



NEW ASPECTS of APPLIED INFORMATICS, BIOMEDICAL ELECTRONICS & INFORMATICS and COMMUNICATIONS

**10th WSEAS International Conference on APPLIED
INFORMATICS AND COMMUNICATIONS (AIC '10)
3rd WSEAS International Conference on BIOMEDICAL
ELECTRONICS and BIOMEDICAL INFORMATICS (BEBI '10)**

**Taipei, Taiwan
August 20-22, 2010**

Recent Advances in Computer Engineering
A Series of Reference Books and Textbooks

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Preface

This year the 10th WSEAS International Conference on APPLIED INFORMATICS AND COMMUNICATIONS (AIC '10) and the 3rd WSEAS International Conference on BIOMEDICAL ELECTRONICS and BIOMEDICAL INFORMATICS (BEBI '10) were held in Taipei, Taiwan, August 20-22, 2010. The conferences remain faithful to their original idea of providing a platform to discuss system architecture, algorithms and data structures, optical computers, nano-computers, intelligent mobile networks, microstrip circuits and components, microwave theory and techniques, lightwave technology, microwave superconductivity, reflectors and lens antennas, applied electromagnetics, physical layer, computer networks, wireless and mobile computing, traffic engineering, network optimization, communication systems integration, cryptology, military communications, programming techniques in communications networks, soft computing and communications, smart interfaces, computer/communications integration, etc. with participants from all over the world, both from academia and from industry.

Their success is reflected in the papers received, with participants coming from several countries, allowing a real multinational multicultural exchange of experiences and ideas.

The accepted papers of these conferences are published in this Book that will be indexed by ISI. Please, check it: www.worldses.org/indexes as well as in the CD-ROM Proceedings. They will be also available in the E-Library of the WSEAS. The best papers will be also promoted in many Journals for further evaluation.

Conferences such as these can only succeed as a team effort, so the Editors want to thank the International Scientific Committee and the Reviewers for their excellent work in reviewing the papers as well as their invaluable input and advice.

The Editors

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Plenary Lecture 1

A DP Model for Optimal Pricing of the Recyclable Products in a Duopoly Market



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Abstract: In recent ten years, because of the rapid progress of technology, the cycle of releasing products is shortened, especially in 3C market. Under a given market scale, this study particularly concerns about the optimal pricing policy where there are two kinds of products having different degrees of greenness from different manufacturers sold by one retailer. The objective is to maximize the retailer(s)'s profit. Based on the characteristic of the multiple periods along the life cycle of a product, in this study, based on Game Theory, a Dynamic Programming (DP) model is developed to analyze the competitive condition as well as the market behavior for two products. In particular, according to recycling principle of WEEE, the retailer(s) will refund the remaining products to the manufacturer with lower price at the last stage. Finally, the proposed pricing policy has been shown to be theoretically valid and thoroughly applicable.

Brief Biography of the Speaker:

Hsiao-Fan Wang is the Distinguished Chair Professor of National Tsing Hua University, Taiwan, Republic of China. She has been teaching at the Department of Industrial Engineering and Engineering Management at the same university, NTHU after she graduated from Cambridge University, UK in 1981. She used to be the Vice Dean of the College of Engineering; the Head of the Department of IEEM, NTHU, President of Chinese Fuzzy Systems Association, Vice President of International Fuzzy Systems Association and Erskine Fellow of Canterbury University, NZ. Also, she has been awarded the Distinguished Research Award from National Science Council of Taiwan, ROC; Distinguished Contracted Research Fellow of NSC and Distinguished Teaching Award of Engineering College, NTHU. She used to be the editor-in-chief of the Journal of Chinese Industrial Engineering Association; also the Journal of Chinese Fuzzy Set and Theories and now is the area editor of several international journals. Her research interests are in Multicriteria Decision Making, Fuzzy Set Theory and Green Supply Chain Management.

