

PROF. ERIC CHENG

鄭家偉教授



Bsc, PhD, CEng,
MIET, SMIEEE, FHKIE

Profile:

Prof. Eric Cheng is a professor in the Dept. of Electrical Engineering of the Hong Kong Polytechnic University. He is the group leader of Utilization of the Department and Director of Power Electronics Research Center of the University.

His research interests cover all aspects of power electronics, magnetics, machines, EMI and drives. He has published over 200 papers and 7 books. Since he joined the Department in 1997, he has been working on 31 research and development projects as a Principal Investigator with total funding of more than \$35 Million.

He also has been Principal Investigator for 4 CERG projects. He has also obtained a number of awards from the institution and university. This includes the best journal paper award, outstanding consultancy award, best teaching, successful patent and valuable consultancy, Hong Kong Eco-Products Award and 16th National Exhibition of Inventions and also the Brussel Eureka Technological Innovation Gold Medal with Mention.

He is very active in conducting professional industrial consultancy work for the industries. The company involved includes both overseas and local company. So far, he has been the project manager of more than 80 consultancy projects with total project amount over \$35 Million.

Introduction

Prof. Eric Cheng has been working on the field of power electronics, notably in the areas of power conversion machines, drives and railways engineering. The application area includes static power conversion, the application to power systems, renewable resources, magnetics, battery, superconducting energy storages, electric lighting, machine design, actuation, drives and transportation. We are actively conducting teaching for undergraduate and postgraduate levels and organizing conferences and seminars regularly to serve both the industry and researchers.

Our aims are to use the above experience to help local industry and the region to improve competitiveness through consultancy services, cooperative projects and research development of new technologies.

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Newsclipping:

Oriental Daily News
08/01/2008

Power electronics is an emerging technique for energy saving. Many of the energy devices are based on the power electronics method. The wind power and solar power are using power conditioning and electric machines drives for the operation on the optimal power point.

Energy saving using power quality correction is also a method which has to be handled carefully as the saving depends on many parameters and operation condition.

Oriental Daily News, The Sun News
15/12/2007

LED street lamp provides god illumination and also long life time. Its fully solid-state enables the many favorable operations as compared with other lighting devices. We are developing the techniques using solar panel to provide the energy source for the LED lighting. Maximum power point tracking using power electronics actuation can enable the solar panel tracking and facing the sun light and also to operate at the best electrical characteristics of the panel.



鄭家偉示範接收板如何跟隨光源轉向，並以充電池儲能轉化電力供LED街燈使用。

【本報訊】神奇太陽LED道路照明系統猶如向日葵「追蹤」太陽，可望為山區居民帶來光明。照明系統由香港理工大學研發，能跟隨太陽移動轉動太陽能接收板以收集能量，而使用LED照明也較傳統街燈更

城市路燈未來趨勢

理大電機工程學系教授鄭家偉表示，傳統街燈使用交流電，需接駁電纜、費用昂貴，對山區地方尤其不便，使用直流電的LED則易於安裝，且電流小，亦易於調校光暗。本報記者曾元萬攝。

神奇纖維衫記住身形 理大研製半年後投產

【本報訊】肥人和瘦人都可以穿。在洗滌過後，穿上身又可回復原狀的纖維技術，可以應用於衣服上達至上述效果，最合適製造內衣和運動服，貼身經過多次洗滌會變形，但形狀記憶纖維的衣服穿上身後可以回復原狀，而且

體溫調節衣服形狀

胡念蓮續稱，應用這項技術生產製作的衣服讓不同身形的人也可穿，因為體溫調節了衣服形狀。除了衣服外，還可以用來做手套，不會愈戴愈鬆。水邊都合乎形。她指這項技術最適合應用於立體剪裁，例如內衣和運動球褲等。現有多間公司表示有興趣，將會大量投產。

環保LED追蹤太陽

神奇太陽LED 道路照明系統猶如向日葵「追蹤」太陽，可望為山區居民帶來光明。照明系統由香港理工大學研發，能跟隨太陽移動轉動太陽能接收板以收集能量，而使用LED 照明也較傳統街燈更省電及環保。自八月開始研發至今，已完成組件模型，正等待業界接洽投產，在社區實地測試效能。理大電機工程學系教授鄭家偉表示，傳統街燈使用交流電，需接駁電纜、費用昂貴，對山區地方尤其不便，使用直流電的LED 則易於安裝，且電流小兼電壓較安全，亦易調校光暗。

Newscutting:



Oriental Daily News
14/01/2008

There is a strong demand of LED to be used in vehicle front and tail lighting. We have developed the power conditioning. Thermal design, and the aging analysis for the LED lighting. We also developed the ballast and power conditioning for HID head light. The design also working with optical design in order to make the electrically and optically well fitted for the automotive environment.

