Meeting reviews global manufacturing research

The Department of Manufacturing Engineering (MFG) hosted the Ninth Annual Meeting of the Global Manufacturing Research Group (GMRG) at the PolyU from 4–6 June.

The GMRG is a multi-national community of researchers dedicated to the study and improvement of manufacturing practices world-wide. It aims to improve manufacturing practice through the development of theory and dissemination of research results. By sharing ideas, results, and concepts with research colleagues and manufacturing executives around the globe, the GMRG serves to strengthen the linkage between research and practice.

The GMRG has a tradition of holding its annual meeting in a different country every year. This year, about 20 members of the GMRG from various countries gathered together at the PolyU to present their research results and hold discussion on production planning and control issues concerning global manufacturing.

Plant visit of the GMRG members to Group Sense International Ltd. in Dongguan in the Mainland.

A plant visit was then organized on 5 June 1998 to Group Sense International Ltd. at Dongguan, China. The members of the GMRG gained both theoretical and practical experience through this event.

For details about the GMRG, please contact Prof. Clay Whybark (e-mail: clay_whybark@unc.edu.) or Prof. W.B. Lee (e-mail: mfwblee@polyu.edu.hk).

First Pan-Pacific Rehab Conference held

To promote exchange of knowledge and practices in musculoskeletal rehabilitation in the Region, the Department of Rehabilitation Sciences took the lead in organizing The First Pan-Pacific Conference on Rehabilitation in partnership with the Sun Yet-sen University of Medical Sciences. The Conference was held in Guangzhou from August 29–31.

The keynote speakers at the Conference were Prof. Sandra J. Olney and Prof. Mark Pearcy, both well known researchers and scholars in rehabilitation and biomechanics. Prof. Pearcy is the Foundation Professor of Biomedical Engineering at the Queensland University of Technology in Brisbane, Australia. Prof. Olney is Professor and Director of the School of Rehabilitation Therapy and Associate Dean (Health Sciences) at Queen's University in Kingston, Canada.

Apart from plenary lectures, the Conference also covered paper and poster presentations covering the sciences in the assessment and treatment of limb and spinal disorders. About 200 researchers and clinicians from Hong Kong, the Mainland, Taiwan, Australia, Finland, the US and Canada attended the three-day conference. A total of 150 practitioners participated in the pre- and post-conference workshops in ergonomics, work rehabilitation, and treatment for low back pain held in both Hong Kong and Guangzhou.

Prof. Olney, keynote speaker (sixth from left) and the conference orgainizing committee posing together in Guangzhou.

Experts share insights into co-op education

During the Asia Pacific Conference on Co-operative Education, held on the campuses of the PolyU and the South China University of Technology in Guangzhou from August 24–28, six eminent speakers were invited to deliver keynote presentations. The following is the gist of their presentations:

Culture, education and the multinational corporation: The challenge of preparing managers for the 'global age'

The speaker: Dr. David B. Lowry is Vice President, Office of Social and Developmental Programs at Freeport-McMoRan Copper and Gold Company in the US, which operates one of the largest mining complexes in the world in Indonesia. Though his main responsibilities are in developmental anthropology in west New Guinea where a mine is located, he also administers a scholarship and international training programme which provides educational opportunities for more than 70 Indonesian students in high schools and colleges in North America and Australia. Dr. Lowry is also President and Executive Director of the Freeport-McMoRan Foundation in New Orleans, Louisiana.

The presentation: The Asian financial crises of 1997–1998 and the attempts of the International Monetary Fund and World Bank to address these issues have forced a reassessment of the so-called post-modernist 'global age.' Where there was confidence before mid-1997 that the world was somehow moving toward a universal culture of economics and work, today there are severe doubts about the short-term viability of a global economic system in which liberal democracy and capitalism could be practiced in many areas of the world.

Dr. Lowry attempted to look at the implications of these developments for education, especially education for work within businesses which are multinational and/or global in nature. Are 'best business practices' universal, or are they particular to a culture? Does American 'down-sizing' and 'right-sizing' work in Asian cultures? Can Japanese work camaraderie be effective in a factory with American 'individualists?' These are questions which all international businesses must face; it is also an issue which educators must face, both educationally and financially. Dr. Lowry reviewed these questions against the multinational experiences of Freeport.

