



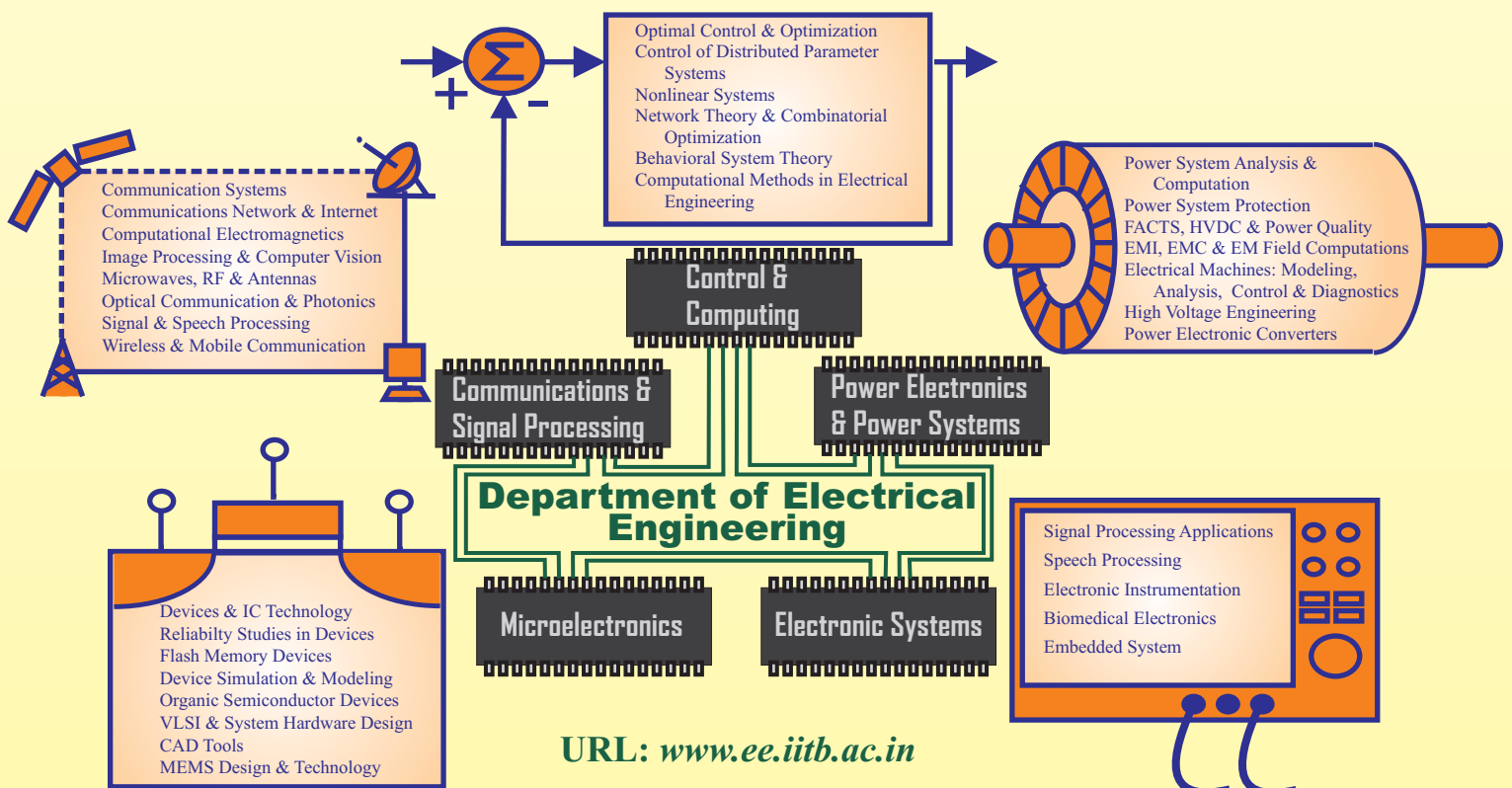
Celebrating Golden Jubilee 1958-2008

Trust With Excellence



Department of Electrical Engineering

Indian Institute of Technology Bombay



Introduction

Indian Institute of Technology Bombay, Mumbai was established in 1958, and the department of Electrical Engineering has been one of the key departments of the institute since its inception. The department has expanded steadily over the last few decades and is now recognized as one of the leading academic and research centers in the world. The department is engaged in a wide spectrum of established and emerging electrical engineering disciplines.

The department has five research groups: **Communications and Signal Processing**, **Control and Computing**, **Power Electronics and Power Systems**, **Microelectronics** and **Electronic Systems**. Also, due to the ubiquitous nature of this branch, the department has substantial interaction with other engineering disciplines. The department has strong links with academia and industry across the world. State of the art computational and experimental facilities enable the department to undertake basic and applied research and provide support to R&D organizations. The faculty is actively engaged in providing solutions to industry problems as consultants. The academic programs of the department are rated very highly in the country. The graduating students are well placed in leading academic institutes, research organizations and industries.

Vision

To be the fountainhead of new ideas and innovations in technology and science.

Mission

To create an ambience in which new ideas, research and scholarship flourish and from which the leaders and innovators of tomorrow emerge.

Goals

To be one of the leading electrical engineering departments in the world and to be known for research, creation of knowledge base, education, industry interaction and entrepreneurial activity.

Academic Programs

The department offers a comprehensive B. Tech program in Electrical Engineering and an intensive M. Tech program in each of the five specializations. The department was pioneer in initiating the five year Dual Degree program (B. Tech + M. Tech degrees) in the specializations of microelectronics and communications. The Ph.D. program offers exciting opportunities for research in emerging areas. Post Doctoral Fellowships are also offered in select areas.

Student Initiatives

The department has a very active students' association (EESA) which organizes various social events, talks by guest speakers and senior students, maintains a well equipped hobby room and coordinates mentor programs for junior students throughout the year. The feather in its cap is an annual two-day event, AAGOMANI, consisting of a workshop and lecture series covering select upcoming fields in electrical engineering, which has become a platform for confluence between the industry, faculty and students over the past few years.



Campus Facilities

IIT Bombay has a picturesque evergreen campus spanning 220 hectares, which lies between Powai Lake, Vihar Lake and hills to the north. The campus is recognized by the Bombay Natural History Society for bird watching with around 120 species of birds. IIT Bombay is a township in itself with most of the 10,000 strong community of students, faculty and staff residing on the campus. The campus has a wide range of facilities including a gymkhana, swimming pool, hospital, guest house, banks, schools, restaurant and one of the best technical libraries in the country. IIT Bombay has a vibrant culture covering all major sports and cultural activities and the annual calendar is packed with competitive, social and entertainment events. IIT Bombay organizes Mood Indigo and Techfest (leading cultural and technology festivals in India, respectively), in addition to a number of cultural, technical and entrepreneurial festivals annually.

Additionally, the Electrical Department has its own library, study rooms, conference rooms, a PC laboratory for general computer usage and a refreshment counter. The department is wi-fi enabled.



