JULY 2009

Centre for Distance Engineering Education Programme

REACH OUT

A NEWSLETTER OF CDEEP, IIT BOMBAY

http://www.cdeep.iitb.ac.in

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National Mission on Education through ICT

invites proposals in the following areas. See the inside flap for details.

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- Teacher training
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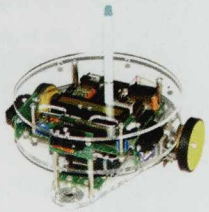
Enliven Engineering Teaching Using Robots!



Our goal as teachers is to produce innovative engineers who can solve challenging industrial and societal problems through the creative use of technology. As such, our success depends on motivating students to learn – the rest happens naturally with the energy and excitement we've helped create. How can we give students more practical experience – an oft neglected need – since infrastructure is traditionally expensive?

Robots and robotic technologies have an intellectual and emotional appeal that transcends the emotion generated by any other engineered product. These technologies are especially exciting for young adults. Robotics represents a practical application of physics, engineering and mathematics that helps animate engineering concepts that are otherwise difficult to grasp. As a result, it is being used by an increasing number of educators at the college level to reinforce computer science and engineering theory. Robotics inculcates an interest in science and teaches basic skills such as problem solving, decision making, goal setting and logical thinking. Many education professionals predict that robotics will soon be taught in schools and colleges, either as a subject unto itself or as an educational enabler for other subjects. The subject is now in its infancy, just like the computer industry was thirty years ago.

Our experience in using robots to teach Embedded Systems at IIT Bombay has shown that when students use robots, it becomes easier to motivate them to master complex engineering concepts. Whereas in the past we had only difficult-to-maintain imported kits, we have now developed, in the Embedded Realtime Systems Lab (ERTS) of the Computer Science and Engineering Department, robots that have local support along with a growing corpus of courseware that makes it easy to incorporate this programme into one's teaching curriculum.

We have used our robots to illustrate concepts of Realtime Operating Systems (RTOS) using open source RTOS ported onto these robots. We use these robots to show how to build complex applications such as adaptive cruise control, lane merging, automatic parking, etc. Students have even built 'jhadoo-katka' cleaning robots that avoid obstacles while cleaning a 'room'. The excitement of seeing moving robots motivates students to overcome operational problems. They acquire a certain maturity in dealing with a 'real world' where, for instance, the location a robot 'believes it is at' might not be 'where it really is' with respect to a space. Where, for instance, wheels slip and sensors are accurate only within bounds. This experience prepares them for similar concerns encountered when they build real embedded systems that drive cars, fly planes or power future consumer devices.

We have now launched project E-Yantra where our experience is available as course slides, assignments, full documentation and code (along with video demos) of interesting course projects (available on our website http://www.cse.iitb.ac.in/~erts). Our attempt is to create a revolution in the teaching of engineering subjects in colleges through robotics. We have started by selecting a few colleges where we help set up a small robotics lab with 10-15 robots in a project funded by the National Mission on Education through ICT. The candidate institution must commit to using the robots for at least two courses in their curriculum. Our lab gives the initial training needed to start using these robots. Interested colleges may fill an online form at http://www.cse.iitb.ac.in/~erts/ApplicationERTSLab.doc or mail us at anant@ee.iitb.ac.in or call us at +91 90040 94490 and we will take it from there.

Prof. Kavi Arya
Project E-Yantra Coordinator,
CSE Department, IIT Bombay

LIVE TRANSMISSION OF TALKS

Being a premier engineering and science institute of the country, IIT Bombay regularly hosts many talks delivered by persons eminent in their own specialized fields. Such talks include Institute colloquia delivered for a more general audience and more specific lectures delivered at the departmental level for research students.

Listening to eminent scientists and technologists is inspirational. Often these scientists narrate sequences of thoughts and events that led to great breakthroughs in the advancement of science and technology. Descriptions of their labs, the experimental set-up and the organizational aspects of implementation of these projects are equally enlightening. Often such talks bring out the cooperative efforts involved not only among scientists in individual labs but also among laboratories that have specialized capabilities.

Talks also involve engineers, technologists and scientists from the industry who are involved in the development of specific products to meet design criteria and goals set by industries such as those related to space, biotechnology, automobile, chemical, etc. Entrepreneurs relate how simple observations can form the basis for designing and marketing a new product or service.

To share these talks with educators, students and industry professionals, CDEEP has been transmitting live these events through EDUSAT and also webcasting them through the internet. Institutes having Student Interactive Terminals (SITs) of EDUSAT can receive these live transmissions and also interact with the speaker at IIT Bombay by asking and receiving answers in real time.