We now have the know-how for the braking, reverse, signal and head lighting. The chassis design, associated thermal and optimization of the driving circuit and power conditioning have been developed.

Oriental Daily News
07/01/2008

The electrical safety is now an important issue as the number and the variation of the electrical appliances are increasing every day. The electrostatic discharging (ESD) in winter or dry day will increase the problem of electrical discharge that will lead to discomfort of users and sometime will cause damage to the appliances.

We have the technology of the design of equipment or appliances that can reduce the ESD and to provide solution to provide the inconvenience of ESD for office and home use.

Electrothermal devices also include the hair-dressing appliances. They are operated by high mains voltage and provide high temperature. The equipment is also high in packing density and therefore the design includes the temperature control, aging, safety, isolation, use of materials are the major concern.

We have developed the techniques for thermal control, alternative method for heating devices, power control and battery operated thermal devices. They provide alternatives solution for heating element and control.





Oriental Daily News
24/03/2008

Electromagnetic interference (EMI) is now a major issue of general public. Everyday we are in contact with the radiation. This includes the microwave oven, induction cooking, cell phone, bluetooth devices, radio antenna, WiFi transmitter, transmission line, switch room and other household and office electrical equipment and wiring. The design of the EMI protection and reduction is now an important technique for power electronics engineers. Proper design will reduce the radiative and conductive interference. It will not only help the users and will also reduce the component usage and cost of the design and re-work. We have extensive experience in EMI and also Electromagnetic compliance (EMC) design and solution. We can provide method for the equipment design and pre-compliance test.



Oriental Daily News
22/01/2008

Electrical safety in electrical appliances is not a simple wiring issue. The overall design in the circuit, wiring, selection of component and environment and functional concern are also part of the design criteria. Simple electrical blanket can also provide safety issue as the power is driven from mains. The high voltage is therefore required to be handled with care. For appliances that may have direct contact with users, the design of the electrical parts should be very careful.

We have extensive experience in power circuit and thermal design. We can also provide solution for thermal distribution and analysis.



Hi Tech Magazine
24/03/2008

Power generation based on alternative energy is a new trend for energy source. Today we are looking for simple and can be applied for daily use proper source. The power devices that converted from mechanical energy into electrical energy have many choice and they all have different operational principle and efficiency. Piezoelectric devices, linear motion devices and magnetic coil can also be power generation. We have experience in the power control and power conditioning. The associated energy storage and energy distribution is also important for such power source development. Using power electronics techniques, the energy can be conditioned to support of office and home use.

Hi Tech Magazine
02/01/2008

Interior lighting and lighting energy saving is now a new fashion for illumination. The design includes the conversion from mains voltage to lower voltage for LED lamp. Energy saving scheme such as day light harvest, occupancy control, and dimming control is now also available using power electronics techniques.

The application also includes decoration, advertising, colour control, medical lighting, and also lighting for hazardous environment.

We have the capability for computer control, colour mixing control, frequency spectrum control and aging compensation.



Industrial and research projects

Prof. Cheng has been working in a number of large industrial and research projects and each will lead to industrial products and high level research results:

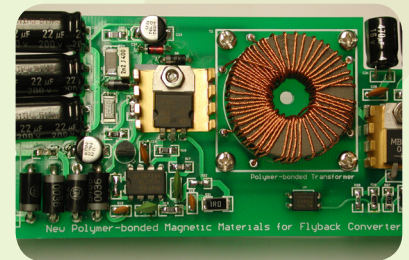
Design and Fabrication of HID and LED Lighting System for Automotive Illumination

The project is to develop the High Intensity discharge (HID) and LED lamp for automotive environment. The technology for HID lamp requires cool start, warm-restrike, dimming control and power conditioning. The operation voltage is high. The LED lamp is developed for the head, signal, tail, brake, reverse and interior lamps. The technology developed includes the power conditioning, thermal management, lighting compensation, circuit optimization. We have developed and installed in commercial vehicle and fully tested for the performance.