Laboratory Facilities

The department is well equipped with numerous laboratories covering all disciplines of Electrical Engineering, the main among which are:

- Bharti Centre for Communication
- Antennas and Microwave Laboratory
- Communications Laboratory
- Digital Audio Processing Laboratory
- Fiber Optic Communications Laboratory
- Information Networks Laboratory
- Multimedia Signal Processing Laboratory
- Networking Laboratory
- SPANN Laboratory
- L. R. Gadre Wireless Complex
- DSP Laboratory
- Vision and Image Processing Laboratory
- Control and Computation Laboratory
- Field Computation Laboratory
- Electrical Machines Laboratory
- Power Electronics Laboratories
- PowerAnser Laboratory
- Power System Laboratory
- Insulation Diagnostics Laboratory
- Fabrication Clean Room
- VLSI Laboratory
- Microelectronics Characterization, Simulation and Computation Laboratories
- Applied Materials Nano-manufacturing Laboratory
- Wadhvani Electronics Laboratory
- Signal Processing and Instrumentation Laboratory
- Texas Instruments Digital Signal Processing Laboratory
- Printed Circuit Board Laboratory

Sponsored Projects

A large number of sponsored research projects are handled in the department. The fields which have been covered in recent years include: Digital Communication, Signal Processing, Cross Layer Design Issues, Communication Networks, Speech, Image and Video Processing, Broadband Wireless Networks, Teletraffic Modeling and QoS Guarantees in

Internet, Design and Development of VoIP Gateways, National QoS Testbed Project, Numerical Issues in Controller Design, Distributed Generation and Renewable Energy Sources, Co-ordination of Protective Relays for Meshed Power Systems, DSP based Power Electronics Applications, Real-time Simulator for Power System and Power Electronics, Field Computations in Electrical Machines, EMI/EMC Issues, Demonstration Facility using Scaled Models for Power System Dynamics, Development of Web-Server for Power System Computations, Sensors and Detectors, Circuit Simulators, Design of Ultra Low Power Custom Circuits, Fault Simulation Acceleration using FPGA, RF Models for CMOS, Reliability and Impact of Technology Scaling.

The major funding agencies include: DRDO, ISRO, DST, MHRD, MCIT, BARC, SAMEER, ERNET, Bharat Electronics Ltd., SBI, BRNS, ARDB, MTNL, BSNL, ECIL, DAE, L&T Infotech, Texas Instruments, Intel, Microsoft Research, TCS, EU,



Applied Materials (USA), Hitachi (Japan), Agere Systems (USA), Institute of Microelectronics (Singapore).

Among the upcoming facilities, the Centre for Excellence in Nanoelectronics is a major initiative by the Ministry of Communications and Information Technology. The ministry is investing over Rs. 50 crores over the next 5 years to set up a state-of-the-art facility for nano-fabrication and advanced semiconductor device characterization. Through additional resources and industry inputs, a Rs. 100 crore experimental Nanoelectronics facility is currently being built at IIT Bombay, which will be a unique facility in the country. Similarly, with generous funding from Tata Teleservices, the Centre of Excellence in Telecommunications Research is being established.

Consultancy Projects

Faculty members of the department are actively involved in consultancy projects. The fields covered in recent years include: Network Planning and Design including Wireless Networks, Broadband Access Networks, Performance Analysis of Networks, Manpower training in Wired/Wireless Communication Networks, Power System Planning and Studies, Power Electronic Simulations and DSP Implementations, Power System Restructuring, Finite Element Computations for Electrical Machines, VLSI System Design Methodologies, VLSI CAD Tools, Simulation of MEMS, Reliability of Devices.

The industry and research organizations that have entrusted us with consultancy projects include: Freescale Semiconductors, Cirrus Logic Software, Tata Infotech Ltd., National Securities Depository Ltd., Feedback Electronic System Ltd., MTNL, SwitchOn Networks, Tata Consultancy Services, Axes Technologies, Cradle Technologies, L&T Infotech, CMC Limited, DRDO, ISRO, SAMEER, BSNL, Renesas Technologies, Xilinx Inc., IBM Global Services Ltd., Cadence Design Systems, Connexant Systems, Tata Consulting Engineers, MSEDCL, CGL.

Research Collaborations

There are many collaborative research projects in progress in the department at all times. The fields covered in recent years include: Wireless Communication, Sensor Networks, Multi Media Information Retrieval, Image and Video Processing, QoS and Security Issues in Wireless Networks, Control and Performance Modeling of Wireless Networks, FinFETs for sub 45 nm Technologies, TCAD Simulations and Modeling for Novel Technologies, Polymer Electronics, RADFETS for Medical Applications, I/O Devices.

The organizations that have collaborated with the department in the recent past include:

International: University of California, Los Angeles (USA), IMEC (Belgium), Tokyo Institute of Technology, EPFL (Switzerland), University of Florence (Italy), University of Trento (Italy), Technical University of Munich (Germany), Groningen University (Netherlands), University of Peradeniya (Srilanka), Intel (USA), Adobe (USA), University of Washington, St. Louis (USA), Texas Instruments, Infineon (Germany).

National: SITAR, CPRI, WRLDC, DRDO, MHRD, BARC, NPCIL, BHEL, TISCO, TCS, REL, CGL, CBIP, Planning Commission, Ministry of Information Technology, National Mission on Power Electronics Technology.



Incubation

In the last decade, a number of faculty members (along with select bright students) have started entrepreneurial ventures. The most noteworthy success stories have been: SwitchOn Networks, Powai Labs, Eisodus Networks, Vegayan Systems and Wilcom Pvt. Ltd.

Educational Outreach

The department regularly conducts Continuing Education Program (CEP) courses as well as delivers video courses, which have been of great benefit to the industry, government organizations as well as other educational institutes. The topics covered in recent years include: Signal Processing, Wavelets, Fibre Optics, Broadband Networks, Nonlinear Systems, Numerical Methods in Electromagnetics, Power System Dynamics and Control, Finite Element Computations for Electrical Machines, Electrical Machines and Drives, DSP Implementations in Power Electronics, Power System Protection, Nanotechnology, Nanoelectronics, VLSI and Electronics Design, Sensors and Bio-sensors for Robust Security, TRIZ and TAGUCHI Methods.

Under the National Programme on Technical Enhanced Learning (NPTEL), the faculty members have developed web and video courses on various subjects in electrical engineering. These courses are available with Centre for Distance Engineering Education Programme (C-DEEP).

Distinctions and Awards

Faculty members of our department have sterling achievements



at both the national and international levels. We as a department are privileged to have with us:

- Recipients of Shanti Swarup Bhatnagar Prize, Swarnajayanti Fellowship, Prof. K. Sreenivasan Memorial Award, Prof. SVC Aiyar Memorial Award, Dr. Vikram Sarabhai Research Award, Ram Lal Wadhwa Award, INAE Young Engineer Award, Alexander von Humboldt Fellowship, among many others
- Editors of IEEE and other national and international journals
- Fellows of organizations like IEEE, IETE, INAE, IASc, NASI, INSA
- Invitees to Distinguished Lectures, Keynote Speeches and Session Chairs at various international and national conferences.

Publications & Patents

Faculty members of the department are well known in both national and international research communities. The Electrical Engineering Department consistently publishes approximately 90 journal papers and 100 conference papers every year. Faculty members of the department have published a number of text books and reference books with reputed international and national publishers. Faculty members also contribute approximately 5 book chapters every year and frequently patent new ideas and techniques based on their research work.



Alumni

The alumni of the department have achieved excellence at the national and international level in all walks of life: academics, administration, management, business, entrepreneurship and social responsiveness. A number of such alumni members have also donated generously for the cause of the department.

Contact

Prof. Subhasis Chaudhuri,
Head, Department of Electrical Engineering,
IIT Bombay, Powai, Mumbai 400076, India.
Email: head@ee.iitb.ac.in, eeoffice@ee.iitb.ac.in
Phone: (91-22) 2576-7401, 2576-7400
Fax: (91-22) 2572-3707
URL: www.ee.iitb.ac.in

Communications and Signal Processing Specialization

Department of Electrical Engineering
Indian Institute of Technology Bombay

www.ee.iitb.ac.in/~comgroup/

Faculty and Research Areas

Prof. P. Chaporkar: Resource Allocation and Scheduling in Wired/Wireless Networks, Optimization and Control of Stochastic Systems, Distributed Systems and Algorithms

Prof. Subhasis Chaudhuri: Computer Vision, Image Processing, Pattern Recognition, Multimedia and Biomedical Signal Processing

Prof. U. B. Desai: Signal Processing, Wireless Communication (Multiuser Detection), Adaptive Signal Processing, Image and Video Processing, Wavelets, Biomedical Signal and Image Processing, Artificial Neural Networks

Prof. Bikash Kumar Dey: Error Correcting Codes, Wireless Communication, Signal Processing

Prof. V. M. Gadre: Communications and Signal Processing with emphasis on Multiresolution and Wavelet based Methods

Prof. Abhay Karandikar: Control and Performance Modeling of Wireless Networks, Quality of Service and Resource Allocation in Wired/Wireless Networks, Digital Communication Theory, Practical Aspects of Networking

Prof. Girish Kumar: Microstrip Antennas and Arrays, Broadband Antennas, Microwave Integrated Circuits, EMI/EMC, RF communication Circuits, Jammers, Signal Enhancers, RFID

Prof. D. Manjunath: Computer and Communication Network Protocols, Systems and Algorithms Performance Modeling, Queueing Theory and Simulation, Stochastic Systems

Prof. S. N. Merchant: Signal Processing, Detection and Tracking, Wireless Communication, Image and Video Processing, Wireless Sensor Networks

Prof. H. Narayanan: Building Large Scale Circuit Simulators, Combinatorial Optimization including Submodular Function Theory, Large Scale System Partitioning

Prof. P. C. Pandey: Speech and Signal Processing, Sensory aids for the Handicapped, Biomedical Electronics, Instrumentation Electronics, and Electro-Acoustics

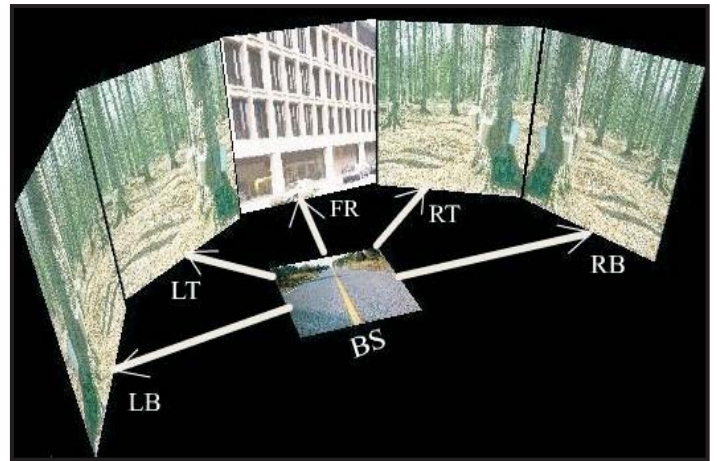
Prof. H. K. Pillai: Control Theory, Optimal Control, Coding Theory, Optimization Techniques

Prof. Preeti S. Rao: Speech and Audio Signal Processing, Digital Signal Processing, Coding of Speech at Low Bit Rates

Prof. Girish P. Saraph: Communication Networks, RF Electronics and Wireless Communication, High Power Microwave Sources and Radars, Fiber Optics and Optical Networks

Prof. R. K. Shevgaonkar: Fibre Optic Communication, Photonics, Non-linear Fibre Optics, Antennas, Image Processing, Radio Astronomy, Wireless Communication

Prof. R. Velmurugan: Statistical and Digital Signal Processing, Signal Processing System Design, Particle Filter Applications and Target Tracking Systems



Laboratories

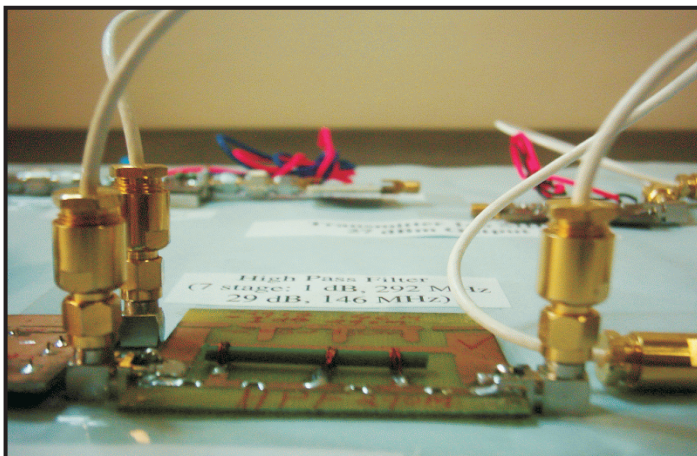
Communications and Signal Processing Group at IIT Bombay focuses research on Digital Signal Processing, Multimedia, Communication Networks, Wireless Networks, Antennas, Microwaves, Fiber Optics, etc. The associated laboratories are: Antennas and Microwave Laboratory, Communication Laboratory, Digital Audio Processing Laboratory, Fiber Optic Communication Laboratory, Information Networks Laboratory, Multimedia Signal Processing Laboratory, Networking Laboratory, Signal Processing and Artificial Neural Networks Laboratory, Texas Instruments DSP Laboratory, Vision and Image Processing Laboratory, L. R. Gadre Wireless Complex, Bharti Centre for Communication.

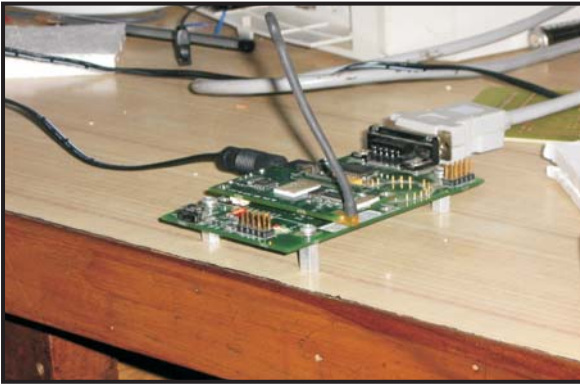
Sponsored Projects

Faculty members of this group undertake various sponsored research and development projects in the broad areas of Communication, Signal Processing, Networking, Speech and Image Processing, etc. Some of the major sponsoring agencies/industries include DST, DRDO, ISRO, SAMEER, ERNET, Bharat Electronics Ltd., SBI, BRNS, ARDB, MTNL, BSNL, ECIL, DAE, MHRD, L&T Infotech, Texas Instruments, Intel, Microsoft Research, Adobe and Siemens.

Consultancy Projects

Along with teaching and research, faculty members of this group also provide consultancy to industries and research organizations like Freescale Semiconductors, Cirrus Logic Software, Tata Infotech Ltd., National Securities Depository Ltd., Feedback Electronic System Ltd, MTNL, SwitchOn Networks, Tata Consultancy Services, Axes Technologies, Cradle Technologies,





L&T Infotech, CMC Limited, DRDO, ISRO, SAMEER, BSNL, etc., through Industrial Research and Consultancy Centre (IRCC) of IIT Bombay.

Collaborations and Other Activities

The group members have been collaborating actively with industry and leading international universities in the following fields: Wireless Communication, Sensor Networks, Multi Media Information Retrieval, Image and Video Processing, QoS and Security issues in Wireless Networks, Control and Performance Modeling of Wireless Networks.

Some of the industries involved in collaborations are: Freescale Semiconductors, Cirrus Logic Software, Tata Infotech Ltd., National Securities Depository Ltd., Feedback Electronic System Ltd, MTNL, SwitchOn Networks, Tata Consultancy Services, Axes Technologies, Cradle Technologies, L&T InfoTech, CMC Limited, Siemens, Tata Consultancy Services, Texas Instruments, Intel, Bharati Telecom, PACE Soft Silicon, Patni Computers, RIMO Technologies, Verifone, Analog Devices, GE Corporate R&D Center, Microqual Techno (P) Ltd, etc.

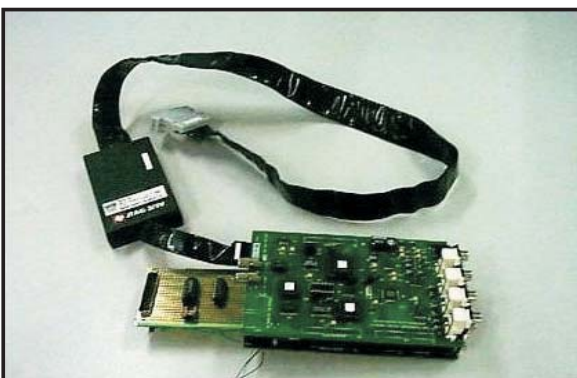
Universities/Joint Research Programme: Some of the examples of joint research works with international universities are: EPFL (Switzerland), University of Florence (Italy), University of Trento (Italy), Technical University of Munich (Germany).

Incubation

Apart from research, faculty members of this group are also keen to convert research ideas into marketable products; the incubation companies Eisodus Networks, Vegayan Systems, Wilcom Pvt. Ltd., etc., are testimony to the same.

Education Outreach

In addition to the regular academic courses faculty members of this group are involved in various continuing education programmes in



the areas of Networking, Internet, Quality of Services, Wireless Communication, Next Generation Networks, Wavelets, Signal Processing, Image Processing, etc., for industries and research organizations.

In addition to these, the faculty members are actively involved in developing various video course modules in the areas of Electromagnetic Waves, Signal Processing, Adaptive Signal Processing, Wavelets, Fibre Optics, Broadband Networks, etc., through the Centre for Distance Engineering Education Program (C-DEEP) of IIT Bombay.

Distinctions and Awards

Faculty members of Communications and Signal Processing group have been awarded with various national and international prizes like Excellence in Teaching Award at IIT Bombay, Bhatnagar Prize, Swarnajayanti Fellowship, P. K. Patwardhan Award, Prof. K Sreenivasan Memorial Award, Prof. SVC Aiya Memorial Award, Dr. Vikram Sarabhai Research Award, Ram Lal Wadhwa Award, Alexander von Humboldt Fellowship, etc. Along with these awards, faculty members of this group have also received other distinctions like being Fellows of IETE, INAE, NASc, IASc, INSA, etc.

Faculty members of this group are also involved in chairing various national and international conferences, seminars. They are also members of IEEE, IETE etc. Many faculty members are regularly invited for talks, keynote speech, chairing sessions, tutorials, etc., at reputed national and international conferences like NCC, IEEE Globecom, IEEE Milcom, IEEE Infocom, ICCV, ICPR, etc.



Publications

Faculty members of this group regularly publish their research work in various journals, conferences, and workshops of national and international repute. Some of their publications have also received awards at these seminars and conferences. Faculty members are also involved in patenting their work through Indian and International agencies.

Following books have been authored/edited by the members of this group: Multifractal Based Network Traffic Modeling (Kluwer Academic Publishers), Broadband Microstrip Antennas (Artech House), Bayesian Approach to Image Interpretation (Kluwer Academic Publishers), Communication Networking: An Analytical Approach (Morgan Kaufman Publishers), Transmission Lines (Tata McGraw Hill), Electromagnetic Waves (Tata McGraw Hill), Depth from Defocus: A Real Aperture Imaging Approach (Springer Verlag), Super-Resolution Imaging (Kluwer Academic Press), Motion-Free Super-Resolution (Springer Verlag), Modelling and Application of Stochastic Processes (Kluwer Academic Press).

Control and Computing Specialization
Department of Electrical Engineering
Indian Institute of Technology Bombay
www.ee.iitb.ac.in/~ccgroup/

Faculty and Research Areas

Prof. S. D. Agashe: Control Theory, Network Theory, Optimal Control, History of Mathematics and Control, Stability Theory, Speech Analysis

Prof. Madhu N. Belur: Dissipative Systems, Behavioral Theory of Control, Adaptive Control, Numerical Aspects, Hybrid Dynamical Systems, Fault Diagnosis

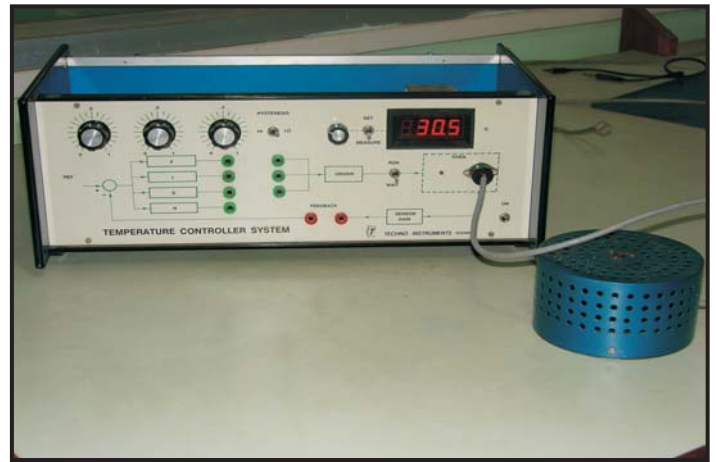
Prof. Prasanna S. Chaporkar: Control of Stochastic Systems, Optimization, Information Theory, Resource Allocation in Data Networks

Prof. Subhasis Chaudhuri: Multimedia, Computer Vision, Image Processing, Pattern Recognition, Biomedical Signal Processing

Prof. U. B. Desai: Signal Processing, Wireless Communication (Multiuser Detection), Adaptive Signal Processing, Image and Video Processing, Wavelets, Biomedical Signal and Image Processing, Artificial Neural Networks

Prof. Bikash Kumar Dey: Error Correcting Codes, Wireless Communication, Signal Processing

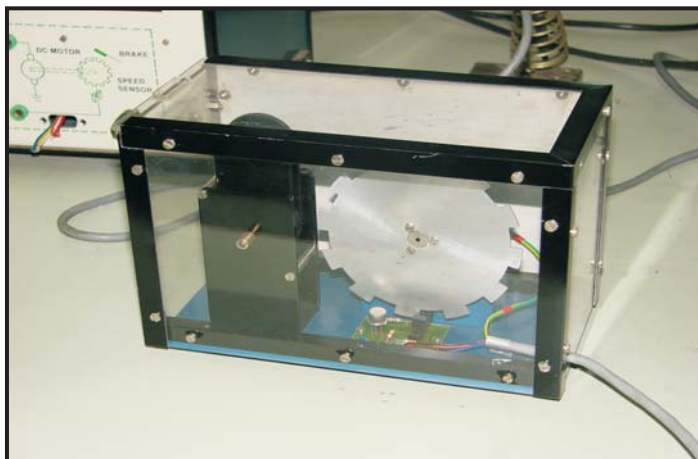
Prof. V. M. Gadre: Communications and Signal Processing with Emphasis on Multiresolution and Wavelet based Methods



Prof. Sachin Patkar: Combinatorial Optimization, Algorithms Design and Analysis, Graph Theory, Geometric Design and Graphics

Prof. Harish K. Pillai: Control Theory, Behavioral Theory of Systems, Multidimensional Systems, Nonlinear Systems, Generalized Linear Complementarity Systems, Coding Theory, Optimization Techniques

Prof. S. A. Soman: Operational Research Application with Reference to Planning and Pricing Issues in Power Systems, Numerical Relaying and Wide Area Measurements



Laboratories

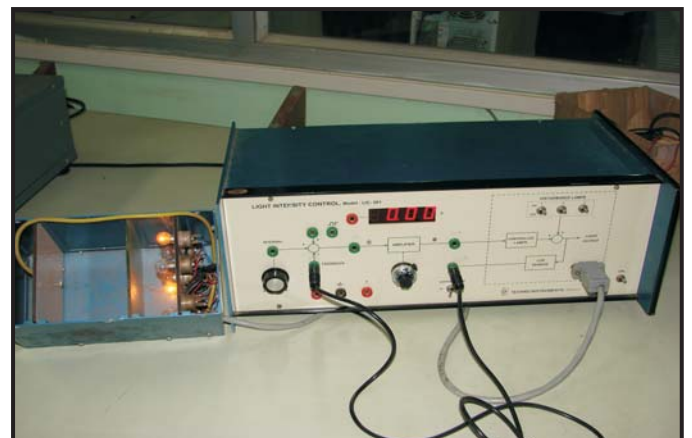
Control and Computing Laboratory: This laboratory provides computational as well as experimental facilities for research in the group. The laboratory has a three tank level control setup, an inverted pendulum control setup, and motor position/speed control setups, among others. For computation and simulation purposes, packages like Scilab, LabVIEW, Matlab, Mathematica, Maple, Ansys and Mupad are available. The laboratory also maintains a Softjain library of reference books related to control theory and computational methods.

