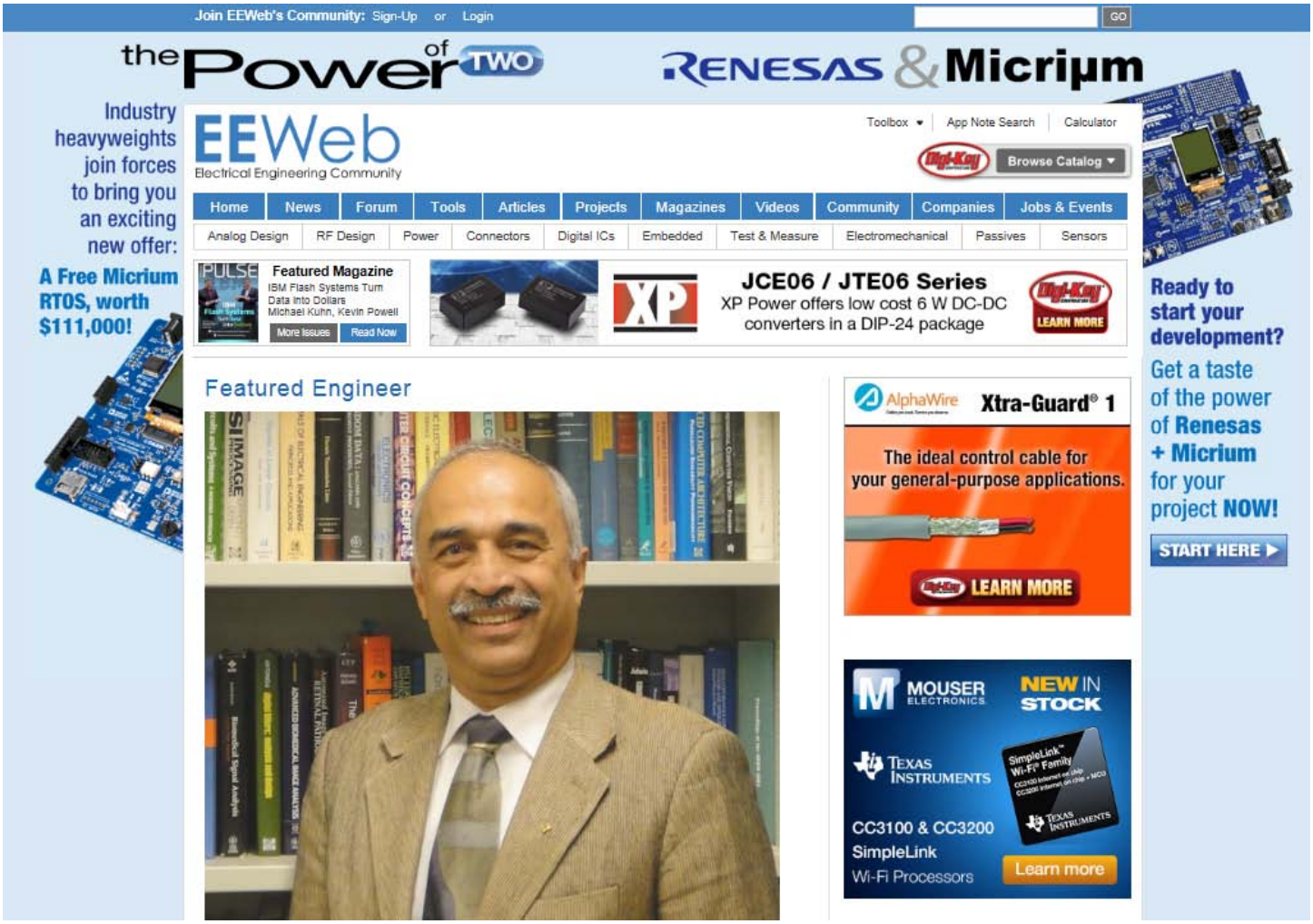

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Rangaraj M. Rangayyan

Interview with Rangaraj M. Rangayyan- Professor, Department of Electrical and Computer Engineering at University of Calgary

Can you give us a little background about yourself?

Rangaraj M. Rangayyan is a Professor of Electrical and Computer Engineering, and an Adjunct Professor of Surgery and Radiology, at the University of Calgary, Calgary, Alberta, Canada. He received the Bachelor of Engineering in Electronics and Communication in 1976 from the University of Mysore at the People's Education Society College of Engineering, Mandya, Karnataka, India, and the Ph.D. in Electrical Engineering from the Indian Institute of Science, Bangalore, Karnataka, India, in 1980. His research interests are in the areas of digital signal and image processing, biomedical signal and image analysis, and computer-aided diagnosis. He has published more than 150 papers in journals and 250 papers in proceedings of conferences. He has been recognized with the 1997 and 2001 Research Excellence Awards of the Department of Electrical and Computer Engineering, the 1997 Research Award of the Faculty of Engineering, and by appointment as "University Professor" (2003-2013) at the University of Calgary. He is the author of two textbooks: "Biomedical Signal Analysis" (IEEE/ Wiley, 2002) and "Biomedical Image Analysis" (CRC, 2005). He has coauthored and coedited several other books, including "Color Image Processing with Biomedical Applications" (SPIE, 2011). He has been recognized with the 2013 IEEE Canada Outstanding Engineer Medal, the IEEE Third Millennium Medal (2000), and elected as Fellow, IEEE (2001); Fellow, Engineering Institute of Canada (2002); Fellow, American Institute for Medical and Biological Engineering (2003); Fellow, SPIE (2003); Fellow, Society for Imaging Informatics in Medicine (2007); Fellow, Canadian Medical and Biological Engineering Society (2007); and Fellow, Canadian Academy of Engineering (2009).

He has lectured in more than 20 countries, and has held Visiting Professorships at the University of Liverpool, Liverpool, UK; Tampere University of Technology, Tampere, Finland; Universitatea Politehnica Bucureşti, Bucharest, Romania; Universidade de São Paulo, São Paulo, Brasil; Cleveland Clinic Foundation, Cleveland, OH; Indian Institute of Science, Bangalore, India; Indian Institute of Technology, Kharagpur, India; Manipal Institute of Technology, Manipal, India; Beijing University of Posts and Telecommunications, Beijing, China; Xiamen University, Xiamen, Fujian, China; Kyushu University, Fukuoka, Japan; University of Rome Tor Vergata, Rome, Italy; and École Nationale Supérieure des Télécommunications de Bretagne, Brest, France. He has developed several algorithms for biomedical signal and image processing applications, including analysis of mammograms for computer-aided diagnosis of breast cancer, analysis of collagen alignment and fine vascular anatomy to study ligament healing and treatment, high-resolution image data compression for digital teleradiology, and computer-aided diagnosis of cartilage pathology via the analysis of knee-joint vibration signals. He has completed the supervision of 26 Master's and 14 Doctoral theses.

How did you get into Electrical/Electronics Engineering and when did you start?

My father was a highly respected industrialist in the city of Mandya, Karnataka, India. His advice as well as the professional and societal respect that he had gained influenced me into studying engineering. Among the various disciplines within engineering, I considered electrical and electronics engineering to be the most challenging and demanding area in terms of the related academic material, and hence was attracted to this field during my high school days in the 1960s and early 1970s.

I saw your webpage; can you tell us about this webpage?

I created and maintain the web page myself with the intention of making my teaching and research material available not only to my own students but to students, researchers, and the general public anywhere in the world.

What are you currently working on?

My current research projects are on various applications of digital signal and image processing techniques for the analysis of biomedical signals and images, with the particular aim of computer-aided diagnosis (CAD). Some of my projects deal with the analysis of mammograms for CAD of breast cancer and analysis of retinal fundus images for CAD of various types of retinopathy.

I am teaching courses on signals and transforms, biomedical signal analysis, and digital image processing with biomedical applications. Previously, I have taught courses on electrical circuits, computer programming, communication theory, digital filters, and digital signal processing.

Do you have any noteworthy engineering experiences?

I work in the area of biomedical engineering, which requires active collaboration with clinical researchers and medical experts. We apply engineering principles and develop methods to design innovative and effective solutions to biomedical problems. The greatest joy is derived in such work when our methods work well and provide a useful procedure, system, or tool that can be used to solve real-life problems.

What is the trickiest bug you have fixed?

Instead of fixing of bugs, I would rather talk about the novel methods and original procedures that we have developed for CAD. One such innovative method we have developed is for the detection of subtle signs of breast cancer in mammograms, known as architectural distortion. Our methods tackle a difficult problem that involves the detection and characterization of breast tissue distorted by cancer at its early stages. The difficulty lies in the vague notion of what is a distorted tissue pattern as compared to normal breast tissue structure. My PhD student, Shantanu Banik, won a Publication Prize of the Institute of Cancer Research of the Canadian Institutes of Health Research for our paper on the detection of architectural distortion in prior mammograms, which was published in the IEEE Transactions on Medical Imaging in February 2011. This is a very special recognition in view of the fact that an engineering project has been identified by our national institutes of health and cancer research as being worthy of a prize.

What is on your bookshelf?

I have innumerable books and journals spanning a wide array of topics in the broad areas of engineering, mathematics, physics, statistics, biomedical sciences, medicine, radiology, cardiology, optics, imaging, instrumentation, computers, data processing… and the list goes on. My projects are interdisciplinary and multidisciplinary and require a good understanding of several subject areas.

You are the author of the two books Biomedical Signal Analysis (IEEE/Wiley, 2002) and Biomedical Image Analysis (CRC 2005). Can you please tell us what those books are about?

When I introduced and started to teach my course on biomedical signal analysis, I found that there was no suitable textbook for such a course. A couple of books on advanced topics in this area were available, but they were not written as textbooks. Therefore, it was my desire to write a textbook on this topic for several years. I could not take up such an arduous task without some concessions from the usual academic duties. I was invited by the IEEE Press to write a book on this topic and then I was fortunate to get a Killam Resident Fellowship in 1998 as well as a sabbatical leave in 2000 that helped me spend several months to concentrate my efforts towards the book. I developed the book based on my lecture notes for my own course as well as several research papers I had published with my students and collaborators. The book took much longer than expected, and was eventually published in 2002. It has been received very well around the world, with a Russian edition and a low-cost paperback edition for selected countries published over the past few years.

After the first book was done, I kept my efforts going towards another textbook on biomedical image analysis which built up on my lecture notes for my graduate course on digital image processing. I was invited by CRC Press to write a book on this topic and I was fortunate to get another Killam Resident Fellowship in 2002 to work on this book. This book turned out to an even greater task than the first one: with hundreds of equations and figures, the book has 1306 pages! This book has also been received well and many researchers, students, and professors from universities and institutions around the world have sent me positive comments.

The two books present introductions to the nature of biomedical signals and images, how the related data are acquired, and what kind of information they carry. The books include rigorous mathematical procedures for signal and image processing and analysis, and decision-making methods for clinical applications. The methods are not easy, so I have tried to facilitate comprehension by giving numerous real-life examples and illustrations. It is most gratifying when I receive comments indicating how useful my books have been in someone's education, studies, or research.

You received plenty of awards and recognitions. What are your secrets to achieve those awards and recognitions?

I am not aware of any secrets but am simply happy and grateful that my work has been found to be useful and of value by my peers, students, and leaders in the field.

Do you have any hobbies outside of work?

I like the classical music of India and play the bamboo flute (bansuri) and the sitar. The raga-based music provides endless scope for learning, exploration, improvisation, originality, innovation, soothing one's soul or spirit, and relaxation. You may visit my website http://members.shaw.ca/raj_rangayyan/ to know more about my music and listen to samples.

What direction do you see yourself heading in the next few years?

For reasons I cannot understand, despite my academic productivity and professional standing, I have not been able to attract substantial research grants over the past few years. The lack of funds has created difficulties in engaging a good number of graduate students to conduct further research in my areas of interest. Fortunately, just as you were somehow attracted to contact me for this interview, several researchers, students, and professors in many countries have approached and invited me to collaborate with them or mentor them in their research projects. I have several active research projects with many groups in Brazil, Italy, India, and China. I am very happy to collaborate with and assist other researchers to the extent that I can. If I am able to attract large research grants, I would like to take some of our methods further towards clinical application for CAD of breast cancer at earlier stages, CAD of retinopathy in premature infants, and other interesting and challenging issues.

As a professor, what words of encouragement you give to your students?

I implore my students to study hard, to pay attention and gain clear understanding of every bit of technical or mathematical detail, to work with dedicated interest, to maintain focus and persevere, and to strive for perfection in their work. Some students may perceive me as being too traditional, strict, and rigid, but I believe these attitudes are important and my advice has been appreciated by many.

Is there anything you'd like to say to young people to encourage them to pursue Engineering?

Engineering is a great profession in the service of humanity with ever expanding scope of application. Engineering provides vast scope for creativity, originality, and innovation —- similar to music as I said earlier. By applying engineering principles, it is possible to alleviate or solve many major issues and problems that afflict humanity. Engineering contributes to improvement of the quality of life. It is well known and recognized that engineering is a difficult area of study that demands substantial effort and perseverance. After the initial difficulties are overcome, engineering is a gratifying profession.

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