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University of Karachi

The International Center for Chemical and Biological Sciences

Role of Mathematics in the Clinical Sciences

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Mathematical models of brain, heart, spinal column and human growth were reviewed with an emphasis on the clinical applications. The models of brain were based on generalized theory of driven harmonic oscillator. Study of group structure provided mathematical definition of brain death. Model of heart was based on standing-wave concept. In addition, static and dynamic models of the human spinal column were presented. The models generated three-dimensional profile of the human spinal column from noncontact, noninvasive, measurements obtained from moiré contours. Moiré fringe topography is a stereophotogrammetric technique, which gives three-dimensional information of any curved surface. Rasterstereography gives local curvatures of the surface. A combination of these techniques was applied to study posture and gait of child, detect and quantify curvatures of spinal column and aid orthopedic surgeons in operations by providing 3-D maps of bony structures to be operated. A model of child growth was described, which included a method to generate detailed growth profile of a child on the basis of records of height and weight of child, six-month apart as well as heights and weights of biological father and biological mother. Clinical examination of a patient was viewed as inverse problem, with significance of precedence and influence graphs in the ordering of examination sequence. Problems and challenges, which could be taken up by the twenty-first-century mathematicians to aid clinicians were presented and resources, already, available in SF Growth-and-Imaging Laboratory highlighted.

About the Speaker: Professor Dr. Syed Arif Kamal, Professor, Department of Mathematics, University of Karachi, Project Director, the NGDS Pilot Project and Convener, National Curriculum Revision Committee in Mathematics, Higher Education Commission, obtained his BSc (Honors), MSc and PhD (Mathematical Neuroscience) from University of Karachi, MS from Indiana University, United States and MA from the Johns Hopkins University, United States as Quaid-é-Azam Scholar. His awards and honors include throughout First-Class-First Position (98.8% aggregate marks in MSc) and 4 gold medals for scholastic achievements. He is a referee of Clinical Biomechanics (Elsavier), Proceedings of the Pakistan Academy of Sciences and Journal of Scientific and Industrial Research. His research, teaching and administrative experiences in institutions of higher learning and R&D organizations span over 27 years. He served as chairman of his department during 2003-6. He has 100 papers to his credit in biomathematics, astrodynamics, relativity, physical mathematics and algebra. He held visiting positions at Malmö General Hospital, Sweden and the Albert Einstein College of Medicine, New York, United States. He developed models of physiological systems (the human brain, the human heart and the human spinal column). He developed and implemented moiré systems at Malmö General Hospital, Malmö, Sweden and the James Whitecomb Riley Hospital for Children, Indianapolis, United States. He lectured on moiré techniques at the Harvard Medical School, United States, the Abdus Salam International Center for Theoretical Physics, Italy, University of Karachi and the Aga Khan University Medical College. He has given 60 colloquia, guest lectures, presentations and seminars at various institutions of higher learning, including Air War College, the Aga Khan University, Higher Education Commission, the Abdul-Salam International Center for Theoretical Physics, Italy and Massachusetts Institute of Technology, United States. In addition, he has conducted 20 trainings and workshops as well as in-service and professional development courses and organized 14 exhibitions, grand seminars, seminar series and conferences.

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