Prof. Abhay Karandikar: Control and Performance Modeling of Wireless Networks, Quality of Service and Resource Allocation in Wired/Wireless Networks, Digital Communication Theory, Practical Aspects of Networking

Prof. S. V. Kulkarni: Transformer Design, Analysis and Diagnostics, Electromagnetic and Coupled Field Computations, Distribution Automation and Distributed Generation

Prof. Vishwesh Kulkarni: Mathematical Programming, Synthetic and Systems Biology, Nonlinear Control Systems, Sensor Networks

Prof. H. Narayanan: Combinatorial Optimization including Submodular Function Theory, Large Scale System Partitioning



PowerAnser Laboratory: In this laboratory, modeling, computation, and software development are carried out in transmission and distribution system planning and pricing, optimal power flow, load forecasting, numerical relaying and relay co-ordination.

Field Computation Laboratory: It has state-of-the-art software for field computation of electrical machines. The laboratory is intended for conducting research in electromagnetic and coupled field systems.



Sponsored Projects

Control and Computing Group at IIT Bombay is a unique blend of control theory and computational and algorithmic aspects arising in Electrical Engineering. The research areas include dissipative systems, hybrid control, coding theory, cryptography, behavioral approach, numerical aspects of algorithms and hardware implementation of computations. Projects and activities in these areas have been funded by DST, MHRD, Texas Instruments, Softjin, Naval Research Board, DRDO and Bharti Foundation.

Collaborations

Some of the faculty members maintain an active collaboration with University of Groningen (Netherlands), University of Southampton (UK), IIT Delhi, University of Pennsylvania (USA) among others. These collaborations have also resulted in some eminent personalities visiting IIT Bombay and giving a series of lectures about current research areas.

Education Outreach

Teaching by group members has not been limited to just students of IIT Bombay, but has been accessible to academic and research institutions

elsewhere and several industries also. Through Continuing Education Programmes (CEP), Eklavya Technology channel and the recent NPTEL project, it has been possible to make lectures available to a wide audience. The main areas of these courses have been nonlinear dynamical systems, wavelets, broadband networks, computational electromagnetics, history of feedback control and Einstein's theory of relativity.

Distinctions and Awards

Members of the group have been awarded with various national and international awards like Excellence in Teaching at IIT Bombay, Bhatnagar Prize, Swarnajayanti Fellowship, Prof SVC Aiya Memorial Award, Prof. K Sreenivasan Memorial Award, Dr. Vikram Sarabhai Research Award, Ram Lal Wadhwa Award, Alexander von Humboldt Fellowship, INAE Young Engineer Award, etc. Along with these awards, group members have also received other distinctions like Fellow of IETE, INAE, NASc, IASc, INSA, etc.

Group members are often involved in chairing various national and international conferences, seminars. They are also members of IEEE, IETE, etc. Many faculty members are regularly invited for talks, keynote address, tutorials, and as plenary speakers at reputed national and international conferences.

Publications

Research in the group has been published in several reputed international and national journals as well as conferences. Some contributions arising from the group which have been fundamental in the development of the concerned theory are in the area of dissipative systems, multidimensional systems analysis and control, Einstein's theory of relativity, matroid theory, combinatorial optimization, principal graph partitioning, approximate algorithms, depth recovery in image processing, information theory and its relation to thermodynamics. The contributions in these foundational issues are a result of the emphasis on the theoretical as well as the computational aspects in Control and Electrical Engineering.



Power Electronics and Power Systems Specialization
Department of Electrical Engineering
Indian Institute of Technology Bombay
www.ee.iitb.ac.in/~peps/

Faculty and Research Areas

Prof. Vivek Agarwal: EMI/EMC Issues, Non-Conventional Energy Processing Techniques, Power Quality

Prof. M. C. Chandorkar: Power Electronics, Power Quality, Static Compensation, Motor Drives

Prof. Kishore Chatterjee: Utility Friendly Converter Topologies, Power Factor Correction Techniques, STATCOM, Switched Mode Rectifiers, Electronic Ballast, Control of Electric Drives

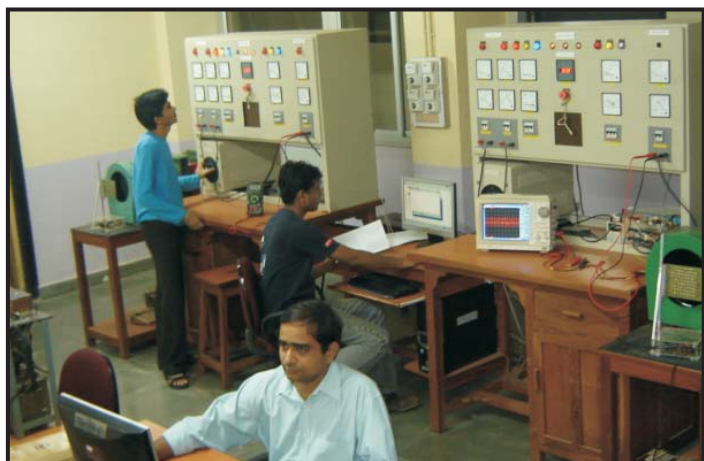
Prof. B. G. Fernandes: Permanent Magnet Machines and Drives, Soft Switched Converters, Power Electronic interfaces for Non-conventional Energy Sources

Prof. S. A. Khaparde: Transmission Line Expansion Planning, Transmission Pricing, Distributed Generation and Micro Grids, Financial Transmission Rights

Prof. A. M. Kulkarni: Power System Dynamics, FACTS and HVDC Transmission

Prof. S. V. Kulkarni: Transformer Design, Analysis and Diagnostics, Electromagnetic and Coupled Field Computations, Distribution Automation and Distributed Generation

Prof. S. A. Soman: Operational Research Application with Reference to Planning and Pricing Issues in Power Systems, Numerical Relaying and Wide Area Measurements

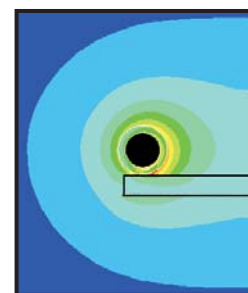
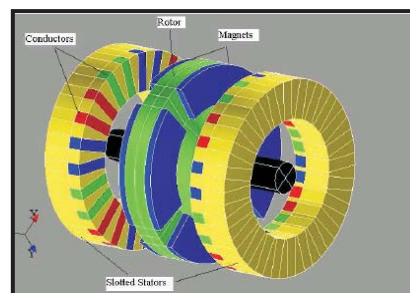


Laboratories

Electrical Machines Laboratory: The laboratory has experimental setups of electrical machines and their drive panels. Undergraduate students learn basic principles of electrical machines through experiments here.

Power Electronics Laboratories: These laboratories have state-of-the-art equipment, instruments and computational facilities for research in power electronics, machines and their control.

Applied Power Electronics Laboratory: The laboratory supports research on renewable energy sources, their power conditioning and interconnection with the grid. Photovoltaic and fuel cell sources are available for experimentation. Facilities are also available for EMI/EMC testing of electronic and power electronic systems. Other activities include power quality improvement, design and



development of new power converter topologies and electronic systems design.

Power System Laboratory: This laboratory houses a demonstration facility for power systems using scaled models of power system components.

PowerAnser Laboratory: In this laboratory, modeling, computation, studies and software development are carried out in the areas of transmission and distribution system planning and pricing, optimal power flow, load forecasting, numerical relaying and relay co-ordination.

Field Computation Laboratory: The laboratory has state-of-the-art software for field computation of electrical machines. The laboratory is intended for conducting research in electromagnetic and coupled field systems.

Insulation Diagnostics Laboratory: This recently developed laboratory has a 100 kV AC/140 kV DC setup. It is also equipped with a partial discharge measurement setup.

Sponsored Projects

The group faculty members undertake sponsored projects in several areas. These include EMI/EMC issues in electronic and power electronic systems, distributed generation, micro grid, renewable energy sources, line start permanent magnet synchronous motors, DSP based sensorless AC drives, real-time simulation of power system and power electronics systems, flexible low cost DSP/FPGA platform for power electronics control implementation, single phase single switch AC to DC converters, power system deregulation, co-ordination of over-current and distance relays for meshed power systems in object oriented paradigm, demonstration facility using scaled models for power system dynamics, HVDC and FACTS, distribution automation and field computations for electrical machines.

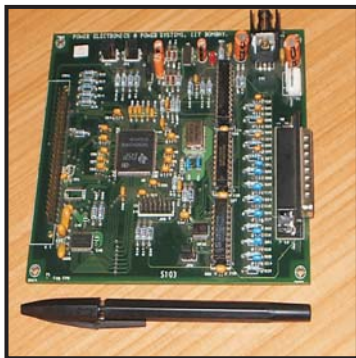




Consultancy Projects

The group continues to have close interactions with several industries and government organizations. These include CPRI, WRLDC, DRDO, MHRD, BARC, NPCIL, BHEL, MERC, TISCO, TCS, REL, CGL, CBIP, Planning Commission, and Ministry of Communications and Information Technology. Faculty members have carried out several consultancy projects for various industries. These consultancy projects are broadly in the following areas:

Power Electronics: Modeling of devices, DSP based DC drives, advanced static VAR compensator control development, high power factor electronic ballast, and single phase STATCOM for railway applications.

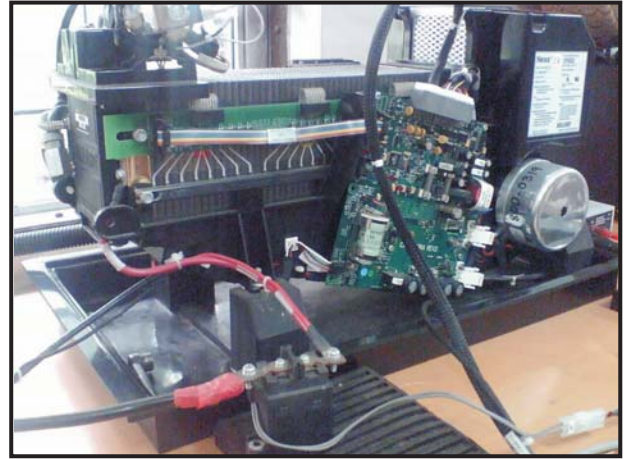


Power Systems: Developing criteria for allocating additional distribution outlets, load flow and expansion planning studies, transmission system planning for short term load forecasting, development of numerical relay for railway traction applications, design of technical specifications for low tension load management system, SSR studies for Jeypore-Rengali project, fast load transfer study for power plant loads, power system stabilizer tuning in western grid, Kanpur-Ballahgarh TCSC controller design, analysis and optimization of insulation design in power transformers, computation of induced voltages in parallel transmission lines, analysis of transpositions on 400 kV transmission line, computations of electric and magnetic fields, and unbalanced voltages for transmission lines, estimation and control of circulating currents in power transformer clamping structure, and theory and applications of low frequency electromagnetics.

Collaborations and Other Activities

The group has collaborations with various industries, research organizations, and universities. The PowerAnser Laboratory has been established in collaboration with TCS to conduct R&D activities and develop web-services for power system network analysis functions. The group has active role in National Mission on

Power Electronics Technology, an initiative of the government's Department of Information Technology. The group also administers *inpowerg*, a mail group consisting of power engineering professionals in India. Group faculty members have also advised the Maharashtra Electricity Regulatory Commission. The Group has organised several conferences, such as the International Conference on Power Systems in Kathmandu, Nepal, in 2004 (in collaboration with Tribhuvan University, Nepal), and the National Power Electronics Conference in 2003.



Education Outreach

The group has conducted many Continuing Education Programs (CEP) for industry and government personnel. It has also conducted a few courses for college teachers. CEP courses have been in areas such as transformers, computational electromagnetics, finite element method, power electronics, power system operation and control, HVDC converters and control, power system stabilizer tuning, power system dynamics and protection, electric drives, power quality, and power system deregulation. Under the National Programme on Technical Enhanced Learning (NPTEL), two web courses, namely, Power System Protection and Power System Operation and Control have been prepared and are available. One video course on power electronics has been telecast on Eklavya Technology Channel on television.

Distinctions and Awards

Several faculty members from this group have received awards such as the IIT Bombay Excellence in Teaching Award, the INAE Young Engineer Award, the AICTE Career Award for Young Teachers, and best paper awards in international conferences.

Publications

Faculty members and students publish their research work regularly in reputed international journals and conferences. Two books have been published by the group faculty members: 'Computational Methods for Large Sparse Power System Analysis: An Object Oriented Approach' (Kluwer Academic Publishers) and 'Transformer Engineering: Design and Practice' (Publisher: Marcel Dekker, Taylor & Francis Group).



Microelectronics Specialization
Department of Electrical Engineering
Indian Institute of Technology Bombay
www.ee.iitb.ac.in/~microel/

Faculty and Research Areas

Prof. Prakash R. Apte: MEMS, Reliability

Dr. Maryam S. Baghini: Analog/Mixed-signal IC Design, Circuit and System Design Challenges in Nano Scale, VLSI Design and Embedded Systems

Prof. S. Chakrabarti: Growth, Characterization and Fabrication of III-V Devices, Nanotechnology

Prof. A. N. Chandorkar: Analog, Mixed Signal and RF VLSI Design, VLSI Devices, Technology and Reliability, Power Electronic Systems, Optically Switched Microwave Components, Sensors, System Packaging

Prof. M. P. Desai: VLSI Design (Circuits and Systems) and Design Automation, Graph Theory and Combinatorics

Prof. Siddhartha P. Duttgupta: Microsystems, Microfabrication

Prof. A. G. Kottantharayil: CMOS Device Physics, Design and Modeling, Materials for Advanced CMOS Devices, Electrical Characterization, Reliability

Prof. R. K. Lal: Device Physics, Defect Characterization, Instrumentation Electronics, Biomedical Electronics

Prof. Souvik Mahapatra: Flash EEPROMs, SONOS, Nanoparticle Storage, NBTI and Hot Carrier Degradation in MOSFETs, High-k Gate Dielectrics, Advanced CMOS Device Reliability

Prof. Jayanta Mukherjee: RF VLSI Design, Analog VLSI Design, Noise Modeling

Prof. H. Narayanan: Building Large Scale Circuit Simulators, Combinatorial Optimization, Submodular Functions, Large Scale System Partitioning

Prof. M. B. Patil: Semiconductor Device Modelling for Circuit Simulation, Mixed-mode Circuit Simulation

Prof. Sachin Patkar: Combinatorial Optimization, Algorithms Design and Analysis, Graph Theory, Geometric Design and Graphics

Prof. R. Pinto: Silicon Devices, Bio-MEMS

Prof. V. Ramgopal Rao: Nanoelectronics, Emerging CMOS Technologies, Physics, Technology and Characterization of sub 100 nm CMOS Devices, Reliability, Bio-MEMS



Prof. D. K. Sharma: MOS Device Modeling, VLSI Design and Technology, Microelectronics - Technology and Device Characterisation, Mixed Signal Design

Prof. Juzer Vasi: MOS Insulators, Novel MOS Devices for ULSI Applications, Degradation and Reliability, Modeling and Simulation

Laboratories

Fabrication Laboratory: Class 100/1000 Clean Room with full CMOS line

VLSI Laboratory: Design Environments, Simulators, Verification Tools, Logic Synthesis (FPGA, ASIC), Backend Tools, FPGA Kits, IMAGE Emulation System

Characterization Laboratory: Complete range of Automated Equipment for advanced CMOS, Bipolar and Circuit Characterization

Microelectronics Computation Laboratory: 3-D and 2-D Process/Device Simulators

Computation and Simulation Laboratory: A Wide Range of Simulators (Process, Device, Circuit), Design Synthesis and Analysis Tools

Sponsored & Consultancy Projects

Faculty members have recently undertaken projects in the following fields: optimization of power transistors (International Rectifier Corporation/Vishay Siliconix), radiation sensors/silicon drift detectors (BARC/ISRO), impact of technology scaling on metastability in CMOS latches (Intel), design of ultra low power multi-lead ECG recorder chip (TCS), nanocrystals and charge trap flash EEPROMs, reliability of oxynitride devices (Applied Materials, USA), reliability of flash and logic devices (Renesas Technologies), a circuit simulator using the look-up table approach (Department of Science and Technology, Govt. of India), SEQUEL: a simulator for real-time and off-line simulation of power systems and MEMS (Ministry of Communications and Information Technology, Govt. of India, Intellisense Software Corp.), RF model for submicron CMOS transistors (Institute of Microelectronics, Singapore), fault simulation acceleration using FPGA (Intel Corp., USA), a nitride based MOSFET dosimeter requiring no external power supply (MHRD), development of SONOS flash EEPROM



(Hitachi, Japan), analysis of CHISEL flash EEPROM, bias temperature instability in MOS devices (Agere Systems, USA), multi-gate MOSFETs (IBM), etc.

Research & Educational Collaborations

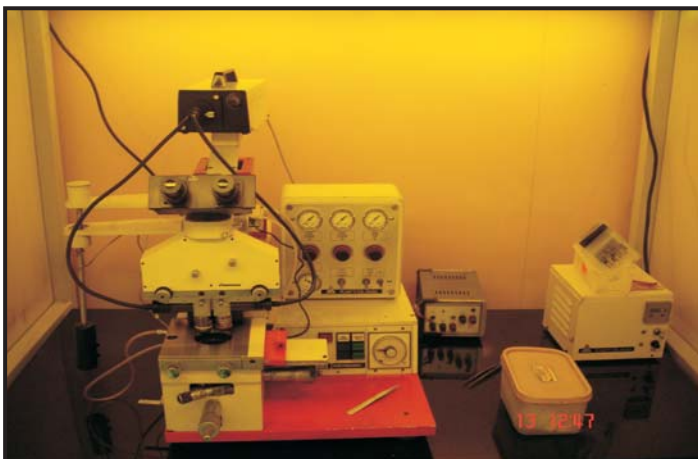
Centre for Excellence in Nanoelectronics (upcoming): The Ministry of Communications and Information Technology, Govt. of India is setting up a state-of-the-art facility for nano-fabrication and advanced semiconductor device characterization, involving an investment of over Rs. 50 crores over 5 years. Through additional resources and industry inputs, a Rs. 100 crore experimental Nanoelectronics facility is currently being built at IIT Bombay, which will be a unique facility in the country. [URL: www.ee.iitb.ac.in/~nanoe/]

VLSI Consortium: It is a joint venture between the microelectronics group and the industry for cutting-edge research in VLSI covering VLSI system design methodologies, VLSI circuit design and CAD tools. The participating industries include Xilinx Inc., IBM Global Services India Pvt. Ltd., Cadence Design Systems Ltd., Tata Consultancy Services Ltd., Tata Elxsi Ltd., Conexant Systems India Pvt. Ltd., Ajit Shelat Technologies Pvt. Ltd. [URL: www.ee.iitb.ac.in/~vlsi/]

Special Manpower Development Program for VLSI Design (Ministry of Information Technology): IIT Bombay is the coordinating institute for the western region and has been provided with high performance computing facilities, hardware development kits and VLSI design software tools from major EDA companies (Cadence, Synopsys, Mentor Graphics, Xilinx, etc.)

Other Collaborations: Faculty members have recently undertaken collaborative research with the following organizations: Intel (novel circuit design and performance of finfets for sub 45 nm technologies), IMEC-Belgium (design and characterizations of multi-gate transistors), Tokyo Institute of Technology (TCAD simulations and modeling for novel technologies), Nanyang Technological University-Singapore (polymer electronics on flexible substrates and their circuit design issues), University of California - Los Angeles (lateral asymmetric channel transistors for mixed signal applications), BARC, SITAR (development of silicon drift detectors & RADFETs for medical applications), Infineon-Germany (I/O devices), etc.

Research funding received over last 5 years exceeds INR 75 crores.



Incubation

Powai Labs: Simulation accelerators and emulators that deliver speed-ups by orders of magnitude in the simulation and verification step of the VLSI system design process.

Processors Algorithms, Research & Technology: Algorithms and supporting software tools for performance enhancements in processor and system-on-chip architectures.

Education Outreach

The group has recently organized the following major conferences: (1) 17th International Conference on VLSI DESIGN and 3rd International Conference on Embedded System Design 2004, (2) 14th International Workshop on Physics of Semiconductor Devices (IWPSD), (3) Microelectronics & VLSI 2005: National level conference on latest trends in microelectronics, nanoelectronics, molecular electronics and electronics packaging.

The group has conducted CEP (Continuing Education Program) courses for industry and academia in the following fields: nanotechnology, nanoelectronics, VLSI and electronics design, elements of microelectronics, sensors and bio-sensors for robust security, TRIZ and TAGUCHI methods.

Faculty Awards & Distinctions

The group includes: a recipient of the Dr. Shanti Swarup Bhatnagar Prize in Engineering Sciences, Swarnajayanti Fellowship awardee, current and ex-editors of the IEEE Transactions on Electron Devices and other leading journals, invitees/guest professors at leading academic institutions all over the world, an IEEE Fellow, IEEE Distinguished Lecturers, past IEEE Bombay Section Chair and other IEEE functionaries, Distinguished Researchers, and Excellence in Teaching awardees.

In addition, our faculty members regularly give invited and distinguished lectures at various international and national conferences, universities and semiconductor companies all over the world, are fellows of national societies such as INAE, and regularly win best paper awards in international and national conferences.

Recent Publications

The microelectronics group actively publishes ongoing research. Publications in the last 5 years include numerous journal and conference papers. The faculty members of the group have also published 10 books (including chapter contributions) in the last 5 years.

Electronic Systems Specialization
Department of Electrical Engineering
Indian Institute of Technology Bombay
www.ee.iitb.ac.in/~esgroup/

Faculty and Research Areas

Prof. Vivek Agarwal: EMI/EMC issues, Non-Conventional Energy Processing Techniques, Microprocessor based Control of Electric Drives

Prof. A. N. Chandorkar: Analog, Mixed Signal and RF VLSI Design, VLSI Devices, Sensors, Optically Switched Microwave Components

Prof. M. C. Chandorkar: DSP/FPGA based Applications in Power Electronics, UPS Design, Embedded Systems, and Power Quality

Prof. U. B. Desai: Signal Processing, Adaptive Signal Processing, Image and Video Processing, Sensor Networks, Wavelets, Biomedical Signal and Image Processing

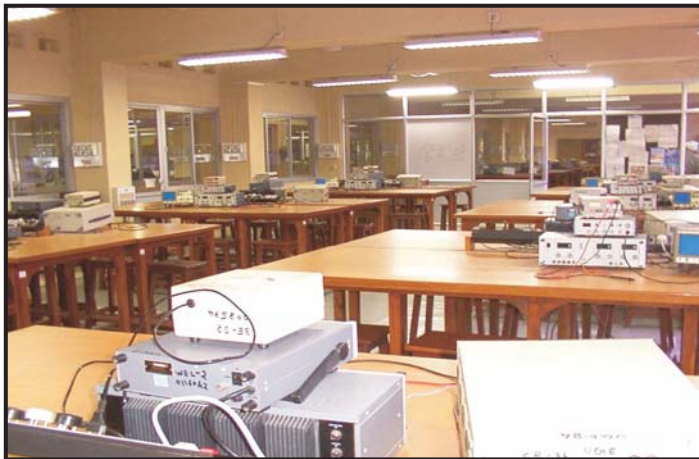
Prof. V. M. Gadre: Digital Signal Processing, Multiresolution and Multi-rate Signal Processing, Wavelets

Prof. Girish Kumar: Microwave Integrated Circuits, RF Communication Circuits, RF Systems like Jammers, Signal Enhancers, RFID, GPS, Microstrip Circuits and Antennas

Prof. P. C. Pandey: Instrumentation Electronics, Embedded System Design, Biomedical Electronics, Speech and Signal Processing, Electro-Acoustics, Sensory Aids for Handicapped

Prof. Preeti S. Rao: Speech and Audio Signal Processing, Digital Signal Processing, Coding of Speech at Low Bit-rates

Prof. D. K. Sharma: Digital System Design, CMOS Analog VLSI Design, Mixed Signal Design, Embedded Systems

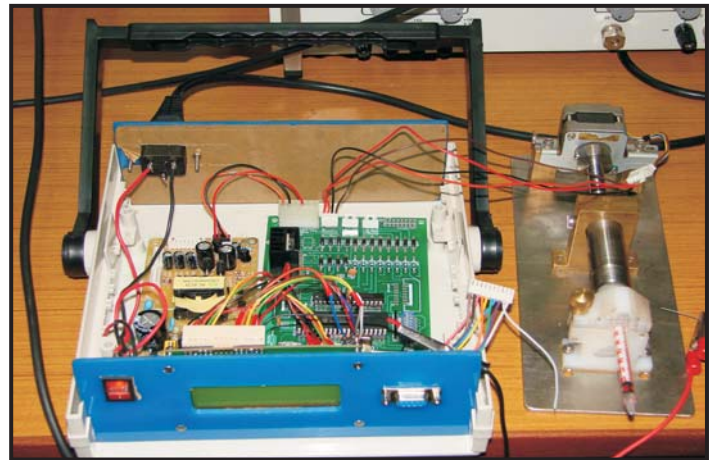


Laboratories

The Electronic Systems Group at IIT Bombay focuses on Embedded Systems, DSP based Systems, VLSI Circuit Design, System Design, Speech and Signal processing. The associated infrastructure and laboratories are:

Wadhvani Electronics Laboratory: Embedded systems and electronic systems design laboratory with instruments like logic analyzer, mega zoom oscilloscopes, lock-in-amplifiers, distortion meter, DSO, LCR-Q meters, FPGA kits, universal programmers for microcontrollers, ARM kits, etc. Softwares: KEIL, Eagle, Altium.

Signal Processing and Instrumentation Laboratory: Acoustic room for recording speech signals, sound meters, data acquisition



cards and other measuring instruments like digital phosphorous oscilloscopes.

Digital Audio Processing Laboratory: Speech and music processing laboratory with Analog Blackfin DSP processors. Speech-processing softwares: PRAAT, Digital Ear, Goldwave, Rasika-Gayika, etc.

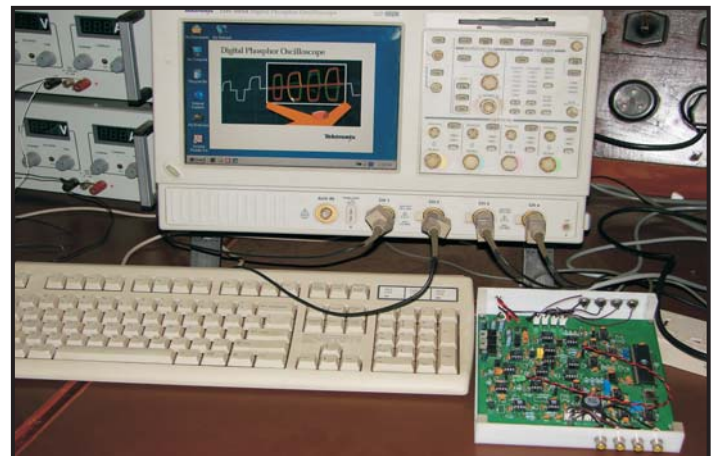
Microwave Laboratory: For design of microwave integrated systems; well furnished with spectrum analyzers, network analyzers, high frequency signal generators, RF test-bench, transmission line trainer systems, etc. RF simulators: IE3D, Puff, Microwave Office etc.

Texas Instruments Digital Signal Processing Laboratory: Texas Instruments DSP starter kits, Code Composer Studio, Texas interfacing kits with USB, AM/FM generators.

Printed Circuit Board Laboratory: Complete LPKF rapid prototyping PCB fabrication setup, Protomat C60, Minicontac 2, Multilayer press, UV exposure machine, LPKF Circuit cam, etc.

Sponsored and Consultancy Projects

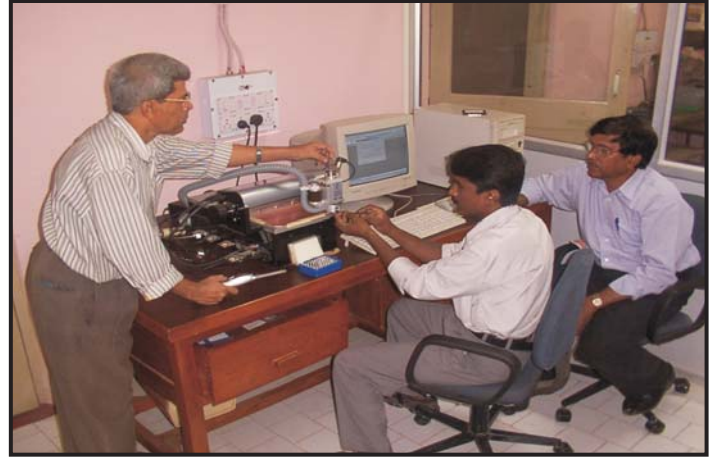
Faculty members of this group undertake various sponsored research and development projects in the broad areas of biomedical electronics, speech processing, VLSI design and DSP. Major ongoing and completed projects include impedance cardiograph, impedance glottograph, ultrasonic hyperthermia, audio compression, speech codec, ultra low power ECG recording chip,



sensor networks, microwave heating systems, etc. Some of the major sponsoring agencies/industries include DRDO, ISRO, SAMEER, Bharat Electronics Ltd., ARDB, Patni Computers, Texas Instruments, MTNL, BSNL, ECIL, DAE, MHRD, TCS, BARC, Microsoft Research, L&T Infotech, Intel, etc.

Industry Collaborations

The group also undertakes various collaborative projects with various reputed industries such as Freescale Semiconductors, Cirrus Logic Software, Tata Infotech Ltd., Feedback Electronic System Ltd., MTNL, Tata Consultancy Services, Axes Technologies, Cradle Technologies, L&T Infotech, CMC Limited,



Siemens, Tata Consultancy Services, Texas Instruments, Intel, Bharati Telecom, PACE Soft Silicon, Patni Computers, RIMO Technologies, Analog Devices, GE Corporate R&D Center, etc.

Memorial Award, INAE Young Engineer Award, etc. Faculty members of this group are also involved in chairing various national and international conferences, and seminars. They are also members of IEEE, IETE and INAE.



Publications

Faculty members of this group have published their research work in various journals, conferences, and workshops of national and international repute. Some of their publications have also been awarded at the seminars and conferences. The faculty members are also involved in patenting their work through Indian and US

Siemens, Tata Consultancy Services, Texas Instruments, Intel, Bharati Telecom, PACE Soft Silicon, Patni Computers, RIMO Technologies, Analog Devices, GE Corporate R&D Center, etc.

Education Outreach

In addition to the academic courses, the group faculty members regularly give lectures in various international conferences, universities and industries. This group is also involved in various continuing education programmes in the areas of electronic system design, mechatronics, DSP, etc. for various industries, colleges and government organizations like IPCL, DRDO, etc.



Distinctions and Awards

Faculty members of Electronic Systems Group are awarded with various national and international awards like Excellence in Teaching Award, Prof K Sreenivasan Memorial Award, S.V.C. Aiya

agencies. Books published by the members of the group: 'Multifractal Based Network Traffic Modeling' (Kluwer Academic Publishers), 'Broadband Microstrip Antennas' (Artech House), 'Bayesian Approach to Image Interpretation' (Kluwer Academic Publishers), and 'Digital Measurement Techniques' (Narosa Publishers).