Development of new polymer-bonded materials for power conversion and EMI

The project is to develop a new polymer-based magnetic core for use in high frequency power conversion. Magnetic cores for inductor and transformer can be replaced by the new materials. The main advantage is lower cost, non-brittle, flexible in shape and recyclable. The technology developed includes the procedure of making the core, the formula developed for controlling the permeability. A number of power converter circuits have been successfully developed to use the core. The materials can also be used for electromagnetic field screening.



Intelligent Energy Saver for Induction Motor Using IVVC Techniques

The project is to develop an alternative motor drive for induction motor system. It can replace the variable speed drive (VSD) inverter for energy saving. The method provides a simple and low cost method and provides constant speed energy saving whereas VSD is for energy saving based on variable speed. The applications include escalator, transportation belt, and air-conditioning system.



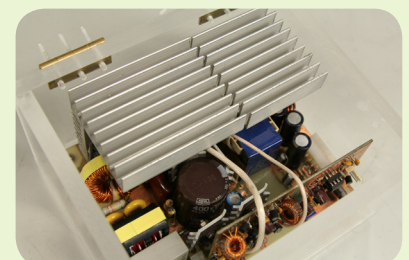
Low cost direct drive for electric vehicle

The project is to develop a low cost motor drive based on in-wheel motor and switched reluctance motor technology for electric vehicle. The in-wheel technique allows the integrated of the motor with the wheel and hence it makes the design of the vehicle simpler. The switched reluctance motor method allows the high reliability and high torque driving performance. The in-wheel motor is now installed in the electric vehicle for test and study.



Formulation of DC Energy Factor and Its Implication on Control Method for High Efficiency Power Electronics Conversion System

The project is to develop a new method for the energy storage in a static power conversion. The energy storage related strongly with the efficiency and the project is to investigate the method to regulate this internal energy and hence to examine the associated control method. Results show that the method can improve the efficiency by more than 20%.



Future projects

The power electronics and motor drives are serving technology that provides solution for both dynamic and static power conversion. The following are projects that under preparation:

Miniature renewable energy tower

Nowadays there are many alternative energy sources and each is to capture energy for solar, wind or hydro. The project is to develop a small energy center which has renewable energy installation such as solar panel and wind turbine generator in the tower. The power is converted into usable voltage such as AC 220V or low voltage DC16V for different applications. The output can be connected to lamps for illumination, communication devices, entertainment apparatus or computer. The technology includes the maximum power point tracking, energy storage and power condition. The concept is to provide a standalone system and it can be transported to remote areas. For example, if an independent power source can be installed in the remote location where the installation of power cable is not possible or too expensive.

DC distribution system

Most of the home, office and industrial apparatus use power from AC source such as 380V, 220V or 110V. In fact most of the apparatus or electrical systems are using DC. There is a front-end rectifier to convert from AC into DC. Therefore if a DC is available there is no need to install the rectifier in the unit and hence the efficiency can be increased and the materials can be reduced. Also DC distribution is well-known to have low cost and higher efficiency than AC counterpart. The question is how to do voltage conversion such as step up and step down. In the past, a simple transformer can do. In DC world, we can now use the latest power electronics technology to provide all these power conversions in a reliable and low cost method. The challenge includes to develop all the safety standards and devices, DC switching and breakers, filters, energy storage and electromagnetic interference. The project can change the concept of the distribution and is a revolution to all power distributions and electrical units. It will also change the world electrical system and provide a huge saving in electricity and materials.

Aerospace Power

The future development will put a large rating in aerospace system. The power conditioning and actuator are now the necessary development in the aerospace system. Today, the entertainment units in aircraft are heavily installed and the power usage and the associated power conditioning, safety and electromagnetic interference are very demanding. The fight control system requires substantial power electronics actuation and intelligence control. The space traveling requires high voltage power, solar power condition and intelligence actuation. The project is to look into these areas and provide new research areas for the subjects.