Co-operative education in China

The speaker: Dr. Zhang Weijiang is Director General, Education Commission of Shanghai Municipal People's Government, China. He has held his present position in Shanghai since April this year. Prior to this, he was Deputy Director-General of Education Commission of Shanghai Municipal People's Government, Vice President, Dean of the Graduate School, Chairman of the Department of Applied Mathematics, and Professor of Shanghai Jiaotong University from 1991–95. Besides, he is the Vice Chairman of the China Association for Co-operative Education and Vice Chairman of the Shanghai Association for Co-operative Education.

(cont'd on page 22)

The presentation: The presentation deals with higher education reform in China in terms of university–industry co-operation in both scientific research and students' training. It also briefly outlines the trend towards the further development of the collaboration among institutions, industries and research institutes. The conventional scholastic university model which separates itself from the society is no longer adequate to meet the challenges arising in the fast economic development. The fast pace of change in the economy and society requires a fast pace of change in the world of higher learning. The scientific researches and the teaching and learning activities have to be considered and designed in the light of the needs from the economic development, i.e. the university teachers and researchers should find ways to involve themselves in the live projects set up by the industry, and the university graduates should be multi-skilled, having a combination of technological, economic and commercial knowledge as well as problem-solving, teamworking, and information technology skills.

Co-operative education has played an important role in this higher education reform in China. It has created a closer relationship between institutions, industries and students, provided the teachers with more chances to understand and serve the industry, and let the students be aware of the changing world of work, take responsibility for their own career and personal development and have the capability of managing the relationship between work and learning throughout their lifetime.

Co-operative education: the Hong Kong experience

The speaker: Dr. Ng Tat-lun is Managing Director–Operations, Global Lighting Products of Eveready Battery Company Inc. in Hong Kong and Director of several companies and organizations including the Hong Kong Plastic Technology Centre located in the PolyU.

Dr. Ng is currently the Deputy Chairman of the Vocational Training Council and Vice-Chairman of the Occupational Safety and Health Council, as well as Chairman of the Production Management Committee of the Hong Kong Management Association. Dr. Ng was appointed a Justice of the Peace in 1992 and was honoured with an MBE in 1995.

The presentation: The past decades saw many drastic transformations in Hong Kong's economic structure from one of an entrepot to one which focused on light manufacturing industry principally concerned with exports, and recently to the structure of a financial and service centre in the Region. Hong Kong lacks natural resources and its progress and success is largely dependent on the resourcefulness of its workforce. It is through extensive co-operation between the industry and the education/training institutions that Hong Kong has been assured of a continuous supply of highly capable workforce to meet its development needs. This presentation gave a brief account of the co-operative efforts by the education /training institutions and the industry in the area of education and training and of how co-operative education operates in Hong Kong.

New horizons in co-operative education

The speaker: Prof. Brian Low is Deputy Vice-Chancellor and Vice-President (Academic) at the University of Technology (UTS) in Sydney, Australia. He took up this appointment in July 1996. During 1990–1996 he held the position of Pro-Vice-Chancellor (Academic Support) at UTS. As Deputy Vice-Chancellor (Academic) at UTS he has overall responsibility for academic leadership and for strategic developments in flexible learning and work-based learning. UTS is the largest provider of co-operative education among Australian universities.

The presentation: A key characteristic of degree programmes at UTS and some other universities is their focus on the professional formation of students and this

can be seen most clearly in their emphasis on practice-based education. Various forms of practice-based education have existed for many years in many countries under generic titles such as co-operative education, clinical practicum, and more recently work-based learning.

The presentation described examples of the various forms of practice-based education and explored in some detail examples of work-based learning developed by UTS. Issues and challenges in work-based learning degree programmes both for universities and for industry were discussed.

Meeting new careers challenges through international study and training exchanges

The speaker: Prof. Abdallah A. Sfeir is Dean of the School of Engineering and Architecture at the Lebanese American University, Byblos, Lebanon. Prof. Sfeirn spent most of his career in education in Lebanon, France and the US. He has been involved in international exchanges and traineeships and has been General Secretary of the International Association for the Exchange of Student for Technical Experience (IAESTE) from 1991 to 1998. IAESTE is an NGO that organizes the exchange of over 5,000 engineering students annually between its 65 members around the world.

