n has the switches n1, n2. A phase winding of the electric machine is connected to a tap between the two switches of each bridge circuit. Thus the phase winding 4 is connected to the bridge circuit 1, the phase winding 5 is connected to the bridge circuit 2, the phase winding 6 is connected to the bridge circuit 3, and the phase winding 7 is connected to the bridge circuit n. The switches 11, 21, 31,. A pulse-width-modulated triggering with chronologically staggered pulses of the individual switches [] 11, 12, 21, 22, 31, 32,. The control circuit 8 in FIG. A buffer memory in the form of a capacitance is connected parallel to the two switches [] 11, 12, 21, 22, 31, 32,. This capacitance is a capacitor 15, which is embodied as an elongated foil capacitor, and to whose two electrodes 16, 17 the switches are connected, distributed over the length of the foil capacitor One foil capacitor 15 suffices as the buffer memory for all the bridge circuits 1, 2, 3,. The electrode 17 of the capacitor 15 has a terminal 18 for the positive potential of a supply voltage, and the electrode 16 is provided with a terminal 19 for the negative potential of a supply voltage. If the electric machine is a starter or starter-generator for a vehicle, then this supply voltage comes from a battery in the vehicle. A detailed description of the mode of operation of the converter will not be provided here, because the invention is directed more to the embodiments of the capacitor [] 15, and the circuit of the converter can have any embodiment, in accordance with the prior art and even differing from FIG. As already noted, the capacitor 15 is embodied as an elongated foil capacitor, which is wrapped around the circumference of the housing of the machine 9. From the standpoint of production, a foil capacitor 15 is simple to make. Because it is wrapped around the outer face of the housing of the machine 9, it claims only very little space. Different thermal expansion of the housing of the machine 9 compared to that of the foil capacitor 15 can be compensated for by means of a slit 30 in the foil capacitor More detailed ways of disposing the foil capacitor [] 15, with the controllable switches of the bridge circuits, on the housing of the electric machine 9 are shown in FIGS. This heat sink 10 can have one or more conduits 20 in its interior for the flow therethrough of a coolant cooling gas or cooling liquid. The foil capacitor 15 is placed on the top of the heat sink 10 and fixed thereon, for instance by means of an adhesive film Besides the foil capacitor 15, the modular bridge circuits are distributed over the circumference of the heat sink The modules of the individual bridge circuits have a substrate, which is fixed to the surface of the heat sink 10 by means of an adhesive film The switches belonging to the respective bridge circuit in this case, the switches 11 and 12 of the bridge circuit 1 represent them all are applied to the substrate 27 and electrically connected to the electrodes 18 and 19 of the foil capacitor 15 via busbars 28 and While in the exemplary embodiment in FIG. All the parts of the arrangement shown in FIG. In the exemplary embodiment shown in FIG. In the exemplary embodiment of FIG. The modules of the bridge circuits are applied directly to the surface of the heat sink 10 in a first plane, and the foil capacitor 15 is located over them in a second plane. The foil capacitor 15 is held in the second plane by means of the busbars 28 and 29, which are contacted with the modules of the bridge circuits that are located under the foil capacitor A converter for electric machines, in particular for starters or starter-generators in motor vehicles, in which the converter comprises a plurality of bridge circuits 1, 2, 3,. The converter of claim 1 , characterized in that the foil capacitor 15 and the switches 11, 12 , contacted with it, of the bridge circuits are fixed jointly on a heat sink 10 surrounding the machine. The converter of claim 2 , characterized in that the foil capacitor 15 and the switches 11, 12 of the bridge circuits are fixed side by side on the cylindrical surface of the heat sink The converter of claim 2 , characterized in that the foil capacitor 15 is fixed on the cylindrical surface of the heat sink 10 , and the switches 11, 12 of the bridge circuits are fixed on an end face, oriented perpendicular to the cylindrical surface, of the heat sink The converter of claim 2 , characterized in that the foil capacitor 15 and the switches 11, 12 of the bridge circuits are disposed in two planes one above the other on the cylindrical surface of the heat sink 10 , and the switches 11, 12 are disposed in the plane located closest to the heat sink The converter of one of claims , characterized in that the heat sink 10 , in its interior, has one or more conduits 20 for the flow therethrough of a coolant.

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In electrical engineering, electric machine is a general term for machines using electromagnetic forces, such as electric *motors, electric generators, and others. They are electromechanical energy converters: an electric motor converts electricity to mechanical power while an electric generator converts mechanical power to electricity.*

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