Plenary Lecture 2

Applying Virtual Learning Environments



Professor Hung-Jen Yang

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Abstract: Virtual Learning Environments (VLEs) provide learners the notation of learning without boundary. Using VLEs poses important educational issues for learning institutions. Without addressing the issues of meaningful learning, their use can compound the mistakes of the earlier period and leave the learner with a inactive, un-engaging experience leading to learning without content and context. System designers need to recognize that learning is a social process and that providing an effective learning environment which facilitates the active acquisition of subject-specific and general expertise, and addresses the need to adopt a specific subject or professional culture, requires more than electronically delivered course notes and email discussion. Quality of learning environment design, use of appropriate tools and the context in which learning takes place are prime factors affecting success in the era of knowledge and lifelong learning. In the presentation, tasks of a virtual learning environment would be proposed. Based upon effective and meaningful learning, ideas of using virtual learning environment would be presented and evaluated according to the criteria of effective and meaningful learning.

Brief Biography of the Speaker:

Prof. Dr. Hung-Jen Yang (born in 1961 in Taipei, Taiwan) is the Director of Center for Instructional & Learning Technology of National Kaohsiung Normal University, Taiwan. He got master degree from University of North Dakota in Industrial Technology major at 1989 and Dr. Degree from Iowa State University in Industrial Education and Technology major at 1991.

From 1991 to 1994, he served as associated professor at Ping-tong teachers' college. In the same period time, he also took the job of computer center director. From 1994 till now, he is working as professor in the department of industrial education and took several different administration jobs. In the semester year of 2003, he was invited as a visiting professor at University of North Dakota, USA. Since 1994 till now, Dr. Yang has already done 25 National Science Council supported projects. His research is focused on both areas of technology education and educational technology.

Plenary Lecture 3

Wireless Telecommunications Services Quality Management



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Abstract: Services quality management represents one of the key features of the wireless seamless telecommunications data solutions dedicated for the Intelligent Transportation Systems. Private solutions can frequently guarantee reasonable service quality level, however, their signal area coverage use to be significantly limited and the economical parameters of private solutions are much less desirable than the ones offered by the public providers. Public providers usually offer high service penetration in widely spread areas, nevertheless, these providers typically do not guarantee even lower level of the data services quality. Widely spread mobile solutions with reasonable quality level can be reached by the dynamical selection of the best possible service from the set of just accessible wireless services. Implementation is based on the seamless switching/routing structures managed by results of those adaptive decision processes. CEN TC204, WG16.1 team has been working on series of documents known as CALM family of standards. CALM is based on L2 switching and for decisions the Policy-based Management (PBM) principles are applied. In contrary to CEN team approach authors of this paper propose "alternative CALM" solution based on the L3 routing managed by the decision processes designed on principles of the adaptive classifications. This solution belongs to category of "intelligent routing". Related alternative solution can be more efficiently implemented if there is available deep enough understanding of the applied technologies. Paper presents the first implementations experiences based on the results of the laboratory studies of three most widely spread data wireless services.

Brief Biography of the Speaker:

The Czech Technical University in Prague in "Technical Cybernetics", PhD in experimental (geo-) physics at the Czech Academy of Sciences, Prof. (assoc.) in Informatics at Faculty of Transport Sciences of the CTU in Prague.

2005 - Czech Technical University in Prague

-Lectures: telecommunications sciences, legal issues of telecommunications regulation, new technology trends, telecommunications in ITS, business management, strategy planning, ...

-R&D: new telecommunications trends and solutions within Intelligent Transport Systems

1993 – 2005 Communications business

-Development of new products, Strategy planning, Business development e.g. of alternative global voice and data communications in the Czech Republic and other countries of the CEE region – namely in Global One (Sprint Int., France Telecom, Deutsche Telekom)

1976 – 1994 Academy of Sciences

-Experimental laboratory and observatory methods in Geophysics - studies of the variations and drift of the Earth magnetic field, Data communication solutions within international and national observatory system

-Computer modeling of magnetic material structures with on-line experimental identification – studies done on the artificial samples with well defined magnetic particles structure. Laboratory measurement of the magnetic properties of rocks

1972 – 1976 Industrial R&D

-Automatic control systems for the technological processes - Computer Numerical Control (CNC)

-Data communications and computer based control within technological processes

Plenary Lecture 4

On Fitness Function and Evolutionary Computation Techniques for Music Generation



Professor Viriato M. Marques

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Abstract: Which features determine the beauty of a musical piece? What makes a melody a good one? The automatic classification of a melody or musical piece as "good" or "bad" resides on data-mining techniques and statistical tools, sometimes helped by some form of subjective evaluation. For automatic music composition many approaches have been used, but Genetic Algorithms, Evolutionary Programming and Particle Swarm Optimization showed to be the most promising ones, given their creative capabilities.

The critical issue in the above described tasks is music feature selection. Simple melodies (pre-processed in order to exclude non fundamental embellishments) or complete musical pieces can be analyzed in various perspectives such as Zipf's law [Manaris et al, 2003, 2007]. Classification tasks can then be supported by classifiers that may include a humanized perspective.

In fact these classifiers are a fundamental piece of the fitness functions of GA's, EP or PSO, responsible for the automatic creation of simple melodies, complete musical pieces or variations on a given theme. These algorithms can be used in stand-alone applications, sometimes complemented with local search techniques, as well as in a sequential way as proposed by [Reis C, Machado J, 2009].

However, aesthetical evaluation is strongly governed by cultural patterns. So, a brief introduction to Western and Eastern music is made and some formal principles that characterize and differentiate these styles are presented. Some of these principles can be easily incorporated into a fitness function. However, a complete and perfect fitness function must also take into account the capacity of emotion evocation as this has been the goal, for centuries, of most part of music styles [Reis C, Marques V, Machado, J, 2008]. Coincidence or not, Darwin's already mentioned the importance of emotional expression for survival and adaptation [Darwin C, 1872].

Brief Biography of the Speaker:

Viriato M. Marques was born at Lisbon, Portugal, in the year of 1957. He is a Coordinator Professor of DEIS - Computer Science Department - of ISEC - Engineering Institute of the Polytechnic Institute of Coimbra - and researcher at GECAD - Knowledge Engineering and Decision Support Group - of ISEP - Engineering Institute of Polytechnic Institute of Oporto. His research interests are Artificial Intelligence, Case-Based Reasoning, Data-Mining, Evolutionary Computation and Fuzzy Systems. He was President of the Scientific Board of ISEC, President of the Computer Science Department of ISEC, Coordinator of the IPC Committee for the European University Association evaluation at ISEC, co-founder of the Portuguese Chapter of IEEE Computational Intelligence Society and chair of the WSEAS conference FS'05, Lisbon, Portugal. He is the author of more than 60 papers published in the proceedings of international conferences, journals and books, such as: CBR for Diagnosis: Evidence Relevance and Case Adaptation, V.Marques, J.T.Farinha, A.Brito, 13th WSEAS Conference on Computers, Rhodes, Greece, 22-25 July 2009; Computational Intelligence Techniques in Engineering, V.Marques, C.Reis, L.Roseiro, J.T.Machado, 2nd Conference on Nonlinear Science and Complexity, Oporto, 28-31 July 2008 (to be published by Springer); Know how retention and divulgation with a Fuzzy CBR System, V.Marques, J.T.Farinha, A.Brito, N.Pincho, ISDA'07 - International Conference on Intelligent Systems Design and Applications, Rio de Janeiro, Brasil, 22-24 October 2007. He has been reviewer or member of the Scientific Committee of various International Conferences. Viriato M. Marques graduated in Electrical and Electronic Engineering by FCTUC - Faculty of Science and Technology of Coimbra University - and obtained his Ph.D. in Engineering Sciences at FEUP - Engineering Faculty of Oporto University. He has professional experience in the field of Information Systems as manager and technical responsible of some enterprises, and finished the piano course at Coimbra Music School.

Plenary Lecture 5

Web-Based Multimedia Editing



Professor Yen-Chun Lin

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Abstract: It should require a nearly complete rewrite of a stand-alone multimedia editing program to make it operational through a Web browser, since it involves a very different environment and technique. We have implemented two interactive, Web-based tools for multimedia editing. One is for image matting. It is the first image matting tool accessible through a Web browser, and can extract a foreground with thin, thread-like shapes. It begins to process inputs immediately after the user has started to paint with a brush roughly along the boundary between the foreground and the background. The user can stop anywhere while painting, and change the width of brush as needed to help achieve good foreground quality. The result is generally better or not worse than those done by some other similar tools. The other is for video editing. Many new functions for editing digital videos, such as adding or mixing audios to a film, have been included. The functions can be integrated into a multimedia blog to enrich the sharing of multimedia contents.