The presentation: Careers are rapidly changing and future engineering professionals must face the double challenge of rapidly changing technologies along with an internationalized work market imposing greater geographical mobility. The implications are that graduates must have a self-sustainable knowledge base and a good preparation to live and compete in a world that extends beyond their natural surroundings.

The presentation surveyed how international educational and technical training exchanges contribute to making engineering programmes respond to these emerging needs. Based on actual case studies, inputs from employers, students and academics from different countries were analysed. Differences and agreements between the three perspectives were outlined with particular consideration for cross-national borders.

Co-operative education: the european experience

The speaker: Dr. Maurits van Rooijen is Director, International Education of the University of Westminster in London, UK.

Dr. Rooijen was founding director of the Centre for European Studies at the Erasmus University Rotterdam. In 1993 he took up his present post and also became Managing Director of the University of Westminster (International) Ltd. Dr. Rooijen has extensive experience with transnational co-op education in Europe and beyond. He is chair of the working party for Universities and Industry/Business, Compostela Group of European Universities. He holds honorary appointments at the University of London, at the Guangdong University of Foreign Studies, Guangzhou, and is executive member of several international organizations.

The presentation: According to Dr. Rooijen, when speaking about Europe, one should appreciate its diversity, especially when it comes to educational systems. In most European countries industrial placements and co-op education have been limited to the vocational education sector. However, there is a clear trend towards co-op education in higher education as well, recognizing the need to smoothen graduates' transition to working life. Probably Britain, with its co-called sandwich courses and enterprise schemes, has been ahead in this respect.

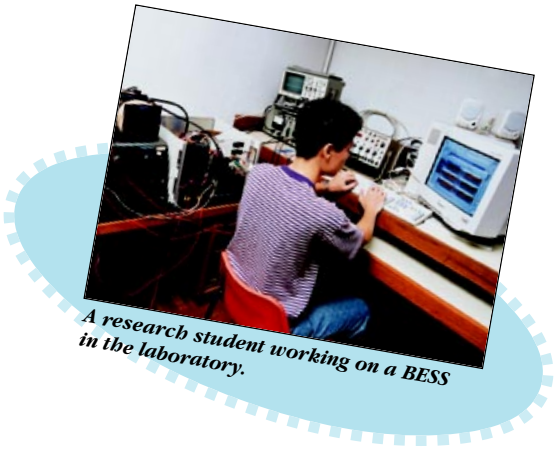
Specifically European is the emphasis on transnational placements. European higher education tend to be quite international in content and this is reflected in trainee schemes. The European Union strongly stimulates transnational co-op education, not only within Europe, but also beyond. For example, the latest EU programme, which is to be launched next year, foresees in industrial placements for advanced students in the EU, China and Japan.

Toward a greener Asia: Battery Energy Storage Systems

The use of Battery Energy Storage Systems to support sustainable energy development in Asia is currently being studied by ***Prof. Danny Sutanto,*** *Professor of the PolyU's Department of Electrical Engineering in collaboration with Dr. Walter R. Lachs, Visiting Fellow of the School of Electrical Engineering, The University of New South Wales, Australia. While such systems can bring many benefits, and many have predicted that electric vehicles will become increasingly popular, the electricity supply industry has yet to be prepared for the introduction of these systems. The following is the story from Prof. Sutanto.*

In many of the emerging economies in Asia, the demand for electricity is growing at least as fast as the growth rate of the economy. For the economic growth to continue, the rising demand for electricity has to be met. Whilst the estimates of the additional generation capacity required vary in detail, in principle, all agree that the capacity needed is substantial and that meeting the need will be difficult. Furthermore, most generation capacity has been coal-based and a significant amount of that is low technology and without flue gas desulphurisation. The effect on the environment is clear for all to see in many countries in Asia. The dilemma in Asia is therefore how to provide the three E's of sustainable energy development — support continuing *E*conomic growth, provide *E*nergy security and reliability and meet *E*nvironmental considerations.

Fortunately, there is at least a partial solution — the use of Battery Energy Storage System (BESS). The use of BESS to support sustainable energy development in Asia is being investigated, in particular, in conjunction with the possible introduction of Electric Vehicle in the future. BESS allows the reduction of the peak demands while filling in the valley of load demand during the night, increasing the efficiency and load factor, and importantly reducing the need for generation expansion in the short term. Unlike power stations, battery energy storage systems (BESS) can, without problem, be placed in proximity to city consumers.



A research student working on a BESS in the laboratory.

Practical advantages

There are many advantages for the entire power system offered by the introduction of BESS. This includes modularity of components, which besides readily allowing units of diverse ratings, greatly simplifies installation or augmentation.

1. *Curtailing peak demands* — When utilized in sufficient quantities to curtail the growth of the annual peak demand, any unexpected increases of demand could readily be absorbed by increasing, at short notice, the amount of energy storage capacity by augmenting existing BESS in as little as six months. This compares with the considerable delays now encountered in commissioning new power stations or acquiring additional lines. Most importantly, the energy storage could curtail daily peak demand — the time when blackout usually occurs in many developing countries.
2. *Improving security* — The much faster responses of the BESS inverters, than the traditional turbo-generator governors, would react to quickly control the effects of any disturbance
3. *Improving reliability* — With the tremendous advantages of locating BESS in distribution networks, back-up supply would be close at hand even if the BESS were not in the consumer's installation. This would make a major impact on consumer reliability as 90 per cent of interruptions to individual consumers are currently due to disturbances in the distribution networks.
4. *Impact on generation* — With sufficient quantities of BESS to curtail daily peak demands, peaking power stations do not have to be manned nor be run up. At light load periods, re-charging the energy storage allows base load generators to be run at higher, more efficient outputs and avoids the need to shut units down. When suitable inverter controls will be developed, energy storage would be able to take over frequency control from generators which would reduce mechanical wear at the power stations. Furthermore, with a sufficient amount of energy storage, it would no longer be necessary to carry much spinning reserve on the generators.
5. *Electricity forecasting* — At present demand forecasting is the area of greatest uncertainty, particularly the fast changes at peak periods. With sufficient energy storage to curtail the peak periods, the need for half hour to half hour demand forecasting would virtually be eliminated.

Prof. Sutanto: Electric Vehicles can bring with it many advantages.

(Photo of vehicle taken with permission from The Hongkong Electric Co. Ltd.)

There would only be a need to forecast the following 24 hours energy demand, to allow the day by day scheduling of generation. By removing demand uncertainty, it would be possible to have uniform daily electricity generation costs, greatly simplifying consumer tariffs.

6. *Utilizing spare batteries of electric vehicles* — A projection of 2.5 million electric vehicles (EV) worldwide has been made for 2005. Such quantities of EV will have a pronounced impact on the power systems. If the Electricity Supply Industry allows EV owners latitude to recharge EV batteries at any time, there will be increases of peak demand which will undermine the reliability of supply as well as adding to the cost of extending and operating the power system. On the other hand if the power systems make preparations to control the times and amounts of charging spare EV batteries, these problems could be averted. If, in addition, the utility access is gained to utilize the EV battery stored energy, very significant operational and cost savings could be gained. These benefits can only be gained if the Electricity Supply Industry is prepared to make up front expenditures to develop a service station infrastructure and provide sufficient spare EV batteries to lease to EV owners. Not only would this encourage community acceptance of EV, but power systems would gain a Greenhouse Gas Emission credit for the reduction of petrol car emissions. The lowered air and noise pollution for city residents would be reflected in reducing health expenditure and community and political approbation for the Electricity Supply Industry.

7. *Additional facets* — Inverters associated with energy storage can allow an undreamed level of flexibility. There are many other aspects of power system operation which will be solved by developing the necessary inverter controls to fulfill the needed functions. Some possibilities are back-up power and "clean supplies" for consumers, interruptible loads, improved emergency responses, etc., which make the advent of energy storage for power systems such a promising avenue.

8. *Potential cost savings* — Sufficient quantities of BESS located at or near consumer installations in the metropolitan distribution networks offer a means of overcoming many of the present operating difficulties. Even though the BESS installations would need to be organized by the distribution bodies, there would be benefits to the grid company, the generating bodies and consumers. These advantages emphasize the need for a co-operative effort by all constituent parties to gain the maximum economies. An estimate has been made of capital and operating costs, to cover the entire power system, of $27,000–31,500 for each kW increase of peak demand. In comparison, the capital and operational costs of BESS (allowing for battery renewals) would be $9,000/kW. If all parties associated with the Electricity Supply Industry would contribute towards the purchase of BESS, they could each reap a handsome dividend, not only in equipment and operational savings, but in an improved level of security for the entire power system.

A new BESS

The research team at the PolyU is currently implementing a novel interactive BESS for demonstration purposes. At the heart of the new BESS is a microprocessor enabling program interface coupled with communication port that permits adjustment to suit varying conditions. The microprocessor controls the running of the inbuilt inverter/charger and bank of sealed lead acid batteries. Rated at 5KVA the unit can synchronize and interact with the power supply. Some of the features are as follows:

- Provide high quality power with negligible harmonics.
- Control the input power from the network to programmed levels using the microprocessor on board.
- Can be used as an uniterruptible power supply (UPS) in situations where continuous quality supply is critical, e.g. medical, computing, communications, etc.
- Reduce flicker interference and peak load demand from the supply.
- Provide redundant fail safe power.
- Can defer, or cancel network refurbishment.
- Allows the easy integration of renewable resources such as solar, wind, tidal etc. into the network.
- Provide voltage support.
- Provide VAR support at the point of supply.

It is hoped that the study will demonstrate that BESS offers an important resource for improving power system control.

Transcending the boundaries: Electronic engineering in the Information Era

The PolyU's Department of Electronic Engineering has recently been renamed the "Department of Electronic and Information Engineering". In this article, Associate Professor of the Department ***Dr. Michael Tse*** *examines the global developments in this trendy field of study and explains the significance that lies behind this change of name.*

One of the key motifs in the advancement of technology is the responsiveness to society's needs. Information technology (IT), in particular, has been developing at a phenomenal pace over the past two decades, and academic institutions will ever be trying to hit a moving target as they prepare people for such a dynamic profession.

The Department of Electronic Engineering at the PolyU, under the headship of Prof. Siu Wan-chi, has taken the initiative to extend its core emphasis from a traditional circuit oriented discipline to a computer and information oriented discipline. And on 11 June 1998 the University's Senate formally endorsed the retitling of the Department as the "Department of Electronic and Information Engineering" (EIE) with effect from the 1998/99 academic year. The new name reflects more appropriately the Department's current practice and future direction in the formulation of educational goals, the implementation of academic programmes, as well as the pursuit of high-level scholarly and applied research. The retitling has gives a clear identification of the Department's role in actively promoting an IT culture within the University as well as in the community.

The following presents a view of the global trends in the development of electronic related technologies, and reviews some major steps taken by EIE in coping with these trends.

Global trends in electronic engineering

Much of the technology that structures and enhances our lives today, in ways we largely take for granted, is of extremely recent origin. It is only a little more than three decades from the invention of the first junction transistor to the prevalent use of Very-Large-Scale-Integrated (VLSI) circuits and systems in trillions of units of information processing equipment found in today's homes and offices. The past two decades have seen a great number of exciting developments in electronic engineering and its related technologies. In the process of this development, electronic engineers have been increasingly involved in the creation, development, maintenance and support of the technologies directly related to the emerging field of information processing.

With but few exceptions, information-oriented applications are becoming the core areas of applications that are supported by electronic engineering. The intense development in these application areas have made the study of the associated technology a discipline in its own right — information engineering.

Information engineering and electronic engineering

The meaning of the term "information engineering" can be translated literally to the art of creating, managing and applying the science by which communication or the reception of knowledge and intelligence is made possible or improved for man and his environment. From the point of view of electronic engineers, moreover, the term "information engineering" refers to the art of creating, manipulating, applying and delivering the technology that enables the intelligent storage, retrieval, management and applications of information which are useful to man. In the usual technical sense of the term, information engineering is connected with the specific types of technology that are associated with the use of computers or computational devices. The realm of information engineering therefore encompasses a variety of basic and applied studies, e.g., computer systems and networking, information theory, software engineering, signal processing, image and pattern recognition, satellite communication, management of large-scale networks (e.g., INTERNET), etc.

Information engineering alone does not contribute to any meaningful real-life applications. To apply effectively the principles of information engineering to real-life problems requires novel conjunction and judicious utilization of electronic technologies. Indeed, information engineering can be brought to bear only if the supporting electronic technologies are prudently developed to meet the needs. For instance, without fibre networks and high-speed photonic/electronic switching devices, data communication would not be possible at such a high speed and reliability, no matter how advanced the protocols, software, and computation techniques are developed in information engineering.

Information engineering and electronic engineering are therefore co-dependent disciplines; one may be considered as fueling the other. It is extremely common to see academic units and research centres, whose primary interest is information engineering, invest considerably in the development of electronic technologies. Thus, the design of most modern electrical and electronic engineering curricula deliberately combines information engineering subjects with conventional electronic engineering subjects.

The rapid and pervasive transformation of electronic engineering, from a traditional electronic and circuit oriented discipline to one that encompasses information processing and computer intelligence, is a central fact of the engineering profession. It calls for the strengthening of the engineers' skills for critical analysis and innovative design based on a broad foundation of knowledge and experience in both the traditional field of electronic engineering and the emerging field of information engineering.

Recent departmental developments

The rapid acceleration of the field of electronic engineering towards information-processing-intensive and massively networked applications sharply heightens the urgency of shifting our educational and research emphasis towards information engineering. Indeed, information engineering is rapidly becoming a core area of study in many electrical and electronic engineering curricula in the US, the UK, Japan, Australia and Europe.

Along with this shifting of emphasis towards information engineering, EIE has over the past few years taken proactive measures to enhance basic facilities, teaching resources and research capabilities in information engineering and its related technologies. However, traditional subjects in electronic engineering remain as major subjects of teaching and research in the Department.

In enhancing EIE's basic facilities and intellectual assets, the Department established the Digital Signal Processing Research Group, now the largest research group in the Department and headed by Prof. Siu Wan-chi. Also, the Computer and Intelligent Systems Teaching Section was restructured in 1995 to deliver a spectrum of subjects in information engineering. The Department now has a highly qualified faculty whose areas of expertise fall exactly on information engineering or related disciplines. Besides, the Department has recently established two new laboratories: the Digital Signal Processing Laboratory and the Media and Networking Laboratory.

In implementating its teaching programmes, the Department has instituted core and elective courses, at undergraduate and postgraduate levels, to teach principles of information engineering. The change in emphasis of the curriculum design in favour of information engineering has become clearly visible with the introduction of new teaching programmes in 1997 under the University's new Credit Based System. Essentially, with the new programmes, students can focus on selected areas of study categorized under different study streams — e.g., telecommunication stream, information engineering stream, etc. — all of which have direct conjunctions with information engineering.

Prof. Siu Wan-chi (standing, right) and colleagues studying Digital Signal Processing.

In the teaching of postgraduate programmes, EIE offers the largest number of Master of Science modules in the University, many of which fall in the discipline of information engineering, e.g., digital signal processing, broadband ISDN and satellite communications, etc.

In research, consistent with the shift of teaching emphasis towards information engineering, a considerable number of research projects are having strong connection with information engineering. In the area of digital signal processing, specifically, the Department has an impressive research track record, having published over 300 journal and conference papers, among which many are related to the core technologies that enable information transmission, storage, manipulation and retrieval. The recent establishment of the Centre of Digital Signal Processing for Multimedia Applications, which is headed by Prof. Siu Wan-chi, further focuses research resources along this direction. With 13 core faculty members and 11 other faculty members who work in related areas, this centre has made some significant contributions to the development of fast algorithms, high-performance signal processor architecture, data compression techniques, video and audio coding, pattern and voice recognition, network management, multimedia applications, medical imaging, etc. In addition, the Department recognizes the important role of advanced communication systems in enabling reliable and efficient distribution of information. The recently founded Wireless Information Systems Research (WISR) Centre in particular is devoted to the development of wireless communication systems. This centre, headed by Prof. Asrar Sheikh, has seven core faculty members who are active in a wide range of research topics including adaptive equalization, interference cancellation, frequency allocation, etc. The Department's other core research areas include power electronics and thin-film optoelectronics.

Looking ahead

The retitling of the Department and all its taught programmes reflects the Department's commitment and determination, not only to train the society's preferred engineers, but also to transcend traditional boundaries in keeping pace with the rapid advancement of the profession.