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NEWSLETTER OF BIO-MEDICAL ENGINEERING SOCIETY OF INDIA

BIO-MEDICAL ENGINEERING ACTIVITIES IN THE DEPARTMENT OF ELECTRICAL ENGINEERING, IIT ROORKEE

History : The Indian Institute of Technology, Roorkee (IITR) is the youngest IIT but prior to this incarnation, it was the oldest and one of the prestigious technical institutes of the country as University of Roorkee. Dept. of Electrical Engineering was incepted in pre-independence era, and it grew into a multifaceted multi-dimensional hub of technical education and research. The bio-medical engineering research in this dept. started in early seventies and the first Ph.D. degree was awarded in the year 1973, for analysing bio-control system and modelling human visual control system. In the mid seventies, when computer applications were in primitive stage, electromyogram analysis began in the department. It may sound quite simple now with super-speed computational facilities, but at that time, its application in prosthesis control was a unique initiative. Prof. P. Mukhopadhyay, laid the foundation of bio-medical engineering research in this department. Since then a number of postgraduate students have contributed to the field of biomedical engineering, and this pursuit is still on. Today, the Dept. has a full-fledged bio-medical engineering research group with dedicated faculty and enthusiastic students. Presently, the department has three well-equipped laboratories with state-of-art equipments for bio-medical engineering research.

The bio-electrical signals have been the choicest field of research for most of the BME researchers at Roorkee. This department has been producing a number of Ph.D. dissertations, research publications, monographs, books etc. and regularly holding seminars, conferences and workshops dedicated to bio-electrical signals. Many research projects in the areas of ECG signal analysis and processing, and computer based interpretation of medical images have been completed. With the computer-aided techniques,

once all the signals are transduced into electrical signals, the domain of research encompasses other fields also. The quest for quality research has always put the department on the cutting edge, and this has attracted a number of world-renowned institutes for research collaboration with IITR. Other research areas include optimization techniques in biological systems, modelling of human auditory mechanism, modelling and analysis of visual, renal, cardiovascular, and pulmonary systems, online processing of ECG & EMG signals for diagnostic and prosthetic purposes, signal processing of low frequency random biosignals using orthogonal functions, pattern recognition techniques in ECG waveform, expert system development for the analysis of bioelectrical signals, ambulatory monitoring and analysis of ECG signals, wavelet transform of ECG signals, ANN based ECG classification etc.

Current Research Activities : Currently, most of the research activities are being conducted on analysis of different medical images, medical imaging modalities, computer assisted electrocardiography, heart rate variability, bio-matrix, telemedicine and biosignal analysis under venom interaction.

Heart Rate Variability is one of the growing fields of research for prognosis of ailments. This work has significantly contributed to the current HRV analysis techniques. The specific contribution refers to HRV in *diabetes mellitus*. Another research in progress is on HRV with feature independent waveform analysis using Principal Component Analysis and Independent Component Analysis. The feature independence is proving useful in coping with the problems of baseline wander, power frequency noise, artifacts and other unsolicited features distorting the waveform. Keeping

in view the importance of HRV analysis for classification of various physiological conditions of the human cardiac system, one more research work is proposed to be carried out on a blend of conventional and recent feature extraction strategies. This work focuses on treatment of low quality signal due to errors in time data series, better methods of nonlinear characterisation of RR interval series, physiological underpinning of observed periodicities in the heart rate time series.

Being an integral part of an IIT, the bio-medical engineering research group is fully aware of its responsibility towards the development and upkeep of the national resources. Snake, scorpion and other venom interaction is a common health hazard in India and every year a large segment of Indian population falls prey to venomous animals and causes a misery to the family as well as to the nation, as most of the people are in the working age group of fifteen to fifty. The bio-medical engineering research group of the department has currently undertaken a unique research project on changes in physiological parameters under venom interaction.

Medical imaging plays a major role in contemporary health care, both as a tool in primary diagnosis and as a guide for surgical and therapeutic procedures. In this area, the research carried out in the department emphasised on the automated analysis of medical images and their compression for telemedicine. This project analysed the mammography images using Support Vector Machine (SVM) for the classification of benign or malignant calcification regions in the images. Different loss-less data compression and encryption techniques for effective use of bandwidth in telemedicine were evaluated and new schemes have been proposed using both, discrete wavelet transform (DWT) and discrete cosine transform (DCT).

We are also exploring the area of automated analysis of medical ultrasound images. The aim of this work is on speckle suppression and feature extraction from the Region of Interest (ROI) in the ultrasound images. Improvement in the existing segmentation techniques for identification of ROI is proposed. Computer Aided Diagnosis in detecting lesions, assessing extent of diseases, and making diagnostic decision, is expected to improve the interpretation of medical imaging. With this very aim, the segmentation and interpretation of ultrasound medical images is underway. It is proposed to use different statistical features, which describe the physical properties of tissues to classify the images pertaining to different anatomical and physiological conditions of the subject.

Other Academic Activities :

- Workshop on “Bio-medical Engineering Education” sponsored by AICTE, New Delhi • Continuing Medical Education Program for Military Hospital, Roorkee.
- National Conference on “Biomedical Engineering”
- About 20 Short Term courses in the field of Bio-medical Engineering have been conducted.

Sponsored Research Projects Undertaken :

- Feature Extraction and Interpretations of Ultrasound Medical Images, (AICTE) • Condition Monitoring System for Human Cardiac System and Large Electric Machines, (DST) • Development of ‘A Computerised ECG Interpreter for Mass Healthcare’, (AICTE).

With the growing involvement of practical medical problems, the BME group exchanges information with a number of nationally and internationally reputed health care and research institutes. Eminent personalities are regular visitors to the department and contribute towards BME research.

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OPEN FORUM (*continued from previous issue)

Need to establish Clinical Engg. Profession in India.

Clinical Engineering in UK :

The Institute of Physics and Engineering in Medicine (IPEM) is a professional body responsible for control and regulation of the Clinical Engineering profession in UK. This profession involves two cadres namely Clinical Technologists and Clinical Scientists and Engineers.

Clinical technologists undergo a three year undergraduate course in relevant subjects and are responsible for day to day operation of equipment in the hospitals. The Clinical Scientists / Engineers is a higher cadre and they undergo six years of training after completing an undergraduate university degree in physics or engineering. At the end of this training period of six years, they face a viva conducted by IPEM and if successful, they are awarded Certified Engineer Degree (C.Eng.). It is obvious from the rigorous nature of the training, that Clinical Scientists / Engineers are mature professionals and can handle the responsibility of equipment management in a much better way. They also are involved in setting up quality system programmes and issues related to accreditation of hospital services. The training for both

the cadres can only be provided by those university departments, which have obtained accreditation from IPEM. Furthermore, a parallel process of state registration of clinical engineers is also in place and this registration is possible only after completion of the six year training. The Clinical Scientists / Engineers also undergo research training and this training in combination with their day to day exposure to patient care environment actually seems to trigger the development of new diagnostic and therapeutic tools.

The subject areas for training of clinical engineers listed by IPEM are : • Physiological Measurement • Bio-mechanical Evaluation and Function • Radiation Protection • Diagnostic Radiology • Nuclear Medicine • Non-Ionizing Radiations • Magnetic Resonance Imaging • Ultrasound • Medical Imaging • Design of Medical Electronic Instrumentation • Assistive Technology • Medical Engineering Design • Medical Equipment Management • Information and Communications Technology

In addition to the above areas certain core competencies have been listed by IPEM, which emphasise on training in quality assurance, regulatory issues and safety.

Clinical Engineering in USA :

American College of Clinical Engineers (ACCE) is the professional body awarding certification to engineers who gain experience of working in hospitals. In order to obtain this certification, these engineers prepare for an examination as per the 'study guide' published by ACCE and take a written as well as an oral examination.

The study guide of ACCE lists the following topics as the essential for certification examination. • Technology Assessment • Regulatory / QA Issues • Risk Management / Safety Issues • Product Development • Miscellaneous topics like Consulting in Healthcare • Information Technology applied to Healthcare • Electromagnetic Interference (EMI) / Electromagnetic Compatibility • Expert Witness • Forensic Medical Technology Related Investigation • Legal Consulting, Healthcare Administration • Telecommunications in Healthcare • Medical Device Security • Project Management • Relationship Building.

Various universities in US have postgraduate level courses in Bio-medical Engineering with a component of clinical engineering.

In addition to UK and USA, countries in Europe as well as developing countries such as Brazil and Malaysia also have developed systems for training and certification of Clinical Engineers.

Other issues in Clinical Engineering :

Taking into consideration the pace of change in technology in healthcare, a need has been felt to have continuing education and periodic re-certification of clinical engineering cadres. Recently, researchers have advocated International Certification for Clinical Engineers through international organizations such as World Health Organisation (WHO).

WHO also operates through Emergency Care Research Institute (ECRI), USA, a non-profit organisation dedicated to addressing safety in healthcare. The UK centre of ECRI has a special mandate "to assist WHO in the development and production of training and reference materials on health care engineering, management, maintenance and repair of health care equipment with emphasis on the needs of developing countries" (<http://www.ecri.org>).