Brief Biography of the Speaker:

Yen-Chun Lin received his BS degree in electrical engineering from National Taiwan University in 1977, MS degree in computer engineering from National Chiao Tung University in 1983, and PhD degree in electrical engineering from National Taiwan University in 1988. Since 1988 he has been on the faculty at National Taiwan University of Science and Technology. Dr. Lin has been a full professor since February 1993, in Department of Electronic Engineering before August 2001 and then in Department of Computer Science and Information Engineering. He is the founding editor-in-chief of the International Journal of Applied Computer Algorithms and Systems. He served as Program Chair of the 2001 International Conference on Parallel and Distributed Computing, Applications, and Technologies and as Guest Editor of The Journal of Supercomputing, March 2003. Dr. Lin received Honorable Mention of Annual Best Paper Award of Journal of Information Science and Engineering in 2001. He was a Visiting Scientist at the IBM Almaden Research Center, San Jose, California, from 1993 to 1994. His research interests include parallel computing and Web-based applications. Dr. Lin is a life member of the ACM and a member of the IEEE Computer Society.

Plenary Lecture 6

Bridging Multi-Core and Distributed Computing: All the Way Up To the Cloud



Professor Denis Caromel

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Abstract: We will share our experience at simplifying the programming of applications that are distributed on Local Area Network (LAN), on cluster of workstations, or GRIDs, and of course, Clouds. We will promote a kind of approach, Network On Ship, to cope seamlessly with both distributed and shared-memory multi-core machines. A theoretical foundation ensures constant behavior, whatever the environment.

The point will be illustrated with ProActive Parallel Suite, an Open Source library for parallel, distributed, and concurrent computing, allowing to showcase Interactive and graphical GUI and tools.

The presentation will give an overview of issues at hand when accelerating demanding applications with Multi-Cores, Clusters, Servers and Clouds. Second, it will detail how one can reduce administration costs and hardware expenditures by virtualizing the hardware resources: monitor and control all resources in a uniform manner, appropriately schedule the distribution of taskflows and applications execution over the available resources. Third, the presentation explains how to manage actual VMs (VMware, KVM, Xen, Xen Server, QEMU, Microsoft Hyper-V) in such an infrastructure, including operations such as Start, Stop, Clone, Destroy. Overall, it is shown how simple it is now to dynamically aggregate and manage many different kinds of enterprise resources (Desktop, Server, Cluster, VMs), and seamlessly upon demand, to extend them with Public Clouds (e.g. Amazon EC2).

The talk will also feature stunning Use Cases: Large Scale Processing of Genomic Sequencing, acceleration of Financial Valuations and of the Analysis of Web Server Logs in an SOA context. When appropriate, the actual cost of running partially or fully onto Public Clouds is presented.

Brief Biography of the Speaker:

Denis Caromel is full professor at University of Nice-Sophia Antipolis and CNRS-INRIA. Denis is also co-founder and scientific adviser to ActiveEon, a startup dedicated to providing support for parallel programming. His interests include parallel, concurrent, and distributed computing, in the framework of GRID and CLOUD.

Denis Caromel gave many invited talks on Parallel and Distributed Computing around the world, over (Jet Propulsion Laboratory, Berkeley, Stanford, ISI, USC, Electrotechnical Laboratory Tsukuba, Sydney, Oracle-BEA EMEA, Digital System Research Center in Palo Alto, NASA Langley, IBM Tom Watson and IBM Zurich, Boston HARVARD MEDICAL SCHOOL, MIT, Tsinghua in Beijing). He acted as keynote speaker at several major conferences (including Beijing MDM, DAPSYS 2008, CGW'08, Shanghai CCGrid 2009, IEEE ICCP'09, ICPADS 2009 in Hong Kong). Recently, he gave two important invited talks at Sun Microsystems HPC Consortium (Austin, Tx), and at Devovx (gathering about 3500 persons).

Plenary Lecture 7

Some Issues and Approaches in Data Mining



Professor Tzung-Pei Hong

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Abstract: Data mining plays a central role in knowledge discovery. It involves applying specific algorithms to extract patterns or rules from data sets in a particular representation. Many researchers in database and machine-learning fields are interested in this new research topic since it offers opportunities to discover useful information and important relevant patterns in large databases, thus helping decision-makers analyze data easily and make good decisions regarding the domains in question. Years of effort in data mining have produced a variety of efficient techniques and applications. In this speech, I would like to present some currently popular and interesting techniques developed in our research group. They include the integration of data mining with soft computing, privacy and ontology. The integration of data mining with soft computing can easily handle quantitative transactions and infer linguistic knowledge. Data mining with privacy can hide some transaction data or rules in the mining process for safety. Using ontology can take domain knowledge into consideration and improve the effectiveness of mining results. Besides, I will also introduce some interesting applications such as knowledge warehouse, web mining and on-shelf purchasing behavior mining.

Brief Biography of the Speaker:

Tzung-Pei Hong received his B.S. degree in chemical engineering from National Taiwan University in 1985, and his Ph.D. degree in computer science and information engineering from National Chiao-Tung University in 1992. From 1987 to 1994, he was with the Laboratory of Knowledge Engineering, National Chiao-Tung University, where he was involved in applying techniques of parallel processing to artificial intelligence. He was an associate professor at the Department of Computer Science in Chung-Hua Polytechnic Institute from 1992 to 1994, and at the Department of Information Management in I-Shou University (originally Kaohsiung Polytechnic Institute) from 1994 to 1999. He was a professor in I-Shou University from 1999 to 2001. He was in charge of the whole computerization and library planning for National University of Kaohsiung in Preparation from 1997 to 2000 and served as the first director of the library and computer center in National University of Kaohsiung from 2000 to 2001, as the Dean of Academic Affairs from 2003 to 2006 and as the Vice President from 2007 to 2008. He is currently a distinguished professor at the Department of Computer Science and Information Engineering and at the Department of Electrical Engineering. He has published more than 350 research papers in international/national journals and conferences and has planned more than fifty information systems. He is also the board member of more than thirty journals and the program committee member of more than one hundred and thirty conferences. His current research interests include parallel processing, machine learning, data mining, soft computing, management information systems, and www applications. Dr. Hong is a member of the Association for Computing Machinery, the IEEE, the Chinese Fuzzy Systems Association, the Taiwanese Association for Artificial Intelligence, and the Institute of Information and Computing Machinery.

Plenary Lecture 8

Our Role as Engineers in Welfare by Using the Internet -Proposals from One Aiming at Simple Common Technology Systems



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Graduate School of Health Care Sciences
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Tokyo, JAPAN
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Abstract: We discuss our possible role as engineers in dealing with the various problems of elderly people and also the weak in their everyday life amid the changing society due to lengthening life-spans and declining birthrates. For this purpose, we describe the conditions surrounding such people that they must face up to and interact with. From several major social perspectives, what sort of welfare we intend to realize, we emphasize the need of closely cooperative relationships in everyday life. Under the evaluation of the past contribution of welfare engineering with their limits and vulnerability, our approach is discussed from a different policy with mainly securing the time and space for people in need, in which relating systems based on high-tech and multiple functions do not necessarily lead to their widespread use. At the same time, we mention the importance of wide-area networks, featuring public benefits, easy replacement of old ones and convenience, in which simple technology is marked by safety, reliability and flexibility. The internet is better used on policies of management including configuration for the cooperation because of its overall convenience, including favorable economics and easy-to-handle equipment. We thereby present opinions from technical viewpoints that have been derived from our wrestling with comprehensive engineering issues related to developing and practical utilization of basic functions for the beneficiaries. Although our argument and views cover some, not all, pertinent aspects, we will try to illustrate and advocate the roles and possibilities that we, the engineers, can play in the future, from the viewpoint of desirable progress in information and communications systems, which can contribute to welfare. Finally, we will mention the intended build-up of future welfare culture based on such technology.

Brief Biography of the Speaker:

Professor Hidetoshi Wakamatsu born on 15.Nov.1946, received his B.E. and M.E. degrees from Yokohama National University in 1970 and 1972, respectively. He received his Dr. of Eng. degree in 1984 from the University of Tokyo. Academic Positions: He was a research Associate at the Institute for Medical and Dental Engineering from 1972-1986, Tokyo Medical and Dental University. From 1973-1974 he was a Visiting Research Associate, Institute for Biocybernetics, Faculty of Medicine, University of Erlangen-Nuernberg, Germany. From 1986-1988 he was an Associate Professor at Ashikaga Institute of Technology, Associate professor 1988-1991, Professor 1991-1992 at Fukui University and Professor, Faculty of Medicine in 1992, Professor, Graduate School of Health Care Sciences in 2001, Tokyo Medical and Dental University. In 1994 a visiting professor, Oregon State University and so on. From 2006 a general chair of Asia Pacific Conference on Control and Measurement.