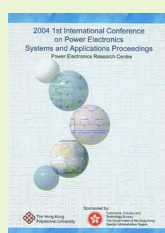
Electromagnetic interference and power

The communication system and many electrical appliances are now heavily used in daily life. Most of the emitted large electric field such as cell phone, blue tooth, internal wireless phone, transmitter, overhead cable, microwave oven, induction cooker and motor. These devices will also affect the power distribution, reliability of the apparatus in the vicinity, health, power loss. Now there is no proper study and there is no accurate model for the understanding of these emissions. The problem will get worse due to more and higher power devices installed and superposition effect. The project will develop the signature of emitted devices and development method of protection and reduction. It is also to develop the correlation of the power loss and signature.

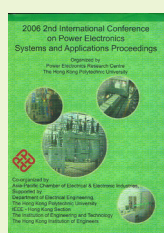
Books:

Prof. Eric Cheng has written a number of engineering books. They include postgraduate and undergraduate levels. He has also edited conference proceedings for the center which have collection of the updated articles in the field.

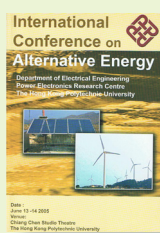
The areas of the books feature the practical engineering and theoretical knowledge as well as teaching in engineering and engineering English.



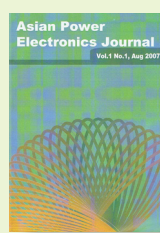
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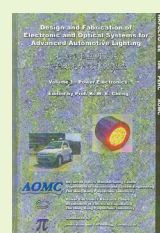
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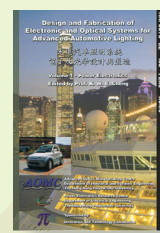
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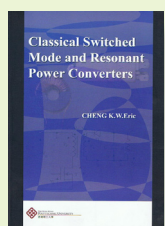
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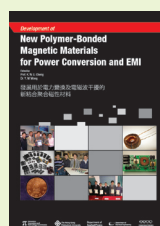
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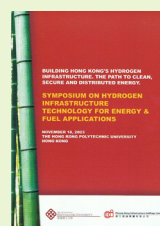
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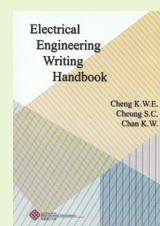
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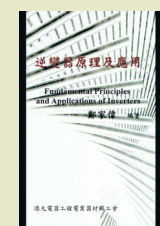
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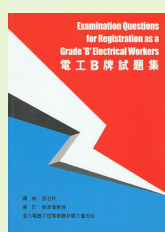
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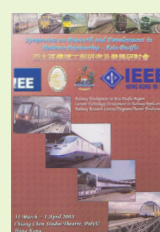
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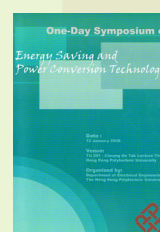
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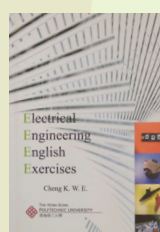
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| a) 2004 1st International Conference on Power Electronics Systems and Applications Proceedings | j) Symposium on Hydrogen Infrastructure Technology for Energy & Fuel Applications |
| b) 2006 2nd International Conference on Power Electronics Systems and Applications Proceedings | k) Electrical Engineering Writing Handbook |
| c) International Conference on Alternative Energy | l) Fundamental Principles and Applications of Inverters |
| d) Asian Power Electronics Journal | m) Examination Questions for Registration as a Grade 'B' Electrical Workers |
| e) Design and Fabrication of Electronic and Optical Systems for Advanced Automotive Lighting Vol. I | n) Solution of Examination Questions for Registration as a Grade 'B' Electrical Workers |
| f) Design and Fabrication of Electronic and Optical Systems for Advanced Automotive Lighting Vol. II | o) The Fundamental Knowledge for Electrical Workers |
| g) Classical Switched Mode and Resonant Power Converters | p) Symposium on Research and Development in Railway Engineering- Asia- Pacific |
| h) Seminar on Power Electronics 2007 Proceedings | q) One-Day Symposium on Energy Saving and Power Conversion Technologies |
| i) New Polymer-Bonded Magnetic Materials for Power Conversion and EMI | r) Electrical Engineering English Exercises |