Clinical Engineering in India :

It appears that no established clinical engineering practice is followed in the country, it would be appropriate to first conduct a nation wide survey to understand the real situation in the country. Further action would be based on the findings of such a survey. It may be necessary that certain steps need to be taken as outlined below.

An appropriate government agency such as AICTE or a non-profit non-government professional body such as Institution of Engineers will have to be identified. Alternatively, a new professional body will have to be formed, which can take up the mandate of establishing the profession of clinical engineering in the country. The activities of such a body can be modelled on the organisations such as the IPEM, ACCE, or through an appropriate combination of similar organisations around the world. The activities of such an organisation would include, • identifying training centres (engineering and medical institution, universities) • deciding accreditation norms for these training centres • preparing and harmonizing the curriculum for clinical engineering courses, • conducting certification examination • maintaining registers of certified engineers, • developing continuing education programmes.

In the longer term it would be essential to advocate for legislation through which, every hospital in the country should employ a minimum number of certified clinical engineers based on the size of the hospitals.

I would like to take this opportunity to appeal to all the office bearers as well as to the members of BMESI to communicate their views on the above

issues through this Newsletter. It would be ideal to open a discussion column in this Newsletter to generate awareness. It would be of great help if it becomes possible to organise a workshop / meeting to discuss the topic and arrive at a plan of action establishing Clinical Engineering profession in India.

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CHAPTER NEWS

BMESI Pune Chapter in association with IEEE and IEEMA organised a series of four workshops on "Operation and Maintenance of various Biomedical Instruments, Devices and Systems". The first workshop on "Instruments and Devices used in Clinical / Pathological Laboratory" was held on 25th Nov' 05. Dr. A. R. Abhyankar Scientist G, DST, New Delhi inaugurated the event and delivered keynote address. The second was on "Instrument and Devices used in Cardiac Analysis and Treatment" and was organised on 10th Dec. 05. Dr. Avinash Inamdar, Heart Surgeon - Sassoon Gen. Hospitals Pune inaugurated the workshop and delivered a talk on cardiac surgical instruments. One of the invited speakers Arvind Savargaonkar - Concept Integration Pvt. Ltd Pune, dealt with the safety standards for medical equipment. Workshop on imaging Systems used in Clinical Applications was conducted on 27th January, 2006 Prof. C.P. Gadgil inaugurated it and gave a talk on 'Fundamentals of Computer Assisted Imaging'.

The Last in the series was on "General purpose Clinical instruments" and was organised on 17th February, 2006. Mr. Nitin Shah – Vice President, Aiza Technologies USA inaugurated the event. Vinay Tipnis - Shonal Medical Pvt. Ltd. Pune spoke on portable X-Ray systems, Dhananjay Thosar of Bionics emphasised on problem identification, maintenance procedures, and interaction approaches, Noted paediatric physiotherapist Mrs. Priya Bhide put forth engineering support required for her profession in making life of physically and to some extent mentally challenged children a bit easier. The video clips on

such patients were appreciated by the participants. Dr. Shyam Damle projected the need of simple but reliable instruments used in General Practice. Madhav Bhate and N.M. Godbole of IEAP (Industrail Electronic & Allied Products, Pune), India's largest BP instruments manufacturer, demonstrated their products with key aspects of servicing, maintenance, and quality control. About 150 persons including post graduate students, faculty members, and professionals attended the workshop sessions.

Dr. Chaphekar Memorial Oration 2006

This is an annual event of BMESI Pune Chapter. Eminent Diabetic Foot Surgeon, activist Dr. Arun Bal was the invited speaker. He spoke on 'Diabetic Foot Problems - Its relevance to public health in India in 21st Century' on 29th April, 2006. Dr. Niranjhan D. Khambete highlighted the profile and achievements of Dr. Arun Bal, our senior member, Capt. RK Bharucha was in chair. The lecture was a real treat.



Dr. Bal motivated the students and faculty to develop simple and essential systems for assessment of Diabetic Foot. Prof. Uttam Chaskar proposed vote of thanks.

Booklet on this speech will be available soon to the interested members of BMESI. Please write to Dr. Mrs. Priti Rege, Chairperson BMESI, Pune Chapter for the copies of the same.

PAST PRESIDENT COMMUNICATES...

The requirement of Medical Devices is rising fast. The Dept. of Science and Technology of Govt. of India has plans to sponsor projects in this area so that medical devices are developed and manufactured in India. I look forward to get in touch with young scientists who can take up projects with enthusiasm and commitment and come to tangible results.

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Prof. Sujoy K Guha

Your valuable suggestions for the newsletter are most welcome. Activity reports, articles, product reviews related to the field of BME are awaited from the members for inclusion in the newsletter. Members are requested to communicate their e-mail IDs to the editor 'engmednews'.

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