Plenary Lecture 9

Age-Related Changes of Elements in the Brain Regions and the Gender Differences of Elements in the Brain Regions



Professor Yoshiyuki Tohno

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Abstract: To elucidate compositional changes of the brain regions with aging, the authors investigated age-related changes of elements in the corpus callosum, anterior commissure, and fornix of white matter and the pineal body, olfactory bulb and tract, mammillary body, hippocampus, and dentate gyrus of gray matter by direct chemical analysis. In addition, the authors investigated whether there were gender differences in the element contents in their brain regions or not.

After ordinary dissections at Nara Medical University were finished, the corpora callosa, anterior commissures, fornices, pineal bodies, olfactory bulbs and tracts, mammillary bodies, hippocampi, and dentate gyri were resected from the cerebra cut at median line. The brain samples were treated with 99.5% ethanol three times to remove lipids. After ashing with nitric acid and with perchloric acid, the seven element contents of Ca, P, S, Mg, Zn, Fe, and Na were determined by inductively coupled plasma-atomic emission spectrometry (ICPS-7510; Shimadzu, Kyoto, Japan).

With regard to age-related changes of elements, it was found that the Ca and Mg contents increased significantly in the hippocampi with aging; the Ca content increased significantly in the mammillary bodies with aging; the P and Na contents increased significantly in the dentate gyri with aging; and the Mg content increased significantly in the fornices with aging. However, the seven element contents did not change significantly in the corpora callosa, anterior commissures, pineal bodies, and olfactory bulbs and tracts with aging.

Regarding the gender differences in the element contents, it was found that the Zn content was significantly higher in the anterior commissures of men than in those of women. In the olfactory bulbs and tracts, it was found that the Ca, P, and Zn contents were significantly higher in men than in women. In contrast, it was found that the S content was significantly higher in the dentate gyri of women than in those of men. However, no gender differences were found in the hippocampus, mammillary bodies, and fornices.

Plenary Lecture 10

Nanomechanics of Soft Biological Materials for Tissue Engineering



Professor Isaac Kuo-Kang Liu

Reader (Professor) in Nanotechnology and Microengineering
School of Engineering, University of Warwick
Coventry CV4 7AL, UK (from 1st Sept. 2009)
Reader in Biomedical Engineering
Institute of Science and Technology in Medicine
School of Medicine, Keele University
Stoke-on-Trent ST4 7QB, UK
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Abstract: It is generally believed that all living systems require certain forces for growth and maintenance of their physiological functions, and this is especially true for soft biological tissues. Although people normally tend to consider large forces which may affect their bodies, recently scientist found that very small (nanoscale) force may have profound influences on human tissue regeneration or deterioration and may consequently enhance their healing process. Hence, mechanical stimuli to enhance cell/tissue regeneration have become a new paradigm for the next-generation therapies such as tissue engineering, regenerative medicine and stem cell therapy. In an ageing population, common diseases such as osteodeterioration, cardiovascular and neurological problems often require tissue replacement/regeneration. Such new self-repairing therapies become increasingly demanding. In this talk, we will report state-of-the-art nanomechanical techniques for stimulating tissue growth and the corresponding physiological responses of the tissues. The applications of these new techniques which are essential for the advancement of the engineered-tissue based therapeutic products for the next-generation of healthcare will also be highlighted in the talk.

Brief Biography of the Speaker:

Dr. Isaac Kuo-Kang Liu is a Associate Professor(Reader) in Nanotechnology at School of Engineering, the University of Warwick, UK. Before joining Warwick in 2009, he was a Reader in Biomedical and Cell Engineering at the Institute of Science and Technology in Medicine, School of Medicine, Keele University, UK and an Associate Professor in the Mechanical and Production School of Nanyang Technological University (NTU), Singapore. He completed his PhD study at the Chemical Engineering Department of Imperial College London, UK in 1995. His research interests include Cellular Bioengineering, Biomechanics, Nanomedicine, Tissue Engineering, and Biomedical Devices. He is a fellow of the Royal Society of Medicine, a fellow of Nanotechnology Institute, and a senior member of American Institute of Chemical Engineers (AIChE). He is an editor of several prestigious journals (e.g. the Open J. Nanomedicine). He has published more than 50 high-impact journal papers in Bioengineering and Biophysical areas and 30 other publications, including 2 US patents.

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