Last year during the Golden Jubilee celebrations of IIT Bombay, many Nobel Laureates, among others, were invited to share their ideas with the IIT Bombay community and most of these talks were transmitted live. For the schedule of talks, visit http://www.cdeep.iitb.ac.in/events.html. It is also possible to go to the live webcast from this page.

CDEEP'S RECORDED COURSES

Given below is the concluding part of the list of classroom courses of IIT Bombay that have so far been recorded through CDEEP. Of course, every semester we continue to record classroom courses and these will get added to this list.

No.	Course name	Course Instructor	Discipline
61.	Principles of Satellite Image Processing	Prof. B. Krishna Mohan	Centre of Studies in Resources Engineering
62.	Nonlinear Dynamical Systems	Prof. Madhu Belur	Electrical Engineering
63.	Electric Drives	Prof. Kishore Chatterjee	Electrical Engineering
64.	A First Course in Optimization	Prof. Shreevardhan A. Soman	Electrical Engineering
65.	Digital VLSI Design	Prof. Jayanta Mukherjee	Electrical Engineering
66.	Microprocessor Applications in Power Electronics	Prof. Mukul Chandorkar	Electrical Engineering
67.	Hardware Description Languages	Prof. Dinesh K. Sharma	Electrical Engineering
68.	Adaptive Signal Processing	Prof. U. B. Desai	Electrical Engineering
69.	Solid State Microwave Devices and their Applications	Prof. Jayanta Mukherjee	Electrical Engineering
70.	Solar Photovaltic Technologies	Prof. Chetan Solanki	Energy Science & Engg.
71.	Energy Management	Prof. Rangan Banerjee	Energy Science & Engg.
72.	An Introduction to Energy Systems Engg.	Prof. Chetan S. Solanki	Energy Science & Engg.
73.	Reading Fiction	Prof. Sudha Shastri	Humanities & Social Sciences
74.	Discrete Event System Simulation	Prof. J. Venkateswaran	Industrial Engineering and Operations Research
75.	Functions of Several Variables	Prof. B. V. Limaye	Mathematics
76.	Linear Algebra	Prof. B. V. Limaye	Mathematics
77.	Calculus	Prof. I. K. Rana	Mathematics
78.	Complex Analysis	Prof. Anant R. Shastri	Mathematics
79.	Advance Strength of Materials	Prof. S. K. Maiti	Mechanical Engineering
80.	Computational Fluid Dynamics and Heat Transfer	Prof. Atul Sharma	Mechanical Engineering
81.	Robotics	Prof. C. Amarnath	Mechanical Engineering
		Prof. B. Seth	Mechanical Engineering
		Prof. K. Kurien Issac	Mechanical Engineering
		Prof. P. Seshu	Mechanical Engineering
82.	Heat & Mass Transfer	Prof. S. P. Sukhatme	Mechanical Engineering
		Prof. U. N. Gaitonde	Mechanical Engineering
83.	Computational Methods in Fluid and Thermal Engg.	Prof. Atul Sharma	Mechanical Engineering
84.	Thermodynamics	Prof. Kannan Iyer	Mechanical Engineering
85.	Transport Phenomena for Material Engg.	Prof. N. N. Viswanathan	Metallurgical Engineering & Materials Science
86.	Physics	Prof. Dipan K. Ghosh	Physics
87.	Process Automation	Prof. P. S. V. Nataraj	Systems and Control Engg.

Process Automation (SC 620)

In recent years, performance requirements for manufacturing and process plants have become harder to satisfy. Stronger competition, tougher environmental and safety regulations, and rapidly changing economic conditions have been key factors in the tightening of product quality specifications. Efficient process automation and control is recognized as an important means for achieving a competitive advantage through safe and improved plant operation and increased profitability.

Motivated by these industrial demands, a course on process automation is offered at IIT Bombay in the Autumn semester 2009 through CDEEP. The objective of this course is to cover key facets of industrial technology related to automation, control, measurement, instrumentation and reliability of control systems.

The course can broadly be divided into four parts. Part A covers the basics of feedback control. It explains how to select and tune PID controllers (including relay-based autotuners and gain-scheduling controllers) and discusses the limitations of single-loop feedback control. It then looks at the various multiple-loop feedback control strategies widely used in industries, such as cascade, ratio, split-range, selective, and feedforward compensation. Subsequently, tuning techniques for multivariable plants are studied. The module ends with the presentation of several experimental case studies carried out in our laboratory. The case studies give more insight into the practical aspects of the various tuning methods for single-loop and multivariable PID control strategies.

Part B of the course is about the basics of measurement and instrumentation for industrial systems, involving temperature, pressure, flow, and level variables. Part C introduces the basics of industrial automation systems: PLCs and their selection, distributed control systems (DCS), and SCADA. Finally, Part D briefly explains the reliability aspects of plant automation. The topics include the basics of reliability engineering, and reliability analysis of sensors, instruments and control systems.

A basic course on control theory is a prerequisite for those planning to take this course. Participants will also benefit by interacting with industry experts who are invited to deliver lectures on some topics, especially on those related to industrial automation.

Prof. P. S. V. Nataraj
Systems and Control Engineering Group, IIT Bombay
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One of IIT Bombay's projects sponsored by the National Mission on Education through ICT is supporting the creation of open source software (see the May issue of Reach Out for details). Although commercial software is very expensive, free and open source software is still not being used widely, one reason being inadequate documentation. Through spoken tutorials, one can create outstanding documentation, making open source software easily accessible.

A spoken tutorial explains a computer-based activity, step by step, along with a live demonstration of it in parallel. The tutorial captures the changes in the screen in the form of a movie, along with a running commentary by an expert. The following steps are needed to create a spoken tutorial: i) Choose the software to be explained through the tutorial; ii) Construct one or more examples that will help demonstrate the above software; iii) Create a script that pins down the sequence of activities and the accompanying explanation; iv) Choose a software that captures the activities on the screen in the form of a video with an ability to record the accompanying voice input; v) Use an editing program that can trim and polish the video file obtained in the previous step; vi) Suppress the audio and superimpose a running commentary in the desired language. A sample of these tutorials is available at www.moudgalya.org, under the link LaTeX tutorials.

There are many benefits, both pedagogical and socioeconomic, in using spoken tutorials. Listening to directions given by a person experienced in using a particular software is always better than ploughing through written instructions. The student can see the cursor movement accompanied by the spoken explanation and can pause, rewind and play it again for better understanding. Also, the student can try the target software in parallel, as she listens to the spoken tutorial and is therefore not just a passive observer.

The file size of a spoken tutorial is much smaller than that of a video recording, resulting in benefits such as small storage size and small bandwidth for streaming. Also, the infrastructure (head phone with audio input, screen capture software) required to create a spoken tutorial is free or inexpensive. Some software packages that capture the screen in a video file are *CamStudio, xvidcap, jing* and *iShowU*.

As the required infrastructure is minimal, a large number of people can create such tutorials, even for the most complicated programs. Since the running commentary can be in a local language, this potentially can reduce the digital divide between urban and rural India.

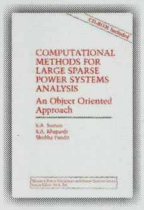
Prof. Kannan M. Moudgalya
Email: kannan@iitb.ac.in

USEFUL LINKS

IIT Bombay homepage	: http://www.iitb.ac.in
Web address of CDEEP	: http://www.cdeep.iitb.ac.in
Web address of NPTEL	: http://www.nptel.iitm.ac.in
All Courses of IIT Bombay	: http://www.iitb.ac.in/acadpublic/Course.html
Live Webcast Courses	: http://www.cdeep.iitb.ac.in/solo
National Mission on Education	: http://www.sakshat.ac.in

BOOKSHELF

Computational Methods for Large Sparse Power Systems Analysis; An Object Oriented Approach



S.A. Soman, S.A. Khaparde & S. Pandit
Kluwer Academic Publishers, 2001
ISBN: 9780792375913

Computational Methods for Large Sparse Power Systems Analysis argues for a paradigm shift from procedural to object-oriented (OO) computation for power-systems analysis. Large power-system computations involve sparse matrices and hence suffer from the curse of dimensionality. This book, however, presents a unified OO treatment for power-systems analysis by emphasizing the use of sparsity exploitation techniques in the OO paradigm to facilitate large scale and fast computing. Sparsity issues including data structures for storing and manipulating sparse matrices, schemes for reducing fills in LU factorization of sparse spd matrices and sparse QR decomposition for large and sparse matrices have been discussed in great detail. Specific applications like large-scale load flow, short-circuit analysis, state estimation and optimal power flow are discussed within this framework.

The chapter on power-system dynamics reviews some dynamic analysis tools for digital simulation and eigen-value analysis. Motivational examples and illustrations are included throughout the book. A library of C++ classes provided along with this book has classes for transmission lines, transformers, substations, etc. A CD-ROM with C++ programs is also included. It contains load flow, short-circuit analysis and network-topology processor applications. Power-system data is provided and systems up to 150 buses can be studied. Large-system modelling of the electricity grid is also critical from the policy perspective where implementation of various market modelling and transmission pricing mechanisms require load-flow analysis. These and related aspects on deregulated power systems, including modelling strategic behaviour of grid-connected entities, hydro-thermal coordination and unit commitment, could be included in the next edition of the book.

Books in this area, apart from the one by Y. Wallach, have not focused on OO programming and large scale systems. This book has combined OO concepts, sparse matrix computing technology, optimization framework and power-system application algorithms very well.

Introductory chapters on basic optimization make this a complete book to teach a one-semester power systems course at the graduate level. It also serves as a useful reference book for advanced researchers.

Dr. Puneet Chitkara
Manager (Market Modelling & Pricing),
Marcodos Energy Markets International

Q & A

1) Do I need to register for Webcast courses?
Yes, register at http://www.cdeep.iitb.ac.in/solo to view the live Autumn '09 courses, free at the scheduled time.

2) If I cannot catch the live lectures, what do I do?
CDEEP will soon make available, free of charge, a Video on Demand facility for this semester's courses. For details, keep visiting our website http://www.cdeep.iitb.ac.in

PROFILE

Prof. Tarun Kant

Prof. Tarun Kant received his B.Sc degree from the University of Allahabad in 1962, followed by B.Tech (Hons), Civil Engineering, IIT Bombay and M.Tech from IIT Kanpur. He joined the Civil Engineering Department of IIT Bombay in 1971 as a faculty member and received his Ph.D degree from IIT Bombay in 1977. He has held important positions in the Institute including that of Chairman JEE-98, Department Head (2000-02) and Dean (Planning) (2001-03).

His research interests lie in the areas of solid mechanics, plates, shells, fibre-reinforced polymer composites, refined higher-order theories, thermal stresses, transient dynamics, finite element and other numerical methods, polymer composites in construction, composite materials and structures, and computational mechanics.

Prof. Kant is a Fellow of the Indian National Academy of Sciences, a Fellow of the Indian Academy of Sciences and a Fellow of the Indian National Science Academy. He is also a recipient of the Prof. H. H. Mathur Award for Excellence in Research in Applied Sciences.

He was twice elected President of the Indian Society of Theoretical and Applied Mechanics and is a founder member of the Indian Association for Computational Mechanics and the Indian Association for Structural Engineering. He is currently an INSA-nominated member on the National Committee of International Union of Theoretical & Applied Mechanics.

Prof. Kant is on the editorial board of four international journals and earlier served on the editorial board of Computational Mechanics. He has supervised 23 Ph.D theses and over 68 M.Tech dissertations. He has more than 120 research papers in refereed journals, edited a set of two volumes entitled *Finite Elements in Computational Mechanics* and co-edited *Advances in Structural Engineering*.

He is also a consultant to many leading organizations and serves on many national research/ advisory/ selection committees and international bodies.

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National Mission on Education through ICT

The National Mission on Education through Information and Communication Technology (ICT) has been launched by the Ministry of Human Resources Development (MHRD) to raise the education levels in the country. It has a total outlay of Rs. 4,600 crore to be spent over a period of three years; 40% of this is for content generation and the balance for establishment of high bandwidth in every one of the 20,000 colleges and 400 universities in India. The details of this Mission may be found at www.sakshat.ac.in or in the January and May issues of Reachout, available at http://www.cdeep.iitb.ac.in/Reachout

Funding is available to any college level educator on any of the eighteen items mentioned in the box on the first page of this newsletter. To receive funding, it is necessary that the project is inter-institutional and the fruits of the project are released as open source. Project proposals may be submitted by going to www.sakshat.ac.in and clicking the link

National Mission on Education through ICT

on the top left hand corner.

The proposal should include a description of the deliverables over a period of three years and also a pilot project that can be demonstrated over a period of about six months. MHRD has established an internet-based reviewing system by a steering committee for quick assessment of projects. Investigators of selected proposals have to make a presentation to the steering committee. MHRD has also established a quick disbursal mechanism for funds. Funding for the main project will be based on the success of the pilot project.

MHRD

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Invites Proposals

Please Visit
http://www.sakshat.ac.in