Research Scholars and Alumni Symposium

March 7-8, 2014
VMCC, IIT Bombay

Souvenir

Sponsored by MHRD, Government of India

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Archway over Corridor

Research, Collaborate and Contribute

Welcome to the third edition of *Research Scholars and Alumni Symposium (RSAS)* conducted by IIT Bombay on 7th and 8th March 2014. This edition of symposium follows the tradition of successful ones held in 2008 and 2010 (which were called as *Research Scholars Confluence - RSC*). As knowledge sharing is very important for research, a seamless interaction with peer level researchers and professionals is desirable. With this motivation, RSAS has been planned with an extended scope whereby research scholars from other institutes are invited to participate in it so that research scholars' community gets connected and grows collectively.

This event provides an opportunity for research scholars to get inspired from experiences of PhD alumni and encourages interaction among research scholars of various institutes. This edition of souvenir includes selected abstracts from research scholar articles, experiences of graduating PhD scholars and most interestingly our PhD alumni interviews sharing their memorable moments during their stay at IITB. We also have a section from *SINE IITB* for budding entrepreneurs.

This event has been organized under the aegis of *Ministry of Human Resources Development, Government of India.* We also thank *PG Academic council, Institute Research Scholar Companion Programme (IRSCP), Research Scholars Forum (RSF)* and all the faculty members at IIT Bombay for their active participation to help us organize the event. We also acknowledge research scholars from various institutes who have shown keen interest to participate and share their research findings. On behalf of the *RSAS-2014* editorial team, we wish all of them a great success in all their endeavours.

Promoting collective reflection on research endeavors and their role in betterment of society.

Thanks and regards,
RSAS-2014, Editorial Team
IIT Bombay

Research Scholars & Alumni Symposium (RSAS-2014) IIT Bombay

RSAS-2014 Program Schedule

Time	Programme Details
Day 1 (7thMarch)	
08.30-09.00 am	Registration
09.00-10.00 am	Inauguration
10.00-10.30 am	High Tea + Poster presentation
10.30-11.30 am	Invited talks 1 & 2
11.30-01.00 pm	7 parallel group discussions
01.00-02.00 pm	Lunch
02.00-03.30 pm	Society for Innovation and Entrepreneurship (SINE, IITB) session
03.30-04.30 pm	Invited talk 3 & 4
04.30-05.00 pm	High Tea + Poster presentation
05.00-06.30 pm	Panel discussion (Summary of group discussions)
06.30-08.00 pm	Cultural events, games etc...
Day 2 (8thMarch)	
09.30-12.30 pm	Technical presentations by research scholars
12.30-02.00 pm	Lunch
02.00-05.00 pm	**Departmental Events (Technical Talks, lab visits and informal sessions)**

Chief Guest (Venue: VMCC Main Auditorium)			
09.00 am	PadmaShree Dr. Mahesh Mehta	CHIEF GUEST	Chemical Engg-1977 Batch, Currently Chairman, Gujarat Life Sciences Pvt. Ltd., Baroda
Invited talks (Venue: VMCC Main Auditorium)			
10.30-11.00 am	Dr. Hariharan S.	Mantra for researchers in these difficult times - Innovate or Perish	Chemistry Dept-1987 Batch, Currently CEO & Joint Managing Director, Solaris ChemTech Industries Ltd., New Delhi
11.00-11.30 am	Dr. Suresh Nair	Strengthening the relationship between academia, industry, and research organizations	Electrical Engg-1987 Batch, Currently President, R&D NeST/SFO Technologies, Kochi

3.30-4.00 pm	Dr. Sivan K.	Role of research scholars in development of indigenous technologies	Aerospace Engg Dept-2006 Batch, Currently, Mission Director, GSLV-D5, Vikram Sarabhai Space Centre, ISRO
4.00-4.30 pm	Dr. Vadiraj Ekkundi	Role and importance of Intellectual property rights in the Indian context	Chemistry Dept-1985 Batch, Currently Head, R&D, Hikal ltd., Bengaluru

Group and Panel discussion moderators (11.30 am - 01.00 pm)		
Prof. Khedker U.	Research journey: Making it structured and joyful	Computer Science Engg Dept-1995 Batch, Currently Professor, CSE, IIT Bombay
Dr. Emandi Rao	Investment portfolio for Research and Development: How many eggs in which basket?	Reliability Engg Dept-2007 Batch, Currently Director & CEO, India Infrastructure Finance Company Ltd., New Delhi
Dr. Chandrika Bhimarao	Is there a disconnect between academic research and societal needs?	Mathematics Dept-1993 Batch, Currently Head, Discovery Informatics
Dr. Kallol Roy	Strategies and policies for enhancing the contributions of research scholars in projects of national importance	Systems & Control Engg-2000 Batch Outstanding Scientist(OS), Head Research Reactor Maintenance Division, Reactor Group BARC, Bombay
Dr. Venkatarao Ryali	Technical profile and skill-set of research scholars: Expectations from industry	Systems & Control Engg Dept-2000 Batch, Currently Manager GE Global Research, Bangalore
Dr. Chaitanya Shah	The inevitability of interdisciplinary research for new technologies	Metallurgical Engg & Materials Science Dept-1995 Batch, Currently Director Mechemco Group, Mumbai
Dr. Binti Singh	Demographic impact of research and innovation: The rural-urban divide	Humanities and Social Sciences Dept-2007 Batch, Currently Professor, Kamla Raheja Vidyanidhi Institute of Architecture, Mumbai

Panel discussion (Venue: VMCC Auditorium)	
Prof. Ali Contractor	Panel Moderator, Chemistry Dept-1978 Batch, Currently Professor, Chemistry Dept, IIT Bombay
Panelists for SINE Session	
Dr. Ravi Pai	Engineering Director, Indian division of Design of Silicon (D2S) Mentor Graphics
Dr. S. Naik	Managing Director, Naik Environmental Engineers Pvt. Ltd. Navi Mumbai
Prof. Preeti Rao	Co-Founder, SensiBol Audio Technologies
Dr. Ajay Bhagwat	Managing Director, Renu Electronics, Pune
Dr. Jiten Apte	Founding member of four start-ups (in areas as diverse as network management software,IT off-shoring, corporate finance advisory, and most recently in igrenEnergi)
Dr. Rajeev Agrawal	Founder-CEO, Innoviti
Prof. Milind Atrey	Professor, Mechanical Engineering, IITB

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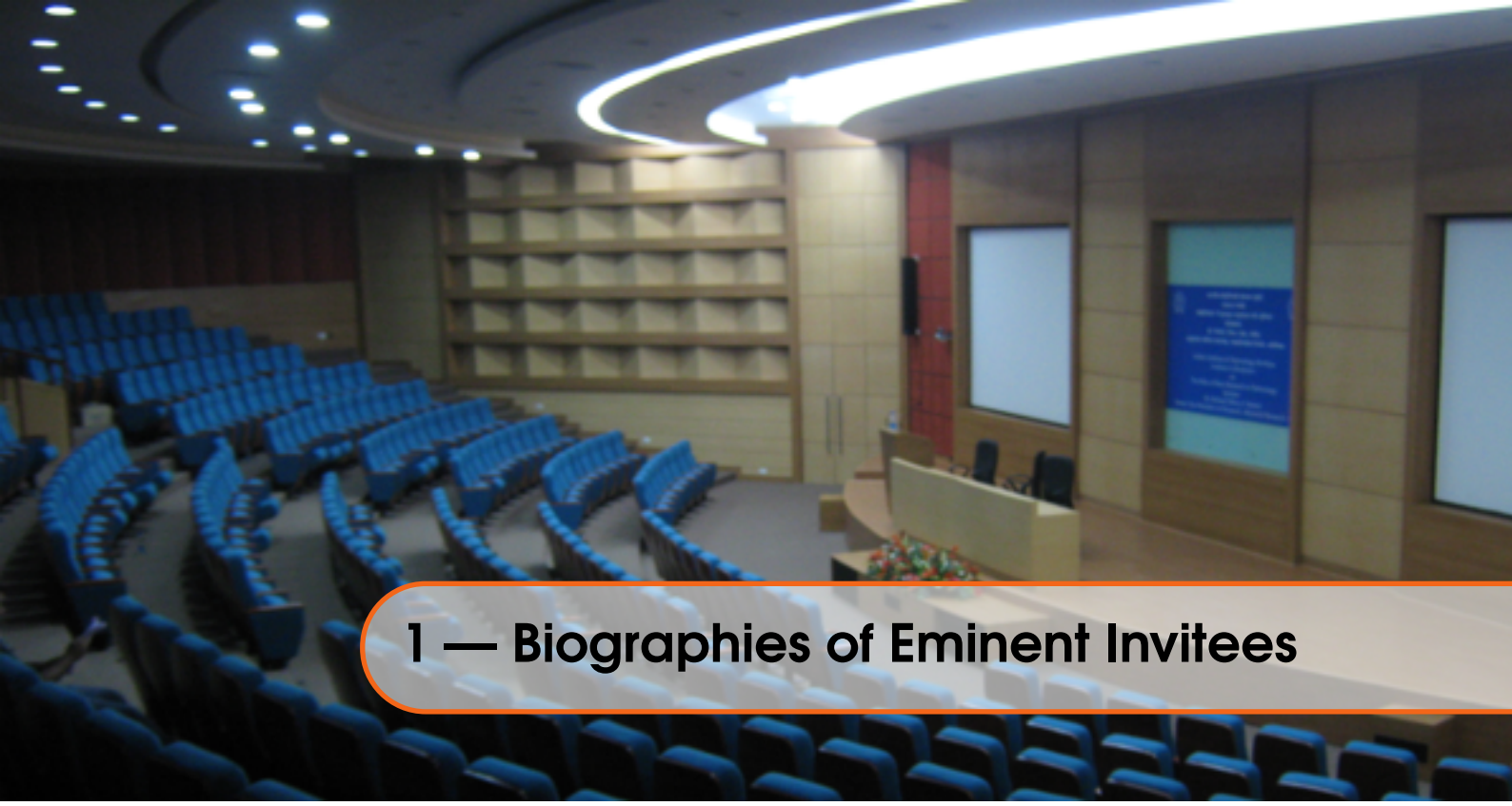
Director's Message

IIT Bombay has been one of the leading institutes for both academic and industrial research. As part of the developmental needs of our country, it is imperative that we expand our research horizons and strengthen our self-reliance on science and technology. Over the past decade, there has been a significant increase in size of research community especially as the number of PhD students has exponentially increased. In order to help the community reach its maximum potential and further leverage this strength of ours, it will be of tremendous use to have a healthy discussion around current status of research, its opportunities and challenges, and strategy for future.

Research Scholars Confluence held during 2008 and 2010 has proved to be a healthy platform for institute research scholars to interact with our diverse alumni. This time, it gives me great pleasure to see the way this event has transformed in the name of Research Scholars and Alumni Symposium. Certainly, this event has evolved as a first of its kind where all stakeholders of research get together and collectively reflect upon their research endeavours and their role as an individual.

This souvenir released during the event conveys the essence of the event by including interviews of several eminent alumni, compilation of opinion surveys of researchers from various environments, opinion pages of prominent personalities along with multi-disciplinary technical proceedings. Seeing this initiative as a budding gesture of a progressive research community, I extend my congratulations to all members of the research community and convey my warm wishes to uphold the excellence.

Prof. Devang V. Khakhar
Director, IIT Bombay



1 — Biographies of Eminent Invitees

Distinguished Chief Guest

***PadmaShri* Dr. M. H. Mehta, Chairman, The Science Ashram / Gujarat Life Sciences and Former Vice Chancellor, Gujarat Agricultural University**

Dr. M. H. Mehta holds B.Tech and Ph.D. in Chemical Engineering from IIT Bombay. He was a visiting scientist at University of California and Arizona. An engineer, an innovator and an able administrator, he has made significant contributions towards strengthening india's agricultural system. He is founder director for a number of world class institutions, industrial establishments and NGOs such as GSFC Science Foundation and GPSC (now named as GGRC), Gujarat Life Sciences Private Ltd, The Science Ashram, Indian Association of Information Technology in Agriculture. He is founder President of National Bioshield Society and Kutch Agri Development Consortium. Dr. Mehta has pioneered several new technologies, eco-friendly processes, techniques and programmes, as a result earning about 16 patents on new processes and products. As the Vice-Chancellor of Gujarat Agricultural University, Dr. Mehta introduced GAU Satellite Krushi Gosthi, the first of its kind in India, to maintain direct contact of the farmers with scientists. Programs like disaster management through innovative technologies and livelihood programmes were popularized through his organizations. His services to the country got him the national recognition by the coveted *Padma Shri in 2011*. Dr. Mehta is providing unique leadership for the Eco Agri Revolution, so important to meet the future challenges. In 2012, he was awarded Lifetime Achievement Award by Agriculture Today and in 2013, he was honoured by Beijing University and Cornell University. Dr. Mehta won 110 m Hurdles from 1962 to 1964 at IIT Bombay and plays Kastha Tarang- a rare Indian instrument and represented IIT Bombay at the First Youth Festival in 1963 at New Delhi. Known as Monty or Muni to his friends, he now lives in Vadodara and is married to Ilaben Bhatt, an artist and they have two children - both Biotechnologists.

Invited Eminent Speakers

Dr. Vadiraj Ekkundi completed Ph.D in Organic Chemistry from the Department of Chemistry, IIT Bombay in 1984-85. He did his Post Doctoral research at Institute of Organic Chemistry, TU Braunschweig, Germany and Department of Chemistry, Boston College, Boston, USA. He was a recipient of the prestigious *'Alexander von Humboldt Fellowship'* from Germany. He has over 25 years of experience in Industrial R&D. He has served as Head, R&D, Ciba Specailty Chemicals in india and global R&D leadership position in switzerland as *"Head of Coloration R&D in Ciba Specialty Chemicals, Basel"*. He has contributed to develop and launch of various novel products and manufacturing processes in the area of active pharma ingredients, agrochemicals and high value specialty chemicals. He represented Ciba in Swiss–Indian Biotech Business forum in New Delhi. He held various positions like Sectional President, Organic Chemistry Section, Indian Council of Chemists 20th Annual Conference, Mysore; member of project review committee, Department of Science & Technology, Government of India and a Member of Indian Chemical Society. He has authored 8 patents and 11 publications. He is currently serving as Head, R&D at Hikal Ltd., Bengalure.

Dr. K. Sivan is an alumnus of Aerospace Engineering, IIT Bombay. He joined ISRO in 1982 in PSLV Project and has contributed immensely towards end to end mission planning, mission design, mission integration and analysis. The mission design process and innovative mission design strategies perfected for PSLV has became the foundation for ISRO launch vehicles like GSLV, GSLV-MK3 and RLV-TD. He is the chief architect of 6D trajectory simulation software, SITARA which is the back-bone of the real-time and non-real-time trajectory simulations of all ISRO launch vehicles. He is the man behind various world class facility commissioned in ISRO like mission synthesis and simulation, parallel computing facility and hypersonic wind tunnel facility, self-reliance in wind-tunnel testing and high altitude test facility for conducting vacuum ignition trials of Indigenous cryogenic engine. He had significantly contributed to India's MARS mission and RLV-TD development program. With a mandate to demonstrate the robustness and reliability of GSLV and flight demonstrate the indigenous cryo stage; he made a complete revisit on the aerodynamic characterization of GSLV. He played the lead role in guiding the team responsible for realization of indigenous cryogenic stage. His technical and managerial leadership led to the historical achievement of most successful GSLV flight with indigenous cryogenic stage, making India proud.

Dr. Suresh Nair, an alumnus of Department of Electrical Engineering, IIT Bombay has spent his initial career with SAMEER, Ministry of Information Technology, Government of India and later shifted to NeST, a multinational private industry as Chief Technology Officer. He has designed and developed many novel products and many are finding excellent market acceptance globally. Dr. Suresh is also the founder of Innobreeze Technologies, a company concentrating on development of bio-photonics based healthcare devices. He is consultant to many other companies. He has nurtured academic –research institute-industry interactions and has got many success stories to tell, including the recently won CSIR award for the best product developed jointly by institute and industry in the five year plan 2012 of DSIR. Dr.Suresh has more than 85 publications, 10 patents, co-authored one book and more than 150 technical reports to his credit. He is member in many of the Government Committees, University boards, Fellow and member in various professional associations. His passion is to mentor youngsters as entrepreneurs.

Dr. Hariharan completed his PhD in Synthetic Chemistry from IIT Bombay and has been active in the Chemical industry over the past three decades handling professional assignments in India, Europe and China. He is currently the CEO and Joint Managing Director of Solaris Chemtech Industries Limited, a group company belonging to the US$ 4 Bn Avantha Group. He is also holds various positions like Chairman for North Zone for Indian Chemical Council and a Member of the Governing Council, Foundation for Innovation & Technology Transfer (FITT) of IIT Delhi. He represents Indian Chemical Council in the task force set up by Ministry of Chemicals & Fertilizers for the rapid growth of Indian Specialty Chemicals Industry. Dr. Hariharan specializes in Business Strategy and Operational Excellence. He is based at Gurgaon, New Delhi.

Invited Group Moderators

Dr. E. S. Rao received his PhD in Reliability Engineering from IIT Bombay. Trained by infrastructure financing by World Bank and Euromoney, he has 15 years of experience in Banking & Finance industry in Project & Corporate Finance, Business Development, Investment Banking, Infrastructure Development and Macro Economic Policy inputs and 10 years in the Telecom & Power Sector industry. He has served as a member in the Sub-Group on Infrastructure (under Working Group on Savings Formulation of the 12th Five Year Plan), member of Sub-Group on Financing Urban Infrastructure in the 12th Five Year Plan, and a member in the Ministry of Finance – DFS Committee on Debt Market Development. Prior to joining IIFCL, he had served with IDFC Group as Director & Business Head and in IDBI as DGM and financed Infrastructure sectors such as Power, Telecom, Gas pipelines, SEZ's, Ports, Airports, Urban Infrastructure and developed financial products like Credit Enhancement-cum-Takeout and Acquisition Finance. He has contributed papers in various National and International Conferences & Workshops and he is in the Editorial Board/Member in two International Journals *"Opsearch" and "Systems Assurance Engineering & Management"*.Currently he holds various positions which includes Chief General Manager, IIFCL; Director & CEO, IIFCL Asset Mgmt Company Ltd (IAMCL-IDF); Director, IIFCL Projects Limited (IPL) and Chief General Manager, Irrigation & Water Resources Finance Corporation Limited (IWRFC).

Dr. Chaitanya Shah did his M.Sc (Chemistry), M.Tech and PhD (Metallurgical Engineering and Materials Science) from IIT Bombay. His expertise includes polymer materials science and technology, polymer matrix composites, protection against corrosion of metals, concrete and polymers with respect to materials selection and process selection, thermoset polymer materials covering entire spectrum of processes and application with respect to materials selection, process selection, design and optimization as well as complete life cycle. He has served for various leadership training, business operations optimization and time bound research and development programs. Currently, he is the Director of Mechemco Resins Pvt. Ltd. & CEO of Royal Thermoset Pvt. Ltd., which are part of Mechemco Group. He has number of international publications and presented in various conferences. He has been Visiting Faculty at Department of Chemical Engineering at University of Notre Dame, Indiana, USA during 1996 and 1998.

Dr. Uday P. Khedker did his PhD in IIT Bombay after his M.Tech in Pune University and B.E. from GEC Jabalpur. He worked at the Department of Computer Science at Pune University from 1994 to 2001. He has been working at IIT Bombay since 2001 and currently is a Professor of Computer Science & Engg. His areas of interest are Programming Languages, Compilers and Program Analysis. He specialises in data flow analysis and its applications to code optimization. He has also been spearheading GCC work at IIT Bombay and has established the GCC Resource Center at IIT Bombay which has the mandate of discovering essential abstractions in GCC code base to make it easier for novices to understand GCC internals, and adding new technolgies to GCC. For the former, he has been conducting workshops and tutorials on GCC internals in India as well as abroad. He has published papers in leading journals and conferences, has contributed chapters in Compiler Design Handbook and has authored a book titled *"Data Flow Analysis: Theory and Practice"* published by Taylor and Francis. He has also worked very closely with the industry as a consultant as well as a trainer of advanced topics in compilers.

Dr.Venkatarao Ryali is a Ph.D. Alumnus of Systems & Control Engineering, IIT Bombay (2000). He did his M.Tech. in Electrical Engineering from IIT Kanpur (1994) and B.E. in Electronics Engineering from Bombay University (1991). His areas of specialization include control system design, optimization, and signal processing. He is currently manager of the Electromechanical Control Systems Lab at General Electric's Global Research Centre in Bangalore. He leads a team of researchers developing advanced & novel control, optimization & signal processing solutions for a variety of GE products & services in the power generation, transportation, healthcare, oil & gas, and water treatment domains. He has been with GE since December 2000 and has worked on and led programs in the areas of traction control of locomotives, optimal design of wind farms, modeling of desalination systems, and model-based signal processing. Prior to joining GE, he was an Assistant Professor in the Dept. of E.C.E. at IIT Guwahati in 2000. He also served as a visiting faculty member in the Dept. of Instrumentation at IISc Bangalore in 2005.

Dr. Binti Singh is a sociologist by training and specializes in planning, policy and governance, and urban theory. She holds a B.A. degree in Sociology from Presidency College, Calcutta, 1999. She also has an M.Phil. (with a specialization in Planning and Development)and a Ph.D.(with a specialization in Sociology) from the Department of Humanities and Social Sciences, Indian Institute of Technology, Bombay awarded in 2005 and 2011 respectively.She has worked on several research projects and has published widely in both national and international peer reviewed academic journals. She received the national level Junior Research Fellowship awarded by the University Grants Commission in 2003. After a two year stint at Yokohama, Japan where she was engaged as an Independent Researcher she returned to Mumbai in early 2013 and has been teaching at Kamla Raheja Vidyanidhi Institute of Architecture and Environment Studies, Mumbai since then. Some of her recent publications are: Changing Contours of Solid Waste Management in India, Journal of Asian Public Policy, Routledge,2012 and Parallel Structures of Decentralization in the Megacity Context of Urban India: Participation or Exclusion? Space and Polity, Routledge, 2012.

Dr. Kallol Roy is a B.Tech (Electrical) from NIT, Kozhikode in 1984 and a graduate of the 28th Batch of Training School at BARC. After graduating from the BARC Training School, he joined the Reactor Group, BARC as an Instrumentation & Control engineer. Subsequently he did his M.Tech in Electronics Design (CEDT, IISc, Bangalore, 1988-1990) and PhD in Fault Detection & Diagnosis (Systems & Control, IITB, 2000). He was also a Post-Doc Fellow at the Univ. of Alberta (Computer Process Control Group, Chemical Dept.), from March 2005 to April 2006. Dr. Kallol Roy has been working on maintenance of instrumentation & controls for research reactors, upgrades of obsolete systems & their retrofit in older plants, formulating predictive maintenance techniques for reduction of plant down-time and also performance assessment of dynamic systems & equipment. His primary research interests are in applications of Bayesian estimation (Kalman filters & their variants) in fault detection & diagnosis of systems & equipment, data processing, data reconciliation & data mining for plant efficiency improvement and application of signal recovery techniques & spectral analysis for diagnostics of embedded sensors. Presently Dr. Roy, holds the position of Head, Research Reactor Maintenance Division, BARC and is also a Professor of the Homi Bhabha National Institute (HBNI), a deemed University.

Dr. Chandrika B. Rao graduated from the University of Bombay, with a Major in Statistics in 1984, and was a recipient of the National Merit Scholarship. She specialized in Applied Mathematics for her Master's degree from Indian Institute of Technology, Bombay (IITB). She received her PhD degree in Mathematics from IITB for her thesis on "A probabilistic analysis of antigen-antibody interactions during immune response". She was a recipient of the Dr U. S. Nair Young Statistician Award from the Indian Society for Probability and Statistics in 1987, for her original work on extending and applying combinatorial probability theory to antigen-antibody aggregation phenomena. On a High Level Post-doctoral Research Fellowship from the French Government, she did further research in Theoretical Immunology with a multidisciplinary group of scientists from Pasteur Institute (Paris) and Ecole Polytechnique(Paris). She has worked in institutes of international repute in biology and medicine including Indian Institute of Science, Bangalore, Centre for Cellular & Molecular Biology, Hyderabad, and Institute of Genomics & Integrative Biology, Delhi. Her research interests have spanned many areas of lifesciences, including immunology, phylogenetics, disease genomics and genome informatics where she has used statistical, mathematical and computational methods for problem-solving. In 2004, she set up a computational drug discovery facility at R & D division of Piramal Enterprises Ltd, Mumbai, India. Activities of her group include structure-based drug design, and various in silico predictions including physicochemical properties, metabolites and toxicities. They work in close interaction with Medicinal Chemistry, Pharmacology, Pharmacokinetics, Met-id, Pre-formulation, Process Research, Toxicology and Regulatory Affairs groups at Piramal. She has also initiated Computational Biology projects for new knowledge generation for use in practical drug discovery projects. These include mining and analysis of large bioinformatics data and mathematical modeling. She is among the rare few individuals who combine expertise in analytical and computational methods with deep domain knowledge of both biology and chemistry in drug discovery research. She has successfully managed a full, computation-driven drug discovery project on xanthine oxidase inhibition, where a novel scaffold was identified through virtual screening and several nanomolar compounds were designed using structure-based design method. The entire project was completed in a short span of 17 months, resulting in a compound showing good in vivo activity. She has a number of publications to her credit in international peer-reviewed journals like J Med Chem, J Allergy & Clin Immunol, Biol Psychiatry and Mol Biol & Evol, Her most highly cited work is an invited brief review, "Managing Protein Flexibility in Docking and its Applications", published in the high impact journal, Drug Discovery Today. She is listed on Linked-in and ResearchGate.

Dr. AQ Contractor obtained his M.Sc.('73) and Ph.D.('78) degrees from I.I.T., Bombay. He has carried out post-doctoral research at Carleton University, Canada and Texas A&M University, U.S.A. He joined the faculty at I.I.T., Bombay in 1984 and is currently Institute Chair Professor in the Department of Chemistry. He has been actively involved in studying the electrochemistry of conducting polymers for more than twenty-five years. He has been collaborating with colleagues across the institute in a concerted effort to utilize the remarkable properties of conducting polymers to develop new sensor technologies.

SINE Panelists

Dr. Jiten Apte graduated with a B. Tech in EE from IITB in 1985 and received an MS (1987) in EE and a Ph. D. (1990) in Computer Science both from Duke University. He has also completed short executive courses in CS at Stanford and in Finance at Wharton. Till the summer of 1997 he worked in R&D Labs of large, marquee organizations like HP, IBM and Bell Labs, before being drawn into entrepreneurship. As an entrepreneur, he has been the founding member of four start-ups, in areas as diverse as network management software, IT off-shoring, corporate finance advisory, and most recently in igrenEnergi, a technology company focused on products for efficient transfer and storage of energy. When not working, He enjoys a good game of basketball, and hopes to be playing the game recreationally, long after the last entrepreneurial venture is a distant memory.

Dr. Preeti Rao is a Professor in the Department of Electrical Engineering, I.I.T. Bombay. She received the B.Tech. EE degree from I.I.T. Bombay in 1984, and Ph.D. from the University of Florida, Gainesville in 1990. She taught at I.I.T. Kanpur from 1994 until 1999, and has been on the faculty in EE at I.I.T. Bombay since then. Her expertise is digital signal processing as applied to speech and audio processing. She has been interested in research and development of technology for Indian music and spoken language applications. She co-founded, with her Ph.D. and Masters students, SensiBol Audio Technologies incubated by IIT Bombay and SINE in 2011.

Dr. Ravi Pai received his Ph.D. degree in 1992 from Department of CS&E, IIT Bombay. His area of research was in algorithms for automatic physical layout in integrated circuits. From campus, he joined a startup, Silicon Automation Systems (now called Sasken), which was an EDA (Electronic Design Automation) startup then. In 2001, Ravi and some of his colleagues in Sasken started a new startup, SoftJin Technologies, which continued to work in the niche domain of EDA. In April 2013, Mentor Graphics acquired the product division of SoftJin which was targeted towards the software development for photomask manufacturing for IC fabrication. Since then, Ravi is working as the Engineering Director of Indian division of Design of Silicon (D2S) group of Mentor Graphics.

Dr. Rajeev Agrawal has done his B.Tech and Ph.D. from IIT Bombay. As CEO of Innoviti, he leads one of India's leading payments company that provides solutions to businesses that helps them cut costs in every payment transaction and use payment options as a marketing tool to drive consumer purchase. Innoviti provides such services to leading organizations in India in the retail, hospitality, entertainment and radio cab segments. Prior to founding Innoviti, Rajeev was Vice President and Head of Broadband Communications Business at Sasken, Bangalore.

Dr. Shirish S. Naik graduated in Civil Engineering from the Indian Institute of Technology, Mumbai in 1976 in the discipline of Civil Engineering, and subsequently obtained his M.Tech and Ph.D in Environmental Engineering from the same Institute. He started his career as Site-in-charge, Sewage Treatment Plant, Kudremukh Iron Ore Project, Karnataka for M/s. Hydraulic & General Engineers Ltd. in 1977-78. After many successful projects for various consultants he joined the faculty of Environmental Engineering at The Indian Institute of Technology (IIT) Mumbai in 1983. At IIT, he was extremely active in Teaching, Research and Consultancy. After over a decade at IIT, Dr. Shirish S. Naik resigned and founded the NAIK ENVIRO Group. As the Managing Director of NAIK ENVIRO, he is specifically involved in the design and detailing of Package Water and Wastewater treatment systems with emphasis on recycle/reuse. He has extensive experience in the field of turnkey projects for water and Waste Water Treatment, Pumping Stations, Air Pollution Control, Environmental Impact Assessment and Hazardous Waste Management and has executed over 100 projects in the above areas. His extensive research in this field has led to the awarding of a patent by the Indian Government.

Dr. Ajay Bhagwat is the founder and Managing Director of Renu Electronics with its headquarters in Pune and sales offices in US, Europe and Singapore. Renu Electronics is set up as a *"100% export oriented company"* in the area of Factory Automation, Medical Electronics and Home Automation markets. The company was one of the first in the country to be in the Global *"products"* business with all the certifications required for doing business in the international markets and has been a leader in the industry. Under his leadership, Renu Electronics was judged to be the best company in Electronics in the State of Maharashtra several times. He has also been a founder of several other companies and has served as a Director on the boards of various companies including KPIT Information Technology Ltd., Cummins Information Technology Ltd., Electronica Mechatronics Ltd., Prizm Electronics Inc., LR Med Inc. and various others. He has been a passionate supporter of fostering Entrepreneurship. He is one of the founding Charter Members of the Pune chapter of TiE (The Indus Entrepreneurs, the largest not for profit organization supporting Entrepreneurs in the world) and has led the mentorship programs for several years. He is also the chairman of the Electronics Committee of the MCCIA (Marhatta Chamber of Commerce, Industries and Agriculture, Pune) and has participated in the making of several key policies in Electronics in India. Ajay was one of the key organizers of his batch's silver jubilee reunion in December 2010. He was the co-chair of the Outreach program which successfully brought a large number of Alumni's to the reunion. He was also the co-leader of the Legacy Project team and continues to represent the batch's interests on the campus. He helps the E-Cell in fostering entrepreneurship on the campus and coordinates the efforts with the student members. He was closely involved and continues to be involved in fund raising to help the Legacy Projects and serves as the point of contact between the core team of the Class of 85 and the Institute.As the latest stint of bringing IITB Alumni's together, Ajay co-founded the *"Y Point Orchestra"* which is a group of IITB Alumni's performing music. It has given a platform and allowed the Alumni's nurture their musical talent. Ajay himself plays the Piano Accordion in this group. The group recently performed on the campus on October 5, 2013.

Dr. Milind Atrey is a Professor in Department of Mechanical Engineering and also a Professor-in-Charge of SINE (Society for Innovation and Entrepreneurship) at IIT Bombay. He graduated from VNIT Nagpur and received his PhD from IIT Bombay in 1991. Before joining IIT Bombay as a faculty member, he worked with Tata Research Development and Design Center, Raja Ramanna Centre for Advanced Technology and Oxford Instruments Superconductivity, UK. His specialization is in Refrigeration and Cryogenic Engineering.

2 — Interview with Dean (ACR)

Prof. Ravi Sinha, Dean (Alumni and Corporate Relations), IIT Bombay
Interviewed by [a]Eranki.L.N.Kiran, [b]Gelli.Ravi Kumar, [c]Puja.Sahu
[a]Educational Technology IDP, [b]Electrical Engineering, [c]Industrial Engineering & Operations Research

What is your opinion on the role of industry, academia and research community in society?

The alumni, particularly research alumni, are very important for their contributions to industry, academia and research. In some ways, all alumni contribute to address different needs of society. During the early years of the institute, the indian economy was less developed and most economic efforts were focused on meeting basic needs of society. In those days, opportunities for significant technical value addition were very limited, and the demand for very highly technologically-skilled people was less. But now, as the indian economy is becoming more developed, new requirements of highly technologically-skilled people are also emerging. This is translating into expanding opportunities for research scholars than at any other time in the past.

How does Alumni and Corporate Relations (ACR) office establish connection among research scholars, industry and the alumni?

The most important roles of ACR office are to keep the alumni and campus community connected through updated information about various exciting activities on the campus and inform them of institute-wide developmental activities and achievements. There are different strategies which we use for accomplishing these depending on the needs of the group. For example, around 50% of our students are undergraduate(UG) students and most do not really get a chance to observe research achievements because of their other preoccupations. So, in order to establish the connection between UG students, alumni with the knowledge generation by research scholars, we bring out several publications. This includes the monthly *newsletter of ACR office*. Other publications include *Insight-a Gymkhana newsletter, and Pulse-a research and development (R&D) magazine*. For us, dissemination of research activities to the alumni is very important since as UG students, they may have never experienced this on the campus. This information is not just useful for improving their understanding of various activities happening at the Institute, but can also help us by making them aware of the opportunities of interactions between their organisation and the Institute.

How is IITB promoting the development of indigenous technology/products?

This is an interesting question! I will give my personal opinion in this regard. If IITB is to emerge as a world class research institution, then we should not talk about indigenous technology at all, rather we should talk about development of state-of-the-art technologies which meet india's needs. Indigenisation of technology often implies adopting or copying an existing international technology. As a leading academic institution, we should maintain our focus on world-class research and development. Development of indigenous state-of-the-art products is more complex since several stages of development are required to take a technology to the market. In some domains, government organizations such as DRDO, ISRO, etc., have been able to achieve great success using indigenously developed technologies. From an academic perspective, it may not be necessary for our Institute to be involved in the entire development process, and can be confined to only some stages where the expertise of IITB is adequately leveraged. As a matter of fact, there is no harm in having many different players besides IITB involved at various steps while developing indigenous products.

What do sponsors expect from IITB research community?

We need to understand the various research sponsors. One group of sponsoring agencies like Department of Science and Technology (DST) and Department of Biotechnology (DBT) support research and development which are not targeted towards specific end-users. So, the projects submitted to these agencies undergo rigorous peer review from research quality perspective. The expectation of these sponsors is the development of new knowledge, approach and/or technologies that enhance the state-of-knowledge in those domains.

Is it the same scenario with multi-national organizations like GE, IBM etc.?

There is another category of sponsors who are interested in supporting applied research. Applied research sponsors will include some government funding agencies like Board of Research in Nuclear Sciences (BRNS), private organizations, and many more. In these cases, it is the need of the organization which drives the funding. The need of funding agency may not necessarily lead to a high-quality research proposal, but there are also situations where the quality of the proposal can be improved by collaborating with IITB.

Do you think publication is the only measure of quality research? If so, why? How can we improve this measure?

Publications are the most widely used measure of research. This may not be the best measure of research quality in some situations but its wide acceptance necessitates that IITB is favourably rated using this measure. In general, if other institutions are compared using a particular widely accepted measure, our institute should not hesitate to be evaluated using the same measure. As a result, we should not spend time on trying to figure out whether it is a good measure or not. High quality research is required in both applied and basic areas. Such high quality work will stand on its own feet. Of course, high quality research output at IITB results in patents, publications, technology transfer, think-tank activity and entrepreneurship. Our institute is doing well in these measures, but can further improve.

Do research programs mould an individual's approach to problem solving at the cost of multidimensionality?

Our research programs are often very unidimensional, in terms of the percentage of time spent on the depth of the problem to the proportion of time spent on width of the problem. This is not unique to IITB, and in many other countries, the research program is equally unidimensional. But those are the countries where society is far more open right from one's childhood, the researchers get the opportunities to develop other skills right from childhood. This does not happen in several developing nations such as ours. In most of these, the lack of exposure and cross-dimensional experience depletes ability to conduct multi-dimensional thinking.

But is it not hampering the interdisciplinary research program?

Yes, it is certainly hampering particularly when the research problem is highly applied. But then what could be the solution? There is no easy solution to it. Our PhD graduates who join as post-docs are far less able to use their research knowledge for addressing industry oriented multi-dimensional challenges compared to post-docs who grow up in more multi-skill school systems.

Most PhD students choose teaching as a profession. What could be the reason? How this trend can be changed?

When we are talking about teaching as a profession, the emphasis is more on people who opt to teach in undergraduate college system. The University Grants Commission(UGC), that administers all universities, focuses more on teaching rather than conducting research. It is not clear why these colleges should only recruit PhD graduates when very limited opportunities to carry out further research are available.

What measures are taken to encourage sponsorship in fundamental research?

Basic research in almost all countries is extensively funded by their governments. On the other hand, funding from private organizations towards basic research is very limited. The financial support to carry basic research comes from various government bodies such as Council of Scientific & Industrial Research, Department of Science & Technology, etc. It is a well known fact that duration of carrying basic research is longer when compared to applied research and thus the time taken to achieve success is also longer. I would like to share an example in this regard for motivating students towards doing research. A professor in one of the other IITs once said that *every night when you go to sleep, you should have satisfaction that you have learned a bit more than the previous day*. Such subtle things nurture self-motivation, which is a significant factor to excel in any field. Sponsorship in fundamental research is far more likely to result in high quality research if the researcher is self-motivated than otherwise.

3 — Interview with Dean (AP)

Prof. Shiva Prasad, Dean (Academic Programmes), IIT Bombay
Interviewed by [a]Eranki.L.N.Kiran, [b]Gelli.Ravi Kumar, [c]Puja.Sahu
[a]Educational Technology IDP, [b]Electrical Engineering, [c]Industrial Engineering & Operations Research

How has IITB evolved as a research institution over the years?

Over the years, many new research based programs have started in IITB, such as M.Sc-M.Tech programme, M.Sc-PhD programme etc. The M.Sc-PhD programme is quite old. In addition to this, other aspects would have contributed to improvement in research support towards equipment and infrastructure. The situation was quite different when we started our career. At that time, even to get a small equipment or for anything pertaining research experiments, we had to struggle a lot. Nowadays, with the established systems in place, It is much easier than it was before for procuring crucial equipments, which can be used by multiple departments. Its easier to get it approved either through funding from the central government or funding from the institute. In our institute IRCC provides funds for many central facilities. It also provides seed grant to newly joining faculty members.

What is your opinion about the role of fundamental and applied research?

Fundamental and applied research are interdependent. Good research eventually comes from heart. That's what is important for developing research appetite. In order for research to materialize to give you a product, that requires many more iterations are needed. What is eventually important for doing research is to train the mind for analytical thinking as well as inquisitiveness for gaining deeper knowledge about the research. It helps to create a sort of knowledge repository though it may not become the foundations for applied research. Yes, both applied and fundamental research play a significant role for betterment of society. In this regard, I remember someone making a funny remark that doing fundamental research is like a owning an additional car which may have some benefit to travel but it is not so important. Indeed fundamental research is important towards a real expansion of core scientific innovations.

What is your comment on the status of Interdisciplinary research? What are its challenges and how are we dealing with them?

Earlier, the scientific education system was divided into areas such as physics, chemistry, biology and mathematics. All these areas had independently evolved to be distinguished from each other. Subsequently, these basic disciplines lead to the emergence of mechanical, electrical, chemical and many engineering and allied scientific areas. Eventually, many of these areas got clubbed together and paved

way towards new hybrid disciplines such as systems and control, educational technology programme, climate studies, etc. Therefore, collaboration among various distinct departments has become essential to conduct interdisciplinary research.

From academic point of view, have any changes been made while introducing new departments such as climate studies, educational technology, etc.?

Many departments and centres have their own programs and can devise their own research areas. Such initiatives have to be driven by faculty members. Faculty should come up with a fascination for interdisciplinary centres wherein people of similar thoughts and ideas can collaborate to conduct research.

What advice would you give to the current research scholars?

I can talk about the advice taht I give to the students, who join my research group. First thing is to get rid of M.Sc mentality, where students learn things only through a well established content. When it comes to PhD level, one should develop a inquisitive mind to open the doors for new directions in research. For example, even while reading a research paper one should not conclude the finding as a final opinion in that area. It surely need intuitive questioning over their research contributions, whether the findings are correct or not. Generally, scholars may become off-track due to hurdles while dealing with research outcomes especially in prolonged research over a period of three to four years. So, one might question whether they have taken right decision or not while worrying about the research outcomes. One should take every opportunity with positive view, and consider as part of life. The moment of excitement when you get the desired results wipes out all struggles faced in the interim.

Does academic structure improve research scholars in terms of pedagogy?

A conducive environment is required to streamline the questioning attitude which also improves the research aptitude. Solutions which worked for you may not work for others. Eventually, each one should conduct the research in his or her own way. One should be open to accept it and yes, our best friends are our criticizers who tell us what is wrong. Somebody who questions you is more important than one who admires you. One should avoid comparing oneself with other students, who could have their own apititude and intelligence.

Dr. Deepti Pradhan
Prospect Research Analyst
Yale University
USA

4 — A Talk with Dr. Deepti Pradhan

Dr. Deepti Pradhan graduated from IIT Bombay in 1986, with a Ph.D. from the Chemistry Department. After postdoctoral training at Pennsylvania State University and Cornell University, she joined the faculty of the Department of Pathology at Yale University. Dr. Deepti also held a joint faculty position at the University of New Haven, in the Department of Biology. Most recently, she has diversified her interests by lending her scientific insight to research in Yale's Office of Development. Dr. Deepti continues to feel very strongly about giving back to society, and to that end she started an independent venture in 2008 - a science café that brings scientists of all stripes to speak to a lay audience. She uses this vehicle not only to reach out to local residents in her area, but also to the wider internet population by sharing videos of these science cafes. For these efforts, she has been recognized with several awards including Person of The Week from The Sound; American Chemical Society's Innovative Science Outreach Award; and the Rika Welsh Community Impact Award.

Interviewed by Alpa Choudhary, Biosciences and Bioengineering, IIT Bombay

Why do research at all? What was the motivation behind you choosing the field of 'research'?

A general curiosity about things around me and why they work and why they don't; the underlying principles about things.

How does research culture differ in IITs and universities abroad?

Not sure how it is almost 30 years since I left, but at that time, it was very different. Particularly in my area of research. Resources were limited, right down to access to journals.

Academia has been a bliss for researchers everywhere. What are the challenges in academic research in India and abroad? How academic institutions can deal with these challenges?

I think the challenges in India and in the US are probably quite different and I'm afraid I'm not equipped to speak to the ones in India at this point in time – in the past, at least in my field, it was access to reagents that was a huge challenge! In the US, funding is the number one challenge and unless one is at the top, it can sometimes feel like you are spending the bulk of your time writing grants to do research. To that end, many universities are trying to work with their development offices to secure funds from philanthropists, thus giving researchers a little breathing space before they get back into the grant writing

cycle.

Since academic institutions are not dedicated only to research, what fraction of time and resources should be shared between teaching and research?

This is a tough one, and really depends on the focus of the academic institution.

Do research programs narrow down ones approach to problem solving, undermining multidimensionality?

Well, one could argue that it depends on one's perspective. One can always find ways to bridge and access expertise of other areas to answer questions in one's own area.

What is the measure for quality research? Does the number of publications reflect quality research?

This is a can of worms.

How do universities abroad encourage the scholars in converting their innovations in patents etc? How does this compare with IITB system?

Here at Yale, one goes and talks to the office of cooperative research if one has a brilliant idea/finding. There is some criticism as to the attention given to some faculty over others, and places like Stanford are more open, but I can't really make any other useful comments on that.

For scholars aspiring to become academicians, should there be courses to hone their teaching skills? Any advice in particular you would like to give to aspiring research scholars.

Absolutely. I think teaching skills are critical to being a successful researcher. Not only should there be training for this area, but there should be avenues for researchers to talk in public forums, both to their peers and to general audiences. The latter is what helps you understand your own limitations in getting your point across, and thus helps you chart out areas to focus on.

How can synergy be built between the academia and industry?

I suppose the first step is to have a continuing dialogue. The fact is that industry is seldom altruistic, and understanding what their angle is right at the outset, can make for more fruitful interactions.

How can academic research contribute to society?

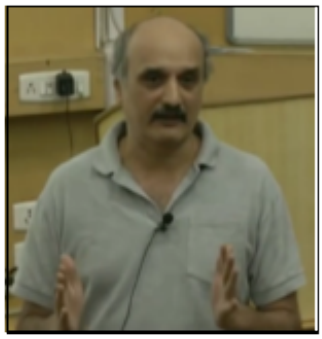
Wow, this is a big one and I could go on for a long time. I think while it is important to do fundamental research, because applied research builds upon fundamental findings, it's important to take a step away from what you are doing every so often, and reacquaint yourself with the society which is making your research possible. In other words, go back and talk to communities and schools – lay persons – about what you are doing. Tell them about it in the simplest possible terms, not how you would speak to a peer. Demystify science for the lay person. In order for a society to flourish, understanding and appreciating and supporting science is extremely important.

Do you think Indian research scholars need international exposure?

Absolutely.

One change you would like to see in Indian research environment for the next 10 yrs?

Encouraging out-of-the-box thinking for students would make a huge difference. Being limited by the thinking of a mentor is stultifying to say the least.



Prof. Milind Sohoni
Head, CTARA and
Professor, CSE, IIT Bombay

5 — In Conversation with Prof. Sohoni

Prof. Milind Sohoni did his BTech and PhD from IIT Bombay. He is a professor at Department of Computer Science and Engineering and the Head of Center for Technology Alternatives for Rural Areas(CTARA), IIT Bombay.

Interviewed by Neelam Rana[a] and Sivamuthu Prakash[a], [a]CTARA, IIT Bombay

You have written a lot about knowledge and society; where does an institution like ours stand?

Knowledge resides in agents like the potter, artisans or even the government servant. They are employed because they are being valued through their empirical knowledge which generates value. So knowledge comes from agents who deliver value. The first modern university, Bologna was started in 11th century in Italy where the idea was to pool in experts and practitioners to train agents by which knowledge can reach the society. The departments in these early universities were arts, philosophy, jurisprudence, divinity and medicine. The traditional science came much later around 16th century, till then universities were mainly cultural i.e. training in the culture and practice. I think our modern Indian universities have missed out on last 200-300 years of training in cultures but during the same time, European universities had played a major role in the social transformation mainly with 300 years of experience in talking about society. Lot of remarkable discoveries came from the members of civil society who were not professional scientists. For example, Carl Linnaeus and Gregor Mendel were priests; Joseph Fourier was a judge and so on. I think that the modern Indian universities should really look at the cultures as the way of embedding science and not just science as an objective. In early days of science, it was basically a cultural construct which is often a matter of contentions with church. For example, the concept of earth moving around the sun in Copernicus age was a major tiff to a wide belief. So, university as civil society is what we should aim for and not just as a trainer of employees.

The current need of society is to improve small and medium scale industries. The role of universities will be providing agents which may be a set of tools to increase the efficiency or a body of people trained to intervene and manage a cluster of industries directly or work with government for the same. So these agents can be an individual or a group or a book which can generate value and propagate good practice.

Why to do research and what should be its outcome?

Research is essential to create knowledge. For example, research can be to analyse and report about a system and its functions which will help us in understanding the system, and knowledge created should directly or indirectly create jobs by showing how agents can be engaged to generate value. The values

need not always be financial, they can be of cultural or social importance or they can be a value of governance like strengthening of democracy.

How should the knowledge created by researchers reach society?

Universities are to provide new professionals and the mode through which the agents operate is either through market or state which is left to the agents/individuals themselves. For example, consider the management of a Taluka level drinking water program as a process. If we define appropriate tools and define the job charts like when and what needs to be done, along with a verifiable money savings or value generation then the mode of application may either be private or State.

What is the role of publications in research?

The main objective of publication is to archive knowledge which is very important for any university. Once the knowledge is published it is like setting up a recipe which can be used by more agents to yield value. However, before thinking about the society, the bottleneck over PhD research is to think if the research has assimilated any value for the institute. For example, if my student works on drinking water and publishes three papers, my way of teaching to next batch of students will improve and so it benefits the institute which in turn can be transferred to the society through students as agents. But if the institute itself doesn't get any value from the publications then it will be a failure.

Do you think academia-industry collaboration will help us reach people in a better way?

People as a system are surrounded by government, market and civil society, along with natural environment and physical assets. We should realise that industries or market cannot cover all the needs of people and not all researches are for providing products. For example, a good research on district planning process can ensure drinking water security. So, essentially all three (government, market and civil society) are valid stakeholders and defining protocols for improving a process is necessarily a vital part of research.

How can we make universities function as regional knowledge resource and local problem solver?

Individuals from universities need to perform several roles which may be consultative or auditing with State and market while it is a public intellectual with civil society. Although agents may perform different roles they should have a clear attribution to their value.

Why our innovations are not easily transformed?

In order to value any scientific research it is necessary to create people or population who value research. People should be able to see what we need and, how and who can deliver it. For instance, in 18th century, a king of Sweden told that all his peasants are literate which was made possible by priests who taught them to read Bible. This knowledge creation helped them to understand the value of knowledge with which they could reach a productivity level almost equal to what India could reach in 1970s. So a population which could appreciate knowledge and its creation is needed to achieve a value. For example, often Government's appreciation of solution is very different; they presume technology to be a magic wand without understanding that it is a process which needs a lot of practice and perseverance. However, it is also the matter of supply and demand; avenues can be created if a clear job chart is available.

One advice which you like to give for research scholars.

Inputs to the system are good enough but measuring the outputs is very important in the feedback loop. Focus on outcomes of processes like failure analysis or model case studies, are important areas of research. Research process should begin from society then move to literature followed by knowledge creation which can be published and finally provide solution to the society. But often research starts from a paper and ends in a paper. So, research should start from the ground and should go back to the ground while generating papers in the process.

Dr. Mangesh Tamhankar
Engineering Manager,
Intel Corporation,
San Francisco, USA

6 — Research Insights by Dr. Mangesh

Dr. Mangesh earned his Ph.D. in Interdisciplinary Program of Reliability Engineering from IIT Bombay in 1997. Before that he earned his B.E. in Electronics & Power and M.E. in Computer Engineering. His area of research during his Ph.D. was Reliability Oriented Optimal Task allocation algorithms in Distributed Data Base Management Systems. He joined as Post-doctoral Fellow at University of Hawaii at Manoa after his graduation and worked there for nearly two years. During his tenure at UH, he worked on a DARPA funded project on Electric Hybrid Vehicle (EHV) Data Base system. Dr. Mangesh developed KWh/miles for various Electric Vehicles in-testing across US (equivalent of miles/gallon of gasoline consumption) using Data Mining techniques and a common On-line DBMS. Dr. Mangesh moved to Silicon Valley, California and has been residing in Bay area for last several years. Dr. Mangesh is currently Engineering Manager at Intel Corporation, managing cross geo teams working on hardware validation, software tools development as well as competitive analysis and projections. Dr. Mangesh continues to work on applied research while at his job, and has recently published three papers and filed two patents. Dr. Mangesh has been actively involved in volunteer activities in the bay area working with local organizations.

Interviewed by Neelam Rana, CTARA, IIT Bombay

Why do research at all? What was the motivation behind you choosing the field of 'research'?

If the mind is inquisitive, there will always be constant need for investigative research to find out answers or to make an effort to find solutions.

How was your transition from research scholar to that of industry professional?

In my case, it was the leading edge post-doctoral work that I was doing that led me into applied part of the research. That also goes back to my answer in question one about finding solutions to problems in real world scenario, which kind of brings closure to your research work.

Please share your views on fundamental and applied research as an industry professional?

Fundamental research in my opinion will always somehow get associated or translated into some useful application or knowledge. So, that's the tie-in, with applied part of the research. You can build on fundamental research to do applied research. As an industry professional, it gives you immense satisfaction with applied research. For a scientist or professor, fundamental research might be the ideal choice. For industry professional, it is easier to validate the applied research, by coming out with relevant

technologies or products that will see the light of the day and evolve into different usage models.

Do research programs narrow down ones approach to problem solving, undermining multidimensionality?

Not necessarily true. It depends on the program. If multidimensionality translates to out-of-the-box thinking, research should not be limiting the ability to approach to solve a problem in different ways.

What are the major differences you see, between Indian and foreign industrial research environment?

I have no experience with Indian industrial environment. In my profession, industrial research is active. In general applied research can be a long-tail research item. E.g., it took 14 years after my research on electric cars to have a commercially available all-electric car in the market.

Your suggestion to improve the synergy between the industry and academia?

Industry and academia should have collaborative research partnerships. It can be in the form of introducing new course work which can be relevant to next generation technology and will equip students with skills to handle the new technological advances as soon as they are out of college. Or it can be in terms of joint collaboration to collaborate on developing proof-of-concept of new technology or advances.

In your opinion what is the role of patent in research? Is patent a hindrance in dissemination of technology?

Filing a patent is important so as to avoid any missed opportunity. In my opinion, patent should not be a hindrance in dissemination of technology. I am still debating on this topic.

How patent is perceived by research community in industry as compared to that in academics?

Patent can be a good asset if you own it, or it can be a cost, if you don't own it and want to use it in your product. It is a double-edged sword. You want to own it at the same time you want to protect it from infringement too.

In your opinion, what can be the bottleneck for burgeoning electronics hardware manufacturing in India?

I think it is the reliable infrastructure that is the bottleneck. Last time I checked, I understood this was the reason. That was about a decade back.

One change you would like to see in Indian research environment in a decade from now?

Focus on research that adds value to national assets, whether in terms of generation of Intelligent Property(IP), Products, Better practices and methods, and betterment of society in general.

Any advice in particular you would like to give to current research scholars and to those who aspire to be one?

Current research scholars – *pick up areas of research, which you think will have a long term impact; your collective mind, attitude and desire will drive you to do something wonderful. Don't be hesitant to think out-of-the box.*

Dr. Ashish Agalgoankar
Lecturer, School of Electrical, Compute & Telecomm. Engg, University of Wollongong, Australia

7 — A Talk with Prof. Ashish

Dr. Ashish P. Agalgaonkar received the B.E. (Electrical Engineering) and M.E.(Electrical Power System) degrees from Walchand College of Engineering, Sangli, India, in 1997 and 2002, respectively, and the Ph.D. degree in Energy Systems Engineering from the Indian Institute of Technology-Bombay, Mumbai, India, in 2006. He was a Scientist at the Energy Technology Centre, NTPC Ltd., Greater Noida, India, from 2005 to 2007 and was associated with the University of Tasmania, Hobart, Australia as a Postdoctoral Research Fellow from October 2007 to January 2008. In February 2008, he took up a position with the University of Wollongong, in Wollongong, Australia, as a Postdoctoral Research Fellow. Currently, he is a Lecturer at the University of Wollongong. His research interests include planning and operational aspects of renewable and distributed generation, microgrids, electricity markets and system stability.

Interviewed by Eranki.L.N.Kiran[a] and Gelli Ravi Kumar[b]
[a]Educational Technology, [b]Electrical Engineering, IIT Bombay

Why do research at all? What was the motivation behind you choosing the field of 'research'?

When I started my PhD, I had a strong motivation of pursuing research in the area of power engineering. At that point in time, I had industry experience of around 4-5 years and varieties of research problems in mind. I was not very clear about identifying any particular research problem but thorough interaction with my supervisors namely Prof. S. V. Kulkarni and Prof. Khaparde, and six months of research work provided me with a stimulus to work on a research problem associated with renewable and distributed energy resources. I had strong motivation/support from my family members, who inspired me to pursue research after marriage, despite having a well-paid job. Also, I was strongly supported by my supervisors at every step. I firmly believe that, a person should do research to bring advancements in his chosen field and never ever choose research for gaining monetary benefits. It was a gradual process for me to experience and enjoy being a researcher at IITB which was another means for me to further study the field of power engineering with which I was associated professionally before pursuing PhD.

How does research culture differ in IITs and universities abroad?

Certainly, Yes. There are better systems and proper guidelines to conduct research abroad, with more emphasis to research problems and well organized funding mechanism which immensely helps a research scholar. There is a better symbiosis between the industry and academia in helping research scholar to

pursue superior challenges in research field as well as in producing highly efficient graduates which can become the backbone of industrial sector. On the other side, the autonomous nature of IITs enables a researcher to pursue a broader path while the structured nature of foreign universities may confine him/her to the set research priorities. The active participation of industries in foreign universities does provide a hands on approach. Like in Australia, the curriculum is heavily influenced by the group of engineers who typically represent the conglomerate of industry.

What are the challenges in academic research in India and abroad? How academic institutions can deal with these challenges? (Specifically for IIT)

The monitorization and industrialisation of education system has led to greater accountability on money being spent on research projects. Current trend of research abroad tends to focus more on the fiscal benefits of a person's research contribution in terms of publications, research grants, patents, etc. It has overshadowed the joys of being a researcher itself to certain extent. On the other side, the IITs, at least during my times, were not so much closely aligned with the interests of the industry. The IITs provide even novice researchers with a flexibility that the overseas researcher can enjoy typically after establishing himself/herself in a specific research field. In India, the emphasis of education is more on the perception that a particular profession provides one a secure and safe future, whereas in Australia or elsewhere abroad, a person makes an informed decision after experiencing a little bit of all available choices and having a good exposure to a wide range of personal interests.

How do universities abroad encourage the scholars in converting their innovations in patents? How does this compare with our IITs?

It depends on whether you are into basic or applied research. For basic research, patenting is more important. For instance, our university has got its legal team in place. Usually, they take care of all the aspects of the process for example dealing with the intricate details associated with running consultancy projects. There are specific groups to provide guidance about securing intellectual property rights. But, I don't think there is push to go for patenting unless the research is really pioneering and impactful. I think more than the number of patents, it is the real value of the patent which matters so everybody including your research team would be keen to assess the reason behind patenting. Unless the value of the research makes it inevitable, people don't go for patenting. Again, this is my personal opinion, being from an engineering background. If you ask someone from the basic sciences, probably they would have a different take.

Do you think Indian research scholars need better and effective platforms for international exposure?

I certainly feel that Indian research scholars should get better international exposure. Presently, it is in the form of international conferences but it could possibly be in the form of exchange programs where students get to stay in overseas universities for a few months. In general, I find that Indian students feel hesitation to approach people, especially academic staff members from the universities abroad. They feel nervous to ask questions about opportunities. A lot of questions like how can I ask about post-doctoral position, should I first study the papers related to the concerned research topic, what the faculty member will think if I ask a silly question and so on might be popping in their mind. On the contrary, once you are exposed to the systems overseas and become a part of it, you will find that there is such a culture of openness that you feel extremely comfortable. I will give you a simple example from daily life. When I came to Australia, I had couple of concerns: filling petrol in the car, which I never did in India and checking the air-pressure in car tyres, which again I never did by myself in India. I was concerned that I might make a silly mistake but people are very helpful and they addressed all my concerns and made me comfortable. That openness is very important. You should express what you feel. Even if you don't know something, you should be able to express yourself. With international exposure, Indian research scholars will be able to contribute new ideas and researchers abroad may reciprocate the same through open interactions. So, such collaborative programs should definitely be in place. Currently, our team has been actively working on establishing collaborations with the universities abroad including IITs. Our faculty as well as university strongly encourage such activities and provide necessary monetary support. Moreover,

in Australia there are scholarships for permanent residents and citizens to visit overseas institutions on exchange programs. Some of my UG students have been to overseas universities like UIUC, Concordia for a semester or two. They get advanced standing for the courses which they complete during the exchange program. There are government scholarships for pursuing even research level internships in the US for instance. It is a very good means to broaden your horizons. Rather than riding it out alone in isolation, this kind of exposure definitely would be a good motivating experience for the research students.

One change you would like to see in Indian research environment?

Increase in Industry-Academia interaction is one thing for sure. The second thing could be more openness and healthy environment. Although IITs are different and better than other Indian institutions, in general if you observe overseas universities, most PhD students are supervised by 3 or 4 people. It is always a team which is involved in supervision, in writing research proposals, in interacting with industries and so on. A team environment is strongly encouraged. Different people have different strengths and everyone in the team can contribute uniquely and complement each other. This is how overseas institutions operate and that could be useful in our Indian system. Although research has to be done at an individual level, I feel once the above mentioned changes occur at the institute level, then it automatically becomes a culture. A culture is because of the people around. A culture cannot be changed unless the person is keen to be involved. I am fortunate to be part of an outstanding group with varied and strong theoretical as well as practical capabilities. We have very strong group interactions, brainstorming sessions and prolonged technical debates. Such activities are immensely helpful in research. Such open discussions are stimulating and are good learning experiences for those involved. IITs do have an open system as they are based on the USA-Canadian pattern to certain extent. But this culture needs to be nurtured/cultivated at an institution level in general. With that, if research scholars from Australia or USA visit IITs, they should feel at home. In this way, overseas researchers will be more keen to participate in exchange programs to visit India, wherein they can contribute and gain more knowledge in a conducive research environment.

How can synergy be built between the academia and industry?

Here, we tend to see that industries as well as academic institutions are equally keen to participate in collaborative research activities. In India, the situation is not the same. There are various different companies with international standing but might not see value in academic collaboration with IITs. In general, I think industry should prioritize and identify different research groups having different core strengths. They should have an option to collaborate with different institutions for different projects or different parts of a project. For example, one part of the project can be outsourced to IIT, other part to some other overseas institution and so on. This way a consortium of different academic institutions and an industry can be formed to capitalise on each others' strengths. Possibly, a body like Confederation of Indian Industry (CII) can build a systematic framework in association with IITs for establishing a platform for Industry-Academia collaboration and ensuring mutually beneficial guaranteed outcomes.

How can academic research contribute to society?

This is a difficult question. We all strive hard to make a significant societal contribution. Although research, in general, does contribute to society in some way, it is extremely difficult to quantify the contribution. We always ask ourselves a question: what are the tangible outcomes of this project (presumably) funded by a government i.e., a hard-earned taxpayers' money. The taxpayers may not be concerned about all the publications but would be keen to know what's in it for them. I feel any honest work definitely contributes to society in some way or the other. For that to happen there needs to be a education-industry-society connect. The industry would naturally be interested more in what is beneficial to it. On a whole, we can say that does depend to a large extent on the priorities of the government. For example, the Australian government sets its research priorities in the greater national interests i.e., largely based on preferences of the community, thus connecting to the societal needs. Typically, people working in the public sector and government funded research agencies collectively deliberate and come up with a set of priority areas. When research gets funded after going through such a methodical process, it is naturally expected that the community benefits will come out of it. In research, in general, one has to be patient, supportive and have faith, knowing that tangible outcomes cannot occur overnight. At the same

time, we as researchers need to reciprocate and put our sincere efforts into a research project.

What is the measure for quality research? Does the number of publications reflect quality research?

To a certain extent it is a relative thing. From my experience, I find that in a year there are only a few papers which contribute substantially to the research field. Even if you refer to those papers after many years, still you can unearth a lot of knowledge from them. This is probably the case even if we consider the situation over the years. There have been rapid changes over the years and many people are now simultaneously working in the same field on similar problems. The scenario has changed across generations. Presently, the education sector operates like an industry and enormous amounts of papers get published on any research field. This is a paradigm shift as compared to previous generations where more emphasis was on quality and not the quantity. Considering the stupendous amount of work being done presently, it is difficult to set a criterion for quality research unless breakthrough in the related field of research is the only measure. It is difficult to gauge the quality or significance of a particular work as compared to others. Since quality is not quantifiable, the number of publications is being considered as one of the key performance index. Perhaps, the best analogy to understand the situation is the movie industry. Over the years the kinds of songs composed have changed. Previously, more importance was given to lyrics as compared to contemporary songs. So people of the previous generation might feel that the songs of today are quite different as compared to those in the past. Yet even people of the present generation like to revel in old songs. In the end, it is a matter of perspective. The music is still enjoyed by everyone. The answer to this question will vary with respect to different people. If you ask me, I think from an individual point of view, quality of research is a relative term. The honesty of conducting dedicated research with perseverance is most important at all levels. It is not just the number of publications. There are many aspects involved. From my point of view, when you are engaged in different activities whether individualistic or group work or discussions involving other people, when you contribute sincerely, that reflects your intent. But from the vantage point of people at higher positions in the hierarchy, they need some performance index for benchmarking research. In such case, because of an extremely competitive environment, parameters like the number of publications and grants do become a measure of quality. I personally think that if you as a researcher in all honesty and sincerity put efforts to contribute to your chosen area, it will automatically eventuate into significant research outcomes. In that case, there is no need to have a specific measure of quality.

What is required to produce high quality research publications (eg: Nature)?

I think that one thing that is essential for high quality research output is passion. High quality research cannot have a set formula. It is a process in which many things are required. Academic credentials, grasping capabilities, insight are a few of the traits which are the essential ingredients. In addition, presentation skills are also important. For instance, if your topic of research is very abstract, you need to know how to convey it to reviewers/readers to facilitate their understanding. A balance of both is needed. In case of Nature, the review process is very different as compared to the journals like IEEE. From my interaction with a colleague from psychology, I came to know that a paper submitted to Nature can be rejected straightway if the reviewers did not find any originality. They have such a strong and clear discretion. This is different as compared to applied research where the review process takes a few months. Over a period of years, I have come to realize that the most important thing for quality research is you should thoroughly enjoy your work. Everyday when you get up from bed, you should get a feeling that you are working on an interesting problem. When you are extremely interested/passionate about something, you tend to read more, prepare, enrich yourself and engage deeply in the research process. Only then will you develop a profound understanding of the topic to be able to contribute significantly. That will eventuate into a high quality research.

Since academic institutions are not dedicated only to research, what fraction of time and resources should be shared between teaching and research?

We have a four pillared structure here – Research, Teaching, Academic governance and Community engagement. A balance has to be struck between the different aspects. There are various pathways to

achieve this balance. Different institutions have different ways of achieving this. For e.g. in IITs and most institutions overseas there are study leaves/ sabbatical leaves which enable you to dedicate yourself to a particular research problem. At other times, balance should be achieved primarily in teaching and research as all the other aspects can be taken care of by your active involvement in the departmental activities. It is difficult to quantify what fraction of time should be shared between different activities. At an individual level if you are interested in a particular research problem, you may like to dig deep into it. Similarly, a passionate teacher may dedicate more time and efforts in developing effective pedagogies for different groups of students. So it is a relative thing. In general, the fraction shared between research and teaching cannot be fixed.

For scholars aspiring to become academicians, should there be courses to hone their teaching skills? What advice would you give to research scholars aspiring to have career in academics?

In my case, I never thought of becoming an academician while I was a student. I always worked with the industry and felt that there are a lot of research problems with the industry where I can contribute. My only remote remembrance about academic aspiration was that my friends used to say to me I would become a good academician by virtue of my communicative nature. It depends on where you work. The industry being a profit making enterprise, they are not interested in open ended research activities. My postdoctoral experience was an eye opener which made me realize my liking for academia, which prompted me to become an academic. I think postdoctoral experience does help if you are interested in becoming an academician. Also, teaching assistant duties like conducting labs and tutorials are good ways to develop teaching skills. Another exercise which can prove useful is a teaching survey. In institutions overseas, anonymous teaching surveys are conducted wherein the students are asked for feedback regarding a faculty member in the form of ratings and comments. In that way, you get the honest opinion of students which helps you understand your inclination as well as improve upon your teaching skills. An international exposure can be definitely useful for Indian research scholars to learn about the pedagogical practices in different universities and sharpen their skills. I think these are the different ways in which teaching skills can be honed in-house as well as through international exposure.

What is the distinction between your stay at IITB and your current profile?

The distinction between my days at IITB and my current work profile is that, at IITB I was involved in core research and was a part of student community, but now the scenario has changed and it's a multitasking process for me as an academic. As I mentioned earlier, I have been working on a four pillared structure involving teaching, research, academic governance and community engagement. I have number of students working on a wide spectrum of research problems which is indeed a challenging task which includes congregation of literature and updating yourself with the state of the art information. As my experience goes, in the initial year or two, supervisors need to have in-depth discussions, deliberations, brainstorming sessions with the PhD students, but in subsequent years the students start owning the project and supervisors start learning from them and end up being on the receiving end. Through the entire learning process, you need to put a lot of time and efforts to be able to come up with a viable solution for your defined problem statement. If you are really enjoying your work then it's bound to be an enriching experience. It's like learning everyday which is the best thing that can happen to you. Core Research, if enjoyed, is very simulating, encouraging and a medium of self motivation. The days at IITB were a golden phase of my life. We had a strong research group and an outstanding research environment. We used to have endless fruitful discussions amongst ourselves and used to have strong human networking through the mode of various conferences and workshops. From my perspective, it was really a priceless journey. The outstanding aspect at IITB was the supportive framework. For instance, may it be any reason, personal or official, we could meet Prof. Khaparde who was always accessible for students and garner the kind of support a student expects during tough times. I always assert that PhD is extremely different as compared to any other programs. Bachelors and masters program are more course work centric, but PhD is a long term commitment wherein a lot of things are happening in your lives apart from research. Lot of personal circumstances keep on changing and challenging you as in someone might get married, someone might have medical problems and a lot of other such things are happening on personal front. As I said earlier, in these testing times, you need somebody to support you. Here a mentor or a guide plays a vital role. He must act as a fatherly figure who is supportive and must be capable of appreciating what is

happening around to make the student feel that level of comfort. Way down my memory lane, I always feel humbled and a sense of gratitude arises when I remember some fatherly figures like Prof. Khaparde, Prof. S V Kulkarni. In today's world, it's a rarity to find such down to earth personalities, to whom you can easily approach and express your situation, and balance your research commitments. Overall, I thoroughly enjoyed my IITB days. I never thought that I would be migrating to Australia. I came to Australia as a postdoctoral research fellow after working for couple years in one of largest generating companies in India. I am a firm believer that you should enjoy what are you are doing. As compared to my earlier work commitments, here the good thing is that we have strong connections with the industry and an outstanding group of researchers and mentors. I have always been very keen to work with the industry. Herein, I get an opportunity to interact with our colleagues from industry on various technical matters. Also, I get to do academic research work with my students and try to establish synergies between academic and practical research.

Any advice in particular you would like to give to current research scholars?

Lastly, my advice to current research scholars is enjoy your research to the fullest and most importantly, keep the same approach going even after finishing your PhD program. Importantly, PhD is just the beginning of the research process; afterwards, it is entirely up to you how you want to take it further. Also my personal suggestion is try and avoid correlating monetary benefits with research work. If you really take pleasure in what you are doing and are honest to yourself, all other things slowly are bound to fall in place. Another important point is: Good to be ambitious but avoid being overambitious in life!

ALL THE VERY BEST IN FUTURE ENDEAVOURS!!!

Dr. Ayesha Chaudhary
Co-founder, Windmill Health Technologies Pvt. Ltd.
New Delhi

8 — Views of Dr. Ayesha Chaudhary

Dr. Ayesha is a co-founder at Windmill Health Technologies Pvt. Ltd.- a healthcare innovation start-up based in New Delhi, India. She received her Doctoral degree in Biomedical Engineering from IIT Bombay, where she developed implantable glucose biosensors for diabetics, and was awarded Gargi Vishnoi Memorial award for best PhD thesis. She is a gold medalist in Biotechnology from Banaras Hindu University. After her PhD, Dr. Ayesha joined the Stanford India Biodesign fellowship. Currently, she is developing an infant resuscitator device that will empower both pediatricians and frontline health-care workers to resuscitate newborns effectively, prevent neonatal deaths and thereby reduce neonatal mortality. Dr. Ayesha was recently named as one of the Young Innovators in India for 2013, by MIT Technology Review magazine, for her research contribution.

Interviewed by Neelam Rana[a] and Sivamuthu Prakash[b]
[a,b]CTARA, IIT Bombay

Motivation for Research

I wanted to work for something which would improve the life of people and have impact on society. I always felt connected with science and so developed interest towards medical sciences where I can come up with innovative solutions. I started with microbiology then moved to biotechnology for my masters and then to bio-engineering for PhD. The real switch happened when I joined PhD and realised that research and innovation should not be confined within labs and should be transmitted to the real world. My aspiration to bring positive change in lives of people has been the driving force which led me into science and research.

Research culture in IITs and universities abroad

The approach to research as such is very different in the US and Europe as compared to India and there we can find more application oriented collaborative researches. For example, we worked on developing a low cost diagnostic tool where Stanford Medical School, Design School and Engineering School were involved. In India, the academic research is somewhat disconnected to industries. Researchers abroad are more independent in performing their research activities. Especially in terms of using the instrument facilities scholars have direct access to operate them. In India we have research assistants to, whom we need to give the sample and then wait for the results. Also, in contrast to universities abroad we lack a

predefined timeline for our academic research program which needs to be addressed.

Challenges in academic research in India

In India, we do not have positive perspective towards academia which is mainly because of underpayings, making it a last career option. In case of research, there is a gap between academia and industry and so academic research is more focused on basic research and even the applied research does not transform into products. There is a disconnect between academic research and real market needs. We need to have a better platform where faculty members and students can have open discussions to share knowledge and learn from each other.

Teaching and research

Professors need to dedicate more time to research students especially during their initial phase of PhD, in order to guide them towards the right direction. At the same time they need to give time for teaching and training to impart knowledge to students and so, 60 percent of their time for research and 40 percent for teaching can provide a good balance.

Reductionist approach to research

Research always opens the avenues to various disciplines and widens individual's learning. Research inculcates logical and analytical thinking for problem solving. Multidimensional research depends on the interest of supervisors and students. Although IITB has the environment, researchers need to be proactive and learn from other labs.

Measure of quality research

Measure of quality research mainly depends on the type of research whether it is fundamental or applied. Publications are important for sharing the knowledge which will help research to reach others and bring recognition for researchers in the scientific fraternity. But at the same time, one should not stress just on producing publications and spend more time on creating them. We need to strike a sweet balance between the time spent over writing and research.

Academic research to patented and commercial products

The transformation is definitely slow in India, but IITs still score good in this aspect as compared to other institutes and has good linkages with industries/hospitals. However, as compared to the US and EU countries, IITs have low rate of transforming research into products and patents. Recently, Dr. Rohit Srivastava (Biosciences and Bioengineering Department) came up with two different devices (glucose sensors), which were launched into the market and have been taken up by the Government of India for commercialisation. Because of the disconnect between industries and academia the transformation rate is relatively slow in India.

A bridge course for research scholars to be academicians

It is a good idea because there is no harm in trying to refine the teaching skills, if someone is really interested in pursuing academics. Teaching and managing students is also a skill which one should learn. Such programmes can be made optional and people who are interested should be provided with such an opportunity. Such kind of training would certainly help in managing graduate students and laboratory, and presenting research work in conferences.

Synergy between academia and industries

Both the sectors need to cultivate positive attitude and respect towards each other's work. Increase collaboration through academia/internship/PhD/Masters projects which should be governed by real demands in the market. This would be good for both students and society. Efforts from both sides are needed and

to be able to ensure smooth functioning MoUs can be developed. Industries can identify a problem and through universities/institutions collaboration/support can find a solution to the problem. This way the gap can be bridged and both parties can benefit.

Academic research's contribution to society

Society has number of problems in regard to health care and people are not able to fulfill basic necessities. A academia can identify these problems and include them in curriculum. Direct application based research in IITB: In Bio-sciences department various labs are working on products - that are directly applicable to real life problems. *Prof. Banerjee* is working on applications directly dealing with cancer therapy and now is in a position to commercialise. *Prof. Soumyo Mukherjee* is working in this direction and has a start-up to further develop and commercialize his technologies. Yes, based on these examples, IITB does follow this approach and is working towards solving society problems.

International exposure for research scholars

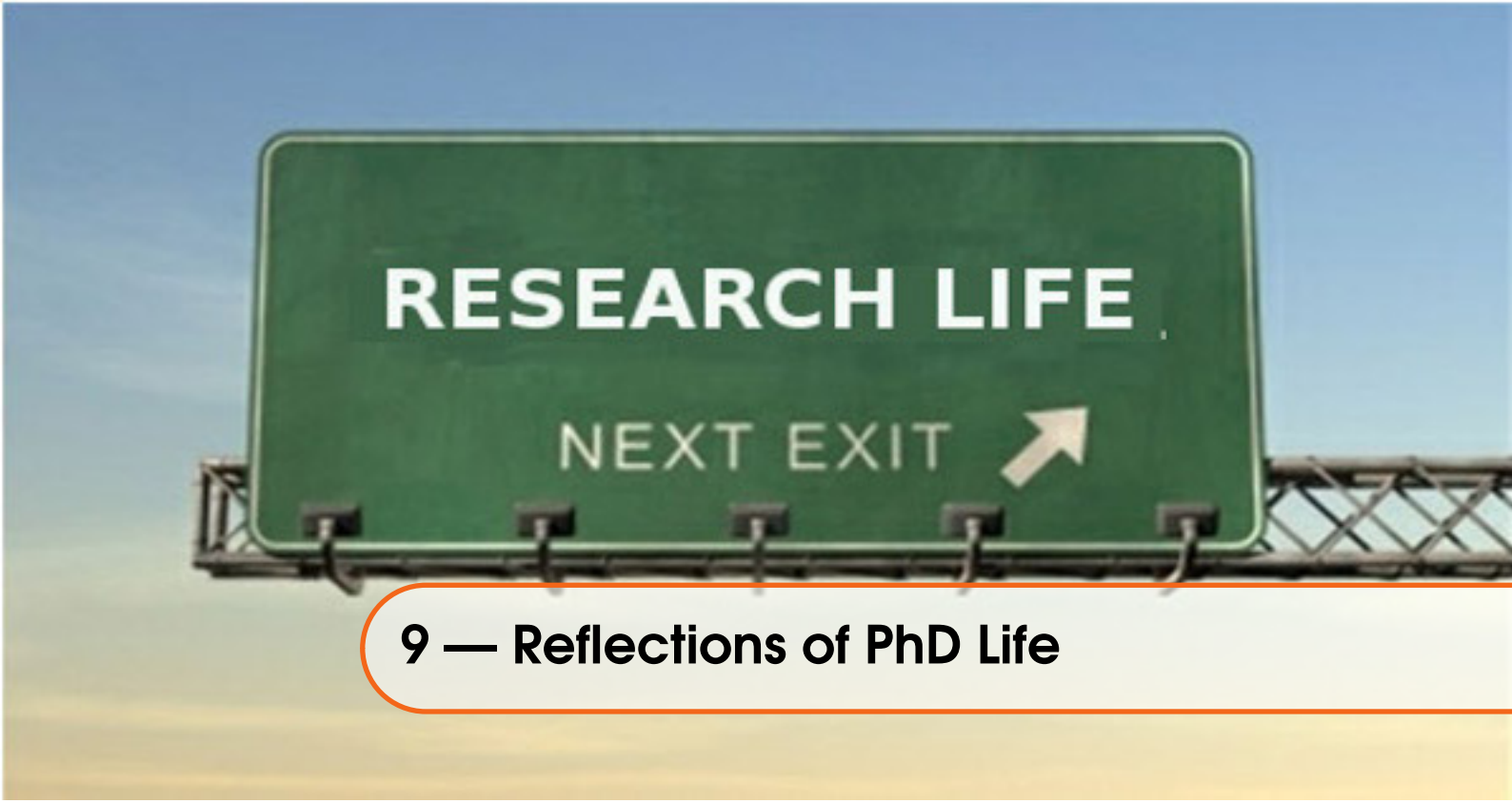
The research environment outside is very different, full of life, full of energy. There is a two way interaction and flow of knowledge between supervisors and research scholars. In such an environment one becomes more innovative and enjoys working, and this broadens the horizon.

One change I would like to see in Indian research environment

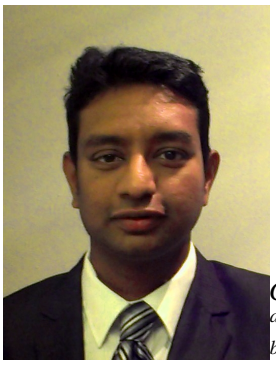
An environment that fosters and promotes innovation and ensures this innovation goes to market and to the society.

Advice to the research community

Research requires lot of patience so scholars should pursue it only if they are really passionate and have inclination. Supervisors should provide freedom, openness, and support to the scholars and treat them as individuals and professionals.



9 — Reflections of PhD Life



Contributed by Prof. Yemula Pradeep Kumar[a], Gelli Ravikumar[b], Eranki L.N.Kiran[c],
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Research!! can be degreed with a doctor of philosophy (PhD), which is the paramount for collection, discovery and generation for knowledge. Knowledge transfer is the key element from generation to generation and has to be religiously practiced and advocated by teachers. So, it is indicative that teaching as a profession makes knowledgeable societies on this living planet. Moreover, we certainly need both teaching and research. Teaching for maintaining knowledge society, research for improving the same. Some animals such as elephants also have knowledge transfer from one generation to another, but their research is little slow. In my personal opinion, research can be collaborative and continuous with having research environment and spirit of research.

Collaborative research is more effective if a small team of students (PhDs, MTechs, BTechs) come together and solve parts of one big burning problem, as compared to each of them solve individual smaller problems. I find it absurd when I see fresh M.Techs wandering clueless in the department in search of *"MTP topic"* while the PhD's are silent in their own world and limit their scope of research saying *"how much can one person do?"*

Continuous research: once a research scholar completes and leaves the institute the research on that topic should not end at IITB. There should be knowledge transfer from seniors to juniors, where in the juniors build upon the findings of the seniors. Overtime, such a culture of continuous built up of research would improve the quality of research significantly. The junior-most batch would find themselves standing high on the shoulders of the seniors and hopefully this results in pushing the frontiers, and breakthrough findings. This might be one formula for success of world class research institutes.

Research environment includes basic things like proper equipment, lively labs, fast computers, adequate lighting, comfortable furniture, etc.. would go a long way in focusing the minds of the students towards the research problem at hands.

Spirit of Research !! "If you know what you are doing, then you are not doing research." Research is like an adventure tour into a forest, where one does not have knowledge of what may come across. Research scholar must be adventurous enough to take up the challenge. Statements like *"I don't know anything about this topic, so I can't work in it,"* limits the capability of the researcher.

Excerpts from Pradeep's PhD Life

Wednesday, July 29, 2009: (*Note: All events mentioned are real.*) The day started at 10:45 am when I woke up in horror realizing that I had to be present by 11 am at a presentation in our lab by Vaskar my senior. My Prof also would be there, I can't afford to be late. A quick walk from my hostel to lab would take at least 5 min. Jumping out of bed I rushed into the bathroom. I get ready and rush to lab about 3 min late. Fortunately for me, there was a major power shut down due to some fault and the power was only expected late afternoon. I spent some time in lab listening the discussion of my Prof. Khaparde (1) (referred to as my prof) and Vasker about the presentation. Its 12:30 now and I got an idea to prepone my meeting with another prof. Sharma (2) from math department. I called him up and met him immediately. He is writing a book and I am kind of helping him out in typesetting the write-up and sprucing up the figures in the book. I showed him my work from yesterday and left to hostel for a quick lunch. Then I remembered that I had to make a presentation for a conference on 30thJuly, in Canada. It's already 29th July here, but the good news is that Indian time is about 11.5 hrs ahead of Canada time, so I have half a day bonus on my deadline. Another Prof. Haq (3) is expected to present our slides in that conference. So I immediately got to work on it on my laptop from my hostel room. In an hour or so, I could put together some 12 slides and still there is some work to be done on it. But I thought of taking a break and a quick nap.

I enquired on phone and confirmed that power has still not restored in EE dept building and asked a friend to call me immediately once power comes. Its 2:30pm and I ran an audio lecture on my computer by Prof. Richard Feynman (4). Feynman is a legendary teacher and I like to slip into sleep listening to his audio lectures. My nap was only up to 3pm when I realized that I had to get back. I had a quick shave and face wash, looking good again, I started back to lab. Meanwhile the power came back and Vasker was ready with his presentation. But I had one more appointment at 3:30pm with yet another Prof. Agashe (5). He will be trying a new way to teach tomorrow, by means of an electronic pen which writes on a computer screen and the image on screen and his voice will be recorded live while he lectures to about 100 students in a class room. I am supposed to be the "tech support guy" who would handle the recording software and hardware problems (if any, I am sure they will be). Well that lecture is tomorrow at 11am. We discussed the technicalities and the bottom line is that I have to present at his class tomorrow. I concluded this meeting and went to the first floor where Vasker was already in his 8th slide presenting his work, which went for about an hour and half with lot of cross questioning from my prof and me!

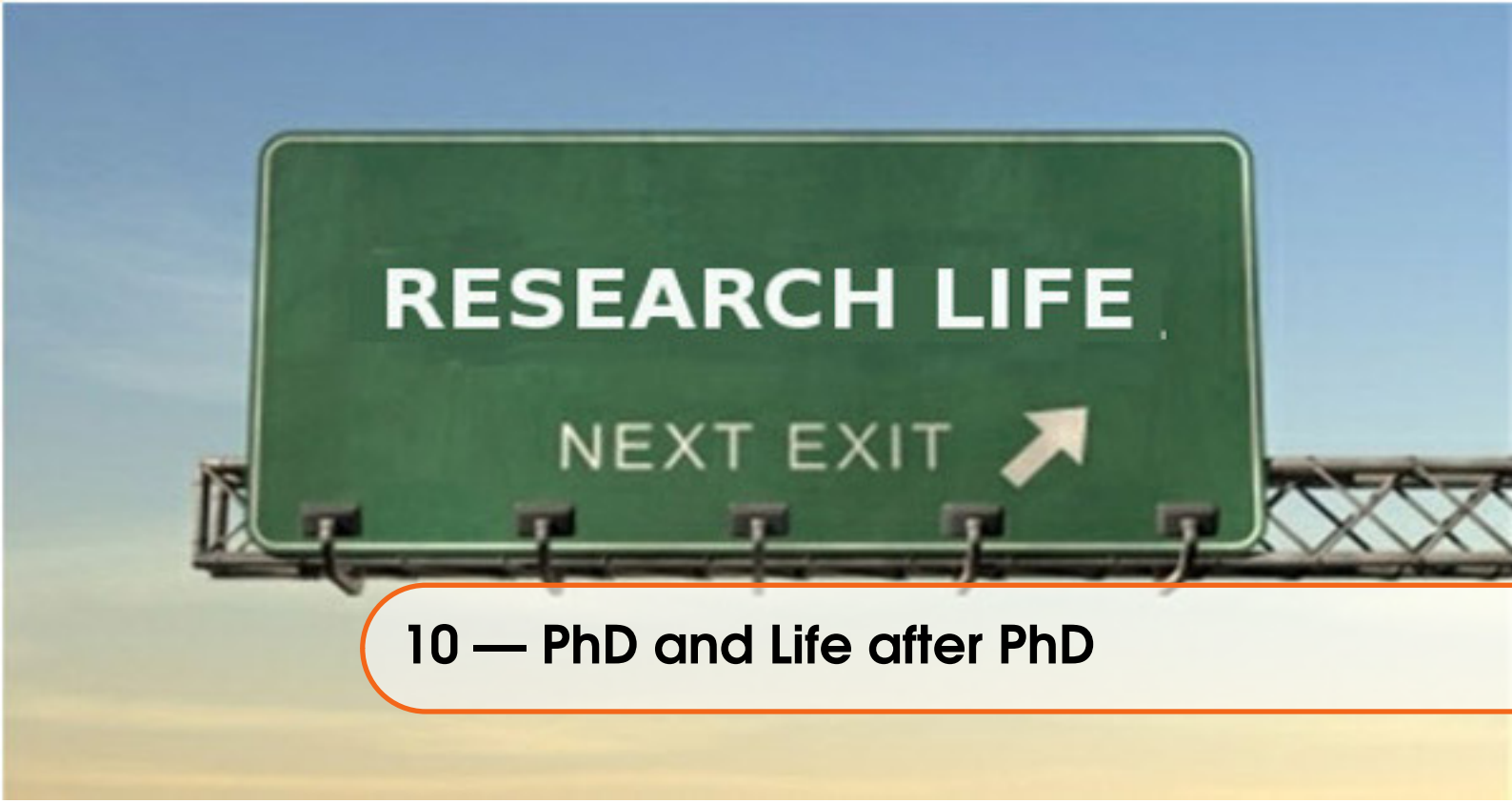
Oops its 5 pm and time for another lecture by yet another Prof. Ivar (6). He is a visiting faculty all the way from Norway. We had a last minute venue change for this lecture and we had to guide the students to new venue. My Prof was interested in the lecture as well so he also came in as a student. I sat with him in the back bench and opened my laptop and showed him the ppt that I made in the afternoon. I promised him to finish it before dinner time because it has to go all the way to Canada on e-mail. But the class went on almost up to 7pm. From there I had to meet yet another Prof. Kulkarni (7). I was supposed to do some debugging of a code written earlier by his student. I asked him a couple of days time for it as I had too much to do already. Then I got a call from my Prof and he wanted to know the progress of my actual research work. For this I said I can present some slides tomorrow evening. There goes one more activity for tomorrow. I was thinking of leaving back to hostel then I received a call from Prof. Sharma, he wanted to see me regarding the book he is writing. We decided to meet at 8:30 pm in his office. This was unexpected. Meanwhile, I opened my laptop again and started working on the half completed ppt.

I had to download an old ppt from the server and included some slides from it. All in all by 8:30pm I

finalized the ppt with some 20 odd slides. I mailed it immediately to my prof who in-turn reviewed it and immediately forwarded it to prof Haq in Canada. Oops again its 8:35 now I called prof Sharma and told him that I will reach his office in 5 min (which is in second floor of math dept). I had to quickly lock our lab, submit the keys at security and rush. There I spend about an hour trying various options of image processing parameters and finalizing the one that he prefers to be included in his book. Once I am done for today I said I shall meet him tomorrow with some more work. I finally reached back to hostel hungry at 10pm. I ordered some food from canteen had it, called up home and talked to my mom and then thought of typing this blog. But the point that I want to highlight here had never came up until now. see the next paragraph, the one that really matters.

If you have kept track of the count, I mentioned about 7 professors above. Now, all of them (except one Prof) are in their late 50s. Some in their early 60s as well. They might have got their PhDs when I was not even born!! And they were teaching since then!! Which means that their teaching and research career is bigger than my age! Despite being at that age, I see these profs with great energy and enthusiasm. They are already brilliant, intelligent and still want to excel. One is writing a book and deeply concerned about quality work, one is helping out his past student in debugging a code, one has come all the way from Norway (other side of globe) to India to teach, one wants to use video recording and projecting software to keep up with the times, one is a chairman of a session in an international conference and so on...! As you can see they work in their offices up to 8:30pm in the evening. I wonder if I can have such energy and enthusiasm and zeal for life when and if I am 60. I am happy and deeply satisfied that I am in Indian Institute of Technology Bombay, a campus with a motto *"Gnanam Paramam Dhyeyam" (Knowledge is the ultimate aim)*, a campus where profs compete with students in work. A place where pursuit of excellence is a way of life.

The only question that I asked myself is - *"Am I doing enough of work which I am expected to do? Am I standing up to and with holding the academic standards that IITB represents?"*.

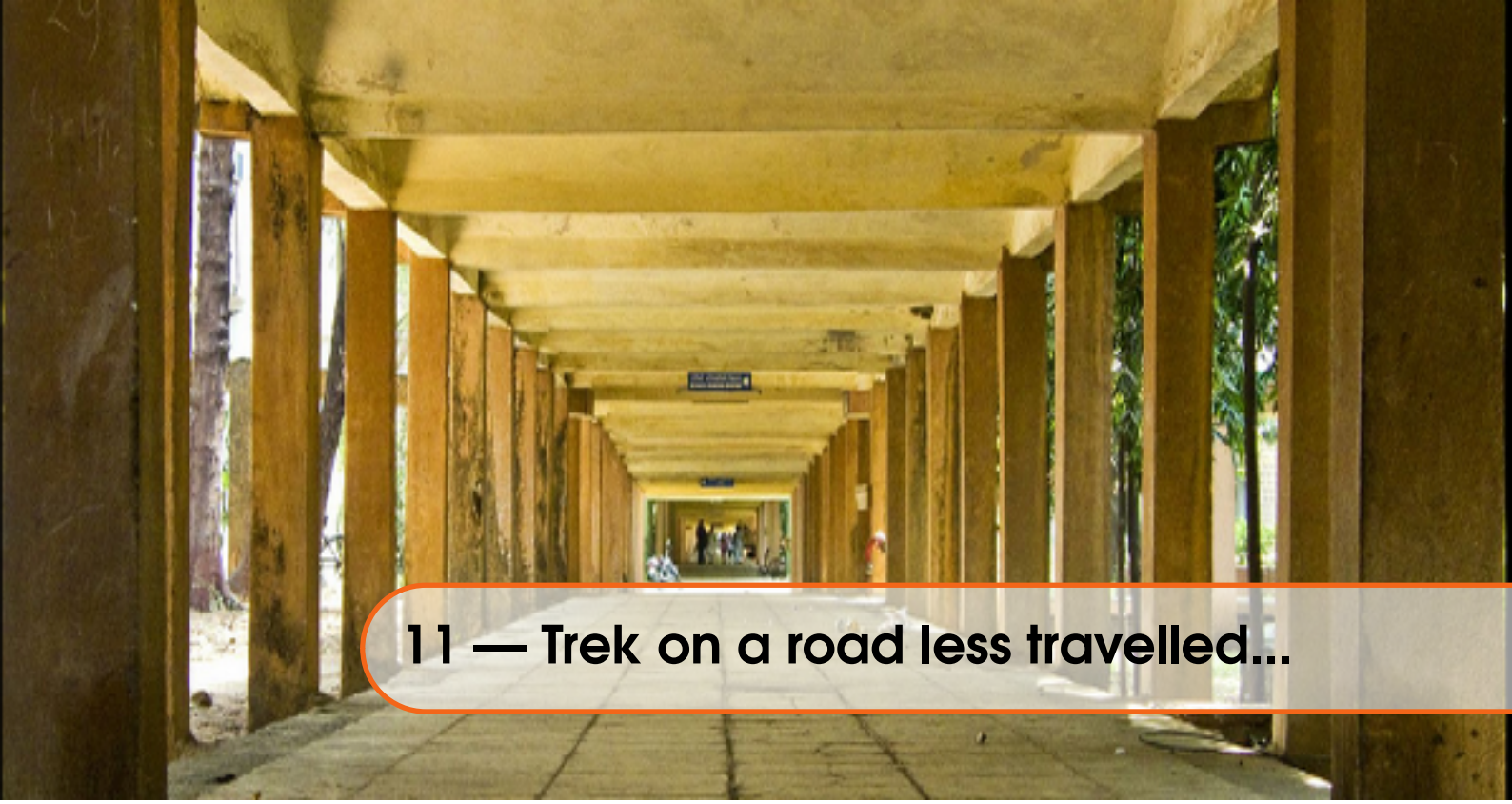


10 — PhD and Life after PhD

Contributed by Prof. Asim Tewari, Mechanical Engineering, IIT Bombay

The last stages of PhD can get you so involved that you often ignore the question of what after PhD. The question of life after PhD sounds similar to the eternal rhetorical question of life after death. But it certainly has more in common to this question than just the sound. *A good PhD is a near death experience, where you reinvent and redeem yourself from a seemingly hopeless abyss.* The years of doctoral dissertation work are in a sense a compressed life span, with its share of highs and lows. Doctoral research conditions your mind to face the most arduous problems in life and makes you realize that if you persist then you can prevail. After completion of PhD, it usually takes you some time to accept the new reality that the doctoral research is complete and you can and should move on with your life. The original research contribution in the doctoral dissertation is certainly a major achievement of the doctorate. However, the bigger achievement is the understanding of the process which leads to original research. The completion of PhD delivers a fulfilling experience of humanistic curiosity leading to a long elated state.

The award of PhD degree is the final step in completion of a self-replication process. The doctoral supervisor successfully replicates his or her PhD degree in the student; which in turn empowers the student to produce more PhDs thus continuing the process of self-replication. Each newer generation of PhDs imbibes characteristics from the previous PhD generations and at the same time acquires some newer skills.The planning for post-PhD is a serious and important activity which should start well in advance.The opportunities for PhDs in this current time are enormous with a demand which is far more than the supply.A PhD puts you in an elite group of professionals which enjoys the exclusive access to teaching and research opportunities in advanced institutes and corporations. However, due to the super-specialization of the dissertation work, it is often desirable to also have diversified knowledge in a broad area. This could be planned by systematic exposure to other research activities or through a post-doctoral experience in an adjacent field.The planning for this needs to be done in accordance with the long-term professional and personal goals. The two major career paths possible after doctorate are in academics or in research. The two however require certain different skill sets but need not be mutually exclusive. Professionals in academic career are encouraged to have industrial research experience and likewise, corporate houses highly value experience in academic research. *However, let us not forget that life after PhD can never be the same again, since your name will never be the same again, of-course with those two letters "Dr".*



11 — Trek on a road less travelled...

Vijay Hanmant Honkalaskar's research voyage in a tribal village. Vijay has submitted his thesis in July, 2013 at CTARA, IIT Bombay.

I completed dual degree (B.Tech and M.Tech) in the department of Mechanical Engineering, IIT Bombay in the year 2007. Thereafter, I worked with Suzlon Energy Limited for a stint of six months. I did not find the work challenging and satisfactory. Therefore, as my research interest goes, I joined CTARA, IITB to carry out action research in the field of tribal development in January 2008. Since my first year of dual degree course, I was associated with the Group for Rural Activities (GRA) in IITB. This initiated my interest in the field of socio-technical development of rural areas. I worked in a tribal village, Gawand-wadi (around 120 km from the campus) for around five years to carry out action research with tribal people. This was quite challenging, satisfying and learning exercise.The challenge was to make friendship with the villagers and to carry out action research with them for their betterment as per their desires, feelings, perceptions and choices. Secondly, it was a relatively new paradigm of research as there wasn't much in terms of relevant literature in this field. It has been quite satisfying work for the key reason of being part of a group that is trying to contribute a relevant (in the present context) research for people's development.

Over these five years, there were a number of dichotomies I dealt with, related to the doctoral work. First one is about flatly organized working culture at IITB and seasonally and relatively less organized working of tribals. It was difficult to keep a thread of work between these two. On one side, Research Progress Committee required a rigorous, disciplined, and timely work. While on the other side, the villagers would carry out the work as per their convenience and seasonal lifestyle. I had to respect both mindsets and practices. Second dichotomy is about the centring on action research from IITB side and focus on the work of people's interest on the villagers' side. Many times, I was involved in carrying out a number of things (such as getting ration cards from local Government offices) that are not related to the research. I had to always keep my eye on both the sides so that I could uphold people's interest in action research work and at the same time conduct action research. Third dichotomy was between idealistic fixes directed by RPC members and the context appropriate choices required for people.

As a part of action research work, I worked to reduce drudgery of women associated in firewood fetching activity. I carried out thermo-chemical modelling of the traditional cookstove to understand the thermo-chemical dynamics for its improvement. I studied the available literature on the cookstove modelling and could perceive a striking fact that most of the conventional modelling is centred on the objective of publication and not on the emulation of the reality. For me, it was not enough to show a novelty in my modelling so that I could publish a research article. I had to emulate the thermo-chemical dynamics in the model so that I could find the key areas of improvement and improve the thermal performance of the cookstove. Thus the strategy I followed was reality emulation modelling than publication oriented modelling. This was the fourth dichotomy. At the end, we (my research guide Prof. Bhandarkar, the villagers and I) could contribute a set of things. Some of these include: 1.Development of a device, Twisted tape pack, that is locally manufacturable and can be simply retrofitted in the existing cookstoves to improve its performance by around 25% and to reduce indoor air pollution significantly. 2. A participatory decision making methodology to select the best alternative among the available ones. We could select and implement a community level water supply scheme in the village in a participatory way. 3. A comprehensive and much realistic thermo-chemical model of cookstove. 4. A methodology of studying and selecting the development agenda with people.

The overall exercise taught me a number of things. Although it looks paradoxical, I am convinced over the years that novelty in action research can be achieved by going closer to the reality and building over the reality. Most of the time, we build our understanding of a phenomena or a system by holding a set of simplistic assumptions about the basic principles, procedures, tools, attitudes, and methodologies. I think that a researcher should question everything that is followed or taken as granted in the respective field. Since the time when science and technology was recognised as key elements for human development, these fields have been grappled with reductionist and mechanistic point of views. My doctoral research experience gave me an opportunity to study systems theory, which presents another worldview. Other than reductionist study of different elements of the system (this is predominantly followed in most of the disciplines of science and technology), systems theory gives attention to the pattern of interconnections of different elements of the system. I learnt to connect backward and forward linkages of technology to our society and ecology. I could also come across a wide and deep spectrum of ideas for development including a number of ideologies, practices, paradigms, traditions and mindsets.

In real life, people see contradictions between different ideological thought processes and practices. Being a systems thinker, I do not see such contradictions. Rather I could appreciate the importance of different ideologies in different contexts. I also recognize that the experience of doctoral research work helped me to increase my patience, will, and perseverance to carry out any kind of work. I would like to share my understanding of proliferation of our ideas into a research contribution. An idea is like a child. It takes birth from our understanding borne out of rigorous study, discussions, plans, strategies and reports. A child requires a healthy and pleasant environment at home to grow into a mature and responsible human being. Similarly, an idea requires a healthy and pleasant environment created by our efforts, perseverance, pleasant and candid interactions with our guide, and our love towards the idea. Otherwise, it does not grow properly and evenly and does not contribute in a great deal to the research community.

I submitted my thesis in July 2013. At present I am involved in a number of social ventures. I (along with a number of local friends) have started spreading the socio-technical work in Gawand-wadi to the other villages in Karjat block. I am a part of a group *'Tech-for-Seva'* that is trying to create a platform for different stakeholders of rural development (technical institutes, NGOs, and CSR of different corporate houses) to come together and carry out grass root work. I am also a founding member of a social business, *Jan-Technology* that aims to develop and disseminate appropriate technologies at grass roots through commercial mechanism and to provide technical and structural support for the traditional businesses run by artisans. I seek to contribute to the development theory by carrying out action research in a number of areas of people's importance at the grass-root level.

12 — When a teacher came for PhD...

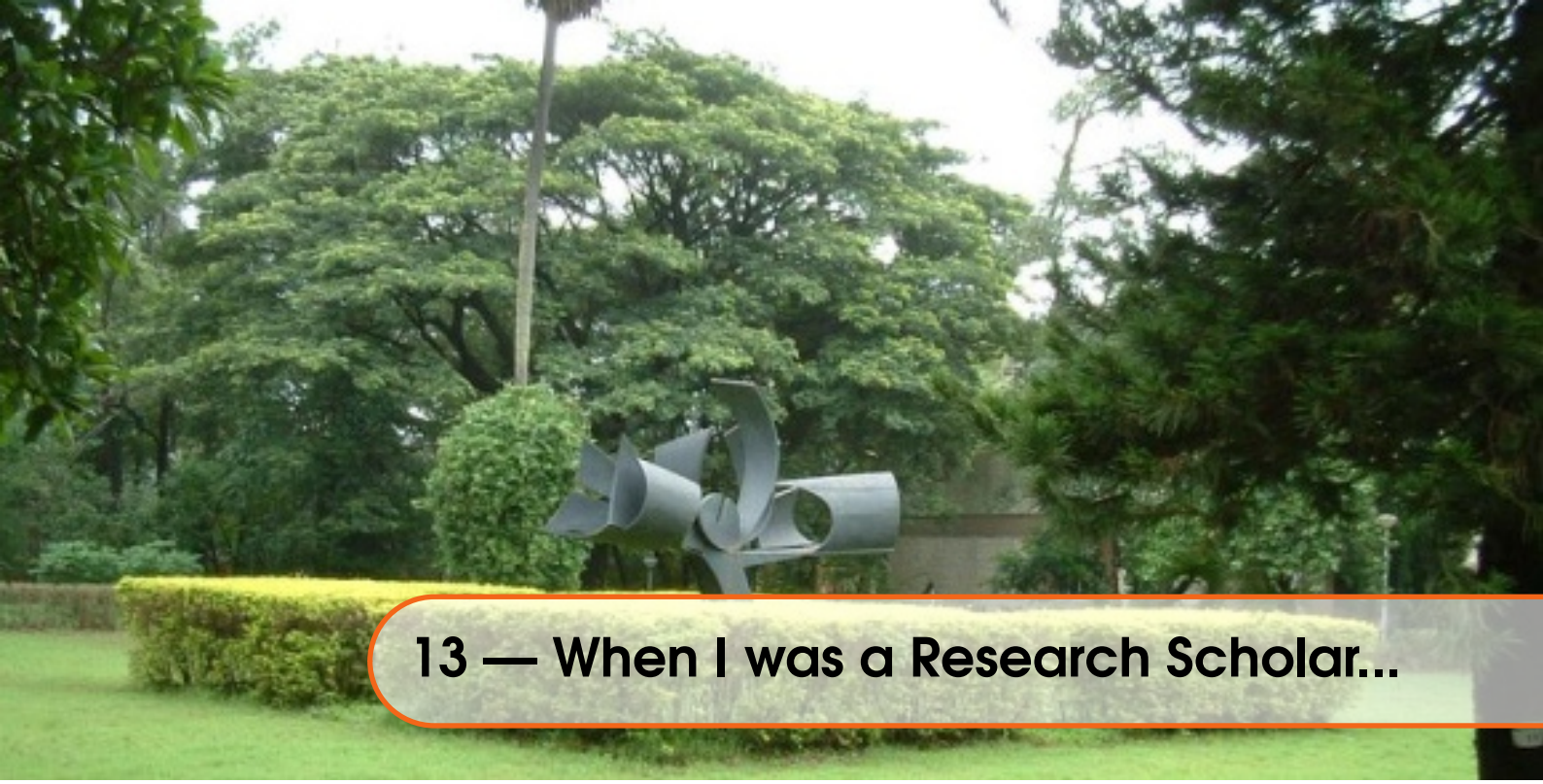
Chetan S. Mistry, Aerospace Engineering, IIT Bombay.
Chetan has just submitted his thesis.

It was really a joyful moment for me and my family to hear about my admission as a PhD research scholar in Aerospace Engineering, IIT Bombay and my dream came true. It was really challenging for me to sit for hours with BTech, MTech and dual degree students as a "student". I left my job and came for PhD. I was in teaching profession for nine years before joining PhD and it was difficult to set my mind as a student. But as time went, I realized the reality and mind accepted the command of being a student. Examination system was totally different from the university I belonged to. It was really tough time to prepare for midterm exams.

After successful completion of coursework, the real work started. Looking at the trend and research demand in global market I proposed my research field to my professor and he agreed to work on the topic. The research topic on which I worked was never thought by me before coming to IIT. It was really a critical situation for me as availability of literature was limited. Most challenging task for me was design and development of experimental setup with necessary instrumentation. I started from scratch for developing a full fledged unique experimental setup. The successful development of the experimental setup gave me confidence to be an independent researcher.

My work was appreciated by ASME IGTI board when I was awarded *"ASME 2013 Young Engineer Travel Award"* in the USA. The award announcement conferring *"the award to the Indian Institute of Technology Bombay, India"* gave me the pride of being *"an Indian" and an "IITian"*.

The work on my thesis has been often exciting, sometimes challenging but always an interesting experience.



13 — When I was a Research Scholar...

Snippets of PhD experiences from Faculty@IITB

A faculty is the closest associate of any research scholar. Every faculty has experienced the joys and sorrows of a PhD life. This experience repeats for professors when they have to go through these phases with the experiences of their supervisee. RSAS Team has collected the snippets of memory lanes from our faculty's PhD life. These memory bytes open a window in the PhD life of faculties in various departments of IITB.

I miss those days when I could drop onto my lab at odd hours and do my experiments. Occasionally, I had company from the friendly campus security guard who on his routine patrol would get curious on seeing me in the lab running the noisy wind tunnel at odd hours.

Prof. A. M. Pradeep,
Aerospace Engineering

Being a PhD student is an experinece in itself. One gets to work on problems that interests us. Apart from this, we get to learn several other aspects related to academic life. Many of these may seem useless/inconsequential then, but when I look back it is amazing how they have shaped my attitude, ability, thought process, etc. I have fond memories of working with our lab-mates over long hours, waiting endlessly for a 2 min meeting with my guide. The best part was my 5 semesters of full fledged teaching that has made me what I am today. The graduate teaching fellow seminar series was something that we could not miss. All in all academic and non-academic life at Penn State is something I will cherish all my life despite many ups and downs!.

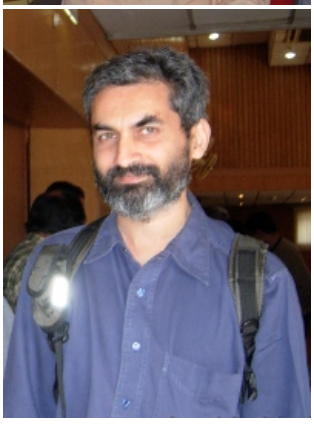
Prof. Arunkumar Sridharan, Mechanical Engineering

Though getting a PhD is not everything in life, the process that I have undergone during PhD made me altogether a better person (both personally & professionally).
Ideally, it also makes every person to feel that what I knew so far is an iota of what is existing in this world. This gives a chance for learning throughout your life.
Prof. Prakash Nanthagopalan, Civil Engineering

I enjoyed collaborating with colleagues from other departments and universities. People from chemistry and biology tend to think a bit more like experimentalist while as a mechanical engineer working in computational techniques, I used to think like a theorist. Over the years, I have tried to change my way to solve a problem which comprises of both theory & experiment. While a new experiment is new data in its own right, the models to explain the new data should be constructed in proper context. My five years of PhD can be summed up as an effort to make proper models for new measurements.
Prof. Rajneesh Bhardwaj, Mechanical Engineering

I remember that I learnt a lot from the other PhD students in the Department and even the Institute. One Saturday afternoon, in the coffee house when I met Sai, a PhD student in the mechanical engineering department and complained about some calculations, he and Pradeep (another PhD student from mechanical engineering) spent the next three hours teaching me maple that saved me at least two to three weeks of laborious manual calculations. It is there that I understood that with right kind of peers, it is possible to do good work with a lot less effort.
Prof. M. P. Gururajan,
Metallurgical Engineering & Material Sciences

The formal as well as informal discussions with the faculties had been really inspiring and generated lots of enthusiasm to work hard and focus on the real issues of research. The interactions with fellow research scholars as well as MTech students broaden the vision and gives insight into each other's work. The greatest learning experience had been the failures in some aspect of the research work, as it became a stepping stone for a remarkable progress in the following research work.
Prof. Atul Sharma, Mechanical Engineering



I was a PhD student in John Hopkins University from 1986 August to 1990 June. I may have been one of the last generation of users of Tex (not latex) to write my thesis. The only way I learned anything in my area of work was to try a set of assignments in each course in each week (no excuse to "solved" problems or internet resources). I used to try to be at my desk at 8:00 am (when my advisor would come for work) and at 5:30 pm (when he left for home) so that he had a very flattering picture of my total working hours.
Prof. Narayan Rangaraj,
Industrial Engineering and Operations Research (IEOR)

★ I learnt Linux, and became a big fan of it ★ Slept a lot, Spent a lot of time in lab (days together, slept there, went out for food and change of clothes only), ★ Hung out with many cool PhD students of other departments and discussed research within. ★ Learnt cooking.
Prof. Ashutosh Mahajan,Industrial Engineering and Operations Research (IEOR)

Read, Think and Work- I followed these three mantra while doing my PhD. In order to find the technological gaps or understanding the problem, I went through lot of research papers/books.Next process was "thinking" to mature the idea(s) obtained from literatures and the ways to yield its proper solution. I also had a lot of discussions frequently with my supervisor, who made my research work more effective.
Prof. Sandip Kumar Saha, Mechanical Engineering

If I think of my PhD I remember the following:
★ 'Akshaya Patra' of knowledge, Prof. Vinod Sharma my advisor.
★ Long tiring nights of search in unknown directions and about numerous never ending string of questions and answers.
★ Long walks in the dark streets of IISc with a single goal: reach coffee house before it closes at 2:00 am.
★ Long and never ending discussions with friends.
Prof. Veeraruna Kavitha, Industrial Engineering and Operations Research (IEOR)

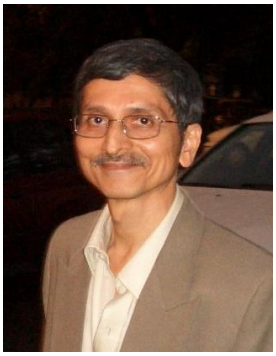
Pursuing doctoral studies was something that I always aimed for ever since I completed my under-graduate studies. Probably this was the reason that made me quit two software-based jobs and join PhD at IIT Kanpur. Today when I look back, I sincerely feel that I took the right decisions at the right times of my academic career. I was fortunate to have gotten an opportunity to work with a person of the highest caliber and research accomplishments for my PhD. During the doctoral program, I was fascinated by the idea of visualization and always believed that if you understand basic sciences, you shall be able to appreciate the intricacies of the phenomena you are studying and also the world around you. The key is to remain focused, maintain your motivation level and above all, enjoy what ever you are doing.
Prof. Atul Srivastava, Mechanical Engineering

PhD was like walking on an unknown path, with branched destination. For me the hardest part of PhD was neither subject matter nor writing the thesis; it was getting over the inevitable slump in the middle. Sometimes, it was sick of reading the same publications, bored at looking at my same computer codes to make it work – many of which had proved unfruitful – and exhausted of working many weekends. How can I forget some of those Friday's evenings, when I had to sit in my office to take care of urgent reports, deadline etc :(*Subsequently, I realized that meeting a new group of people, who were interested in me, and not in my research, was one of the cure. Another interesting moment was those of pangs of envy you feel when your friends get their first publication, and you still are in the queue. But then your time comes and you feel sheer elation when your first paper gets accepted* :)

Prof. Aftab Alam, Department of Physics

I was an external company-sponsored PhD candidate, and it wasn't easy for me to tackle both fronts-research and company duties. Although it was a hectic period, it gave me a satisfying experience at the end. Fortunately, I was given freedom by my guide at IIT Bombay and the company to pursue research in my areas of interest. Luckily for me, a few technical issues faced by the company provided me practical problems to work on. There were sleepless nights when there was pressure of getting novel as well as useful results. Literature survey (collection) used be a major component of research work those days unlike today's era in which hundreds of relevant papers are available at a google clique.I remember to have derived formulae involving long derivations in the initial period, followed by computer-based simulations running over a few weeks. Anxieties associated with experimental work added flavour to the whole process. And then who will forget those tensions associated with decisions on submitted manuscripts to journals and the happy moments when they got accepted. Those days, manuscript submissions and review processes were not paperless with associated delays and uncertainties. I really enjoyed the research journey which was truly a rewarding experience in terms of professional growth and for developing skill sets.

Prof. S. V. Kulkarni, Electrical Engineering



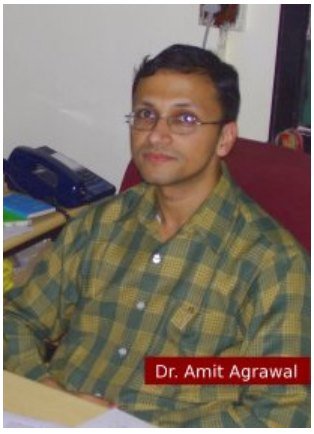
The life was simple – good wavelength shared with guide, freedom to work independently, (false) hope for a distinguished career, academically charged atmosphere at the IIT, pleasant and thinly populated campus and above all: happiness and stress-free life associated with poverty!

Prof. M. C. Deo, Civil Engineering

My days as a PhD student at IIT Delhi were full of burning enthusiasm to explore new frontier in signal processing, a delightful experience of heartwarming interaction with peers and faculty and sometimes, frustration at junctures when things did not seem to move. I always looked forward to the day when research scholars from IITs came forward to do things together. RSAS 2014 is, in that sense a dream come true!
Prof. Vikram M. Gadre, Electrical Engineering

I learnt a working for long hours. I distinctly recollect the incident of myself getting locked in a computer lab working late in the night. Later I had to climb down from the window for coming out. Those were the days of maximum self learning. Learnt how to utilise information available around into useful knowledge. The skills that were acquired are becoming very handy in the present age of information explosion.
Prof. K V Krishna Rao, Civil Engineering

I did my phd in the period 1989-1993 after spending 4 years 1982-86 btech and 3 years in the US. For me, the PhD finished the thought processes which had started during my BTech and which had continued during my stay in the US. It was then that various things came together. It was also the time for me to make the biggest investments in studying various branches of knowledge.
I was easily reading about 70-80 books a year. It was also the time for me to travel through india's villages, forests and mountains and enjoy the monsoons.
Prof. Milind Sohoni, Centre for Technology Alternatives for Rural Areas (CTARA) and CSE



I find PhD to be closest to the age old 'Gurukul' system. I personally found PhD to be an experience which cannot be matched by any other degree. It gave me a lot of time to digest subtle concepts from my field, and confidence to look beyond my area of 'expertise'. The maximum amount of learning perhaps happened in those four years for me. It also brought to the fore that how wrong published work in the best journals can be, and taught me to stick to the right ground despite all odds.
Prof. Amit Agrawal, Mechanical Engineering

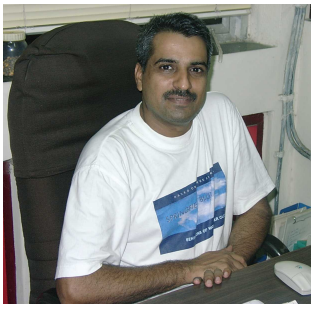
Those were the best years of my student life. There was ample opportunity to learn what you wanted/liked, to make new friends across the cultural/disciplinary boundaries, to travel and explore the world and to volunteer for social causes. It seemed as if there was no time constraint-in fact, "doing PhD" was used a shield to postpone some hard decisions in life. This was the time when I picked not only the research skills for the future career, but also the basic survival skills - including cooking!
Prof. Anand B Rao,
Centre for Technology Alternatives for Rural Areas (CTARA)

For a few months after coming back to IITB to pursue a PhD, life was very peaceful. There was only one course to attend (Electronic Circuits taught by Prof. M. S. Kamath) and my supervisor did not have time to meet me. But a few months of this peaceful existence led to a nervousness about the future and I began to worry seriously about my thesis. After struggling for a couple of years with irreproducible experiments, I started getting things right. Another couple of years of focussed lab work followed and then a struggle to put down the results in the form of a thesis. But finally there was some clarity and a realization of what is meant by the scientific method.
Prof. A. Q. Contractor, Department of Chemistry

I remember the highs and the lows. There will be periodic phases of doubts where I wondered whether all this research was worth doing and whether it mattered. Then suddenly some will be accepted and the mood will be lifted.
Prof. Om Damani, Computer Science and Engineering

During a seminar by a famous Knot Theory person, Prof. V.F.R. Jones at IMSc Chennai(Nov 1992), he challenged one problem which cannot be done. I raised my hand saying that the problem can be worked out using Chern-Simons theory. I did prove it within a year that chirality of certain Knots can be detected using Chern-Simons theory.
Prof. P. Ramadevi, Department of Physics

PhD ? A roller coaster ride through a tunnel where the light at the end comes suddenly. Eight to ten coffees and endless discussions with fellow comrades is what stays at the end. Won't mind going back again!!
Prof. N. C. Narayanan,
Centre for Technology Alternatives for Rural Areas

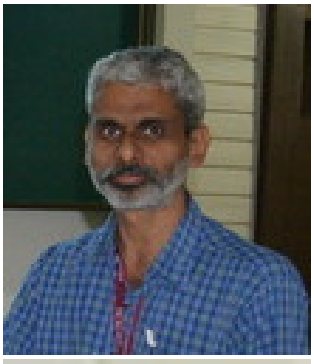


During my PhD life, I experienced a transition to digital medium. Internet just started and we had one computer for the entire hostel and bandwidth of 32Kbps. We have to wait for one hour to get our chance, that too for 15 minutes. It was fun fighting for your turn and enjoy 15 minutes usage, Outside world was not aware about e-mail and this restricted our e-communication. This helped in forming groups across IITs and interaction almost on real time basis (one hour delay). IIT Bombay had best Internet among all the IITs and I believe today we have the best.
Prof. H. Arya,
Aerospace Engineering

My life as a research scholar (or graduate student, as it used to be called) was a series of highs and lows. When I joined the graduate program at Harvard on fellowship, I was given one year to explore and find out what I wanted to do. As part of that I did rotations in various groups trying to figure out whose work I was most interested in. Finally I ended up joining a lab where I was given complete freedom to do whatever I wanted to do. My final PhD thesis ended up being very different from what I had initially planned or proposed to do. There were times in between when it felt like I am never going to graduate! I was stuck on a minor problem for months. And then there were times when I didn't realize that my work was progressing until I gave research update talk in group meetings and my lab-mates and my advisor were quite appreciative of it. Sometimes we tend to get so bogged down with small problems in our research that we forget to enjoy the graduate student life!
Prof. Prakriti Tayalia,
Biosciences and Bioengineering (BSBE)

After my PhD defense my advisor invited me along with my labmates for dinner at his home. Once we were there he introduced us to his wife and children. When he introduced me to his wife she mentioned to me that she was jealous of me. This was because for the last 4 years my advisor spent more time working with me during weekends than with her!
Prof. P. J. Guruprasad
Aerospace Engineering

My office used to be next to the seminar room of our department in UCSD. I attended most of the weekly seminars during my stay there; mostly for the free coffee. Most of the topics were unrelated to my work and I was dozing off half the time but I still think that I learnt a lot by just listening to various people talking about their work.
Prof. Kowsik Bodi
Aerospace Engineering



Couple of things that I can recall include:
The open mindedness of it, it is both enriching in many ways and fascinating in many ways, but a challenge as well. That something will workout, if one keeps working @it -'hangs out'.
Prof. N. Hemachandra
Industrial Engineering and Operation Research

I never thought that I'll become a Supervisor!!
Prof. R. Balaji
Civil Engineering

IIT Bombay

SINE

Business Incubator

Society for Innovation and Entrepreneurship

Prof. Milind Atrey,
Professor-in-Charge, SINE

14 — SINE

Creating Employers and not Employees....

Contributed by Prof. Milind Atrey,
Professor-in-Charge at Society for Innovation and Entrepreneurship (SINE),
and Professor in the Mechanical Engineering Department, IIT Bombay.

According to 2013: HR Trends – Changing Talent Paradigm by NASSCOM, almost two million employees from Gen Y are overwhelming the IT-BPM industry today—more than 60% of this industry's workforce is born after 1980. But it also states that there are more than 2,400 product start-ups—from various ecosystems such as mobility, e-commerce, education, telecon VAS, etc., in India – and that Gen Y includes entrepreneurship as one of their top five professional priorities. So ***how are our premium institutions grooming the next generation of graduates to stand on their feet in tomorrow's world? Could entrepreneurship really be the answer?.*** *As a hands-on member of the innovation ecosystem at IIT Bombay (IITB), Professor Milind Atrey relates how one of India's foremost technology institution encourages innovation and entrepreneurship on campus, and why it has come a long way from just teaching to research and now, entrepreneurship.*

The entrepreneurial initiative of IIT Bombay was set up in 1999 as a pilot project under the guidance of Professor Deepak Phatak. The initiative was generously supported by IITB alumni like Kanwal Rekhi and Nandan Nilekani for its infrastructural and operational requirements. The programme was initially oriented towards IT as it originated in the School for Information Technology. It [catered to this department] for five years until other departments developed an interest in it. Several faculty members with their repertoire of various research projects were keen on the opportunities offered by this programme, of converting [their projects/ideas] into possible business ventures. It was then that IITB and the Government of India s(GoI), through the Department of Science and Technology, envisaged the idea of setting up a formal technology business incubator on the campus.

Thus, in 2004, the Society for Innovation and Entrepreneurship (SINE) came into being, as an independent legal entity. The incubator is housed in an area of 10,000 sq. ft., spread over two premises within the campus. SINE has so far incubated 47 companies, with 17 companies presently in the incubator. The rest have graduated successfully, or have been acquired, with about eight having closed down. Half of the incubated companies are faculty-driven, and 19 are such where the technology [developed] from

the institute has been converted into businesses. The success of SINE lies in the fact that more than 50% companies are funded by angels, VCs, and financial institutions and are also revenue-generating. A few are funded by strategic partners, some of which have also raised their next level of funding. SINE companies have collective revenues of about ₹100 crores, and have generated about 1,000 jobs.

SINE has its own governing board where the director of IITB is the chairperson; the board has an equal representation of institute faculty and external individuals of repute, who are industry professionals, alumni, VCs, and entrepreneurs themselves. The members not only help in policy matters but are also good mentors for SINE and its companies.

Under the wing at SINE

The mandate of SINE is to look at business ideas that fulfill two criteria:
They [should] have an IP backing them, which need not necessarily be patented; SINE does not prefer services or consultation ideas. At least one of the core promoters should be from IITB community, which includes graduating students, alumni, faculty, permanent staff, and other research partners. The methodology is quite simple: anyone with an idea walks in to SINE. We discuss to see if the idea merits a business case or not. If it does, the person is asked to write a business plan, which then goes through the due diligence of an internal review. At this stage, much iteration is done [to the business plan] in collaboration with the applicant to perfect it from all aspects. This is followed by an external review by experts who could be from the said domain, an entrepreneur, or an investor. Depending on the external reviewer's opinion, a call is taken on whether to incubate the project or not. The ideas could be from any of the three categories—pure economic value, strategic value, social impact.

Further, based on the level of maturity of the idea and the actual need under incubation, SINE has three kinds of incubation support, viz. regular incubation where infrastructural support is given at subsidised cost, virtual incubation if infrastructure is not required, and pre-incubation if the idea is in its nascent stage and needs to be tested and validated before being taken up as a business case. The SINE incubation programme is for three years. SINE believes in not just providing infrastructural support to its incubates, but also in giving intangible support in the form of inhouse guidance, retainer professional services such as CA/lawyer/HR, accessing funders' network, mentors, advisers, and institute resources such as labs, faculty support, technical guidance, etc. SINE also helps in creating the desired brand name for its companies and in enabling the necessary ecosystem where the companies are nurtured to evolve into independent/successful business ventures.

Challenges of turning an innovation into a business

Entrepreneurship is a challenge. It is risky and there is a fear of potential failure. SINE, frequently, plays the *devil's advocate to the applicants, by shattering the myth that technology is the most important aspect of the business, and technology alone can sell*. They are told that while technology is essential, key aspects that drive the idea is the team, and the market need that it addresses. SINE often states that between an A team with a grade B idea and a B team with a grade A idea, SINE would choose the former, as execution is the key for the success of any business idea. It is here that innovation becomes important for the entrepreneur to be able to shift gears as per market needs. Good entrepreneurs not only become worthy role models, but are also an asset to the economic needs of the country by being job creators. Institutes such as IITs and IIMs are great seedbeds of such ideas and incubators. It is here that all the stakeholders come together to help the ideas see the light of the day. These institutes are therefore working on setting up entrepreneurship centres where students can benefit from focussed courses on entrepreneurship. This enables them to eventually pursue setting up of their own ventures, as one of the career options. Being from such institutes, they can afford to try, and in the event of a no go, can easily opt for regular job options. Start-up failure which was once a taboo, is now working out to be a desirable learning experience.

Culture of innovation at IIT

IIT Bombay has an active Entrepreneurial Cell (E-Cell), run by its students. It conducts various activities such as ideation, idea validations, and business plan competitions through events such as Ideaz, Eureka, and E-Summit. Here, the students from all over the country, are given a platform to present their ideas to a panel of experts consisting of well-known entrepreneurs, industry professionals, VCs, mentors etc. SINE closely works with E-Cell and guides them through the various activities, which in turn helps SINE to source good business ideas. SINE also organises meetings, through various fora, to bring together students from all academic levels, such as BTech, MTech, and PhD to help in team building and ideas' evaluation.

Manoeuvring the next curve

Going forward, SINE envisages an incubation capacity for 50 companies with a multipronged approach:
All efforts will be made to include nonengineering departments like Humanities, the Management School, and the Industrial Design Centre. SINE will also widen its focus from pure technology-backed ideas to include process driven ideas, which have a sustainable business and revenue model. Increase the scope of pre-incubation by largely targeting the student body to help their ideas to be tested out and validated. To extend its virtual incubation concept beyond the existing geography of Mumbai. As a test basis, SINE has set up a Virtual Incubation arm at Pune with the generous help of one of its alumni. While plans are on for SINE's own building, SINE may hire space outside of the campus to accommodate companies beyond its existing capacity. Enable both backward and forward integration starting from interaction at lab-level ideas and provide support right up to established corporates.

SINE aspires to be the vital link in the entire value chain supporting entrepreneurship. Considering the huge young human resource available in our country, incubators such as SINE are essential to tap the potential of entrepreneurship and generate employment avenues. It is my strong belief that entrepreneurship is the next big revolution, like IT, waiting to explode in India. IITB alumni too have pledged their support to SINE, by recently initiating a platform called 'I-Ascend' to foster the spirit of entrepreneurship amongst the institute community. It will be heartening to see that our students flock to join such start-up companies as interns or graduate trainees due to challenges these job profiles pose as against the heavily paid routinely standard jobs, I am extremely hopeful that the success of the incubator model developed by IITB inspires large-scale entrepreneurial activity in other institutes of our country as well.

"Creating employers, not employees" by Prof. Milind Atrey was first published in Innowin magazine (Volume 1, Issue 3) by Spenta Multimedia on behalf of the Marico Innovation Foundation.

15 — List of Accepted Abstracts

15.1 Oral Presentations

1. Improved Algorithm for Graph Isomorphism Using Vertex Invariant

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Graph Isomorphism is a technique to match the structure of one graph with another. An application like Chemical drugs, computer networks, social networks, geographic maps requires the information to be represented in the form of graph. In social networking huge database is required to be processed which can be represented in the form of graph. In sequential algorithm of graph isomorphism is implemented for the undirected labeled graph. In the existing algorithm, the input graph is matched with the model graph by using the vertex invariants. Vertex invariant is the property in which the group of vertices is formed based on the degree and label of graph. Vertex having the same degree and same label are grouped into one group. Vertex permutation is performed on these groups. Adjacency matrix is created of the permuted group. Input graph is matched with the model graph using the adjacency matrix. If the input graph matrix is matched with the model graph then the two graphs are equal and graph isomorphism is detected otherwise the two graphs are not isomorphic. For N number of model graphs in database/ persistent memory, existing algorithm compares adjacency matrix of test graph with the adjacency matrix each of the model graph and therefore N iterations are required. But in our algorithm it will only compare adjacency matrix M of input graph with a model graph if all conditions such as Z-count, type of graph, partitioning group count, degree, and label are satisfied and therefore less than N iterations are required. The modified algorithm works for labeled as well as unlabelled graph.

Keywords : Graph Isomorphism, Vertex Invariant, Z-count

2. Understanding Himalayan Earthquakes using High-precision Global Positioning System (GPS): Insights from the Darjiling-Sikkim Himalaya

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The Himalaya is seismically a high-risk zone and several earthquakes in the recent past in the Himalaya have caused extensive loss of life and property. As millions of people reside in the foothills of the Himalaya and will be severely affected during future earthquakes, it is important to understand the mechanics of these earthquakes. High-precision Global Positioning System (GPS) is a tool that has been recently (1996 onwards) developed to measure surface displacements to an accuracy of a few millimeters in seismically active regions. Causative faults or dislocations that slip and simulate the measured surface displacement

and velocity field can then be modeled to understand where strain is accumulating in the mountain belt. We illustrate this methodology in the Darjeeling-Sikkim Himalaya (DSH) based on measurements from 18 GPS stations from 1997 to 2009. Dislocation modeling was done to simulate the measurements using a forward modeling approach based on dislocation theory of Okada (1992). The dislocation modeling suggests that strain is accumulating along three fault planes at varying depths in the DSH and is likely to result in major earthquakes in the future.

Keywords: Global Positioning System, Darjeeling-Sikkim Himalaya, Dislocation modeling

3. Multi-Gene Entropy Liquefaction Model: A dynamic approach

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It is well understood that a large number of seismic as well as soil parameters are involved which affect the occurrence of liquefaction during an earthquake, making it necessary to identify the significant parameters based on their contribution to liquefaction phenomenon to expedite the assessment of liquefaction. Subsequently, the authors have already introduced a new technique to extract the significant parameters based on their weightage as obtained by employing entropy analysis; one of the Multi Criteria Decision Making Tools (MCDM). Further, the authors have established a promising dynamic response based approach by integrating the effect of significant parameters representing dynamic soil properties and ground motion parameters to characterize liquefaction potential at a particular site. An elementary deterministic empirical liquefaction model (EELM) to identify liquefaction susceptibility has also been developed by the authors using this approach. In present work an endeavor is made to formulate the probabilistic model within multi gene symbolic regression framework.

Multi gene genetic programming (MGGP) is a robust variant of Genetic Programming (GP), which is designed to generate mathematical models of predictor response data that are "multi-gene" in nature. In routine MGGP analysis, the linear coefficients for each of the evolved genes of an individual are estimated using ordinary least squares method whereas in present work, these linear coefficients are derived from entropy analysis. The multi gene entropy (MGE) based formulation of Liquefaction Susceptibility (LS) model referred as Multi Gene Entropy Liquefaction Model, 'MGELM' in the present work. Non-liquefied and liquefied cases are represented by binary variables 0 and 1, respectively. The predictor variables included in the analysis are: $(N_1)_{60cs}$ normalised SPT blow count corrected for fines content; σ'_v(kPa), effective stress at a depth of interest, v_{max} (m/s), maximum peak ground velocity; G_{max} (kPa), small strain shear modulus and dur (sec), duration of seismic motion.

Keywords : seismic soil liquefaction, entropy analysis, multigene symbolic regression

4. Correlation between ionic conductivity and microstructure in Li_2O – Al_2O_3 – TiO_2 – P_2O_5glass ceramic.

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Solid state electrolytes have advantages over liquid electrolytes (used in commercially available Li-ion batteries) in terms of increased safety and size reduction. Many Li ion glass ceramic compositions have been tried over past few years; however only a few of them turned out to be satisfactory as battery electrolytes. As apart from high ionic conductivity, they should possess high density, good electrochemical stability, ease of handling etc., in order to qualify as battery electrolyte. Li_2O – Al_2O_3 – TiO_2 – P_2O_5 (LATP) glass ceramicisone such system.It shows high room temperature conductivity (~ 10^{-3} S/cm) andthermal,electrochemical stability.Our focus is to studythe effect of heat treatment parameters (T,t) on ionic conductivity and evolution of microstructurein it. LATP glass was fabricated by conventional melt quench route and converted to glass ceramic by controlled heat treatment. The precipitating ceramic phase was identified using X-ray diffraction method. Scanning Electron Microscope images were obtained. Correlation is drawn between the increased conductivityand observed microstructure of the precipitated ceramic phase.

Keyword: Solid Electrolytes, Li ionconducting Glass Ceramics, Heat Treatment

5. Real Time Industrial (Operator) Monitoring System

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Industries are the biggest workplace all over the world, also there are large number of peoples involves as a worker and most of them are work as a machine operator. There are many systems developed for industrial work place, some of them, monitors machine processes and some do monitoring and control of machine parameters. Such as speed, temperature, production batch count etc. However there is no such system available that provides monitoring of operator during their work is in progress at workplace. This paper proposes the monitoring of the operators and the machines, by Real time Operator-Machine Allocation and monitoring system (Omams). Omams allocates a work machine to worker at entry point itself. It uses automation with RFID and one of the standards of wireless communication method. The system can be industry specific. Through this research paper our approach is to make fair allocation of machine to the operator in industry and reduce hassle for efficiency calculations.
Keywords : Real Time Monitoring, Monitoring System, Machine Allocation, Machine Operator Allotment

6. Optimizing Reservoir Operation Using Hybrid Chaotic Genetic Algorithm

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Optimizing the operations of a reservoir are complex because of uncertainty in the input variables, non-linear relationship between the variables, conflicting and competing multiple objectives, non-convexity of problem, and discontinuity of the solution space. One of the important advancement made in systems engineering is the development and application of various optimization techniques. Recently, the evolutionary algorithm based soft computing techniques are used in optimizing complex water resources systems. Genetic Algorithm (GA) is one of the soft computing techniques. The GA starts its search from the randomly generated initial population of possible solutions to attain the global optimal solution over the generations. Hence the results of the evolutionary algorithm mainly depend on the randomly generated initial population for the effective search and faster convergence. However, the simple GA is slower in convergence and may results in sub-optimal solutions for complex problems with hardbound constraints. Hence, chaos technique is coupled with GA to improve the search and for faster convergence. The Hybrid Chaotic Genetic Algorithm (HCGA) is applied to complex hydropower reservoir namely, Koyna Reservoir for optimal hydropower production. The results showed that HCGA converged quickly than simple GA for non-linear hydropower optimization.
Keywords :Genetic Algorithm, Chaos, Reservoir Optimization, Hydropower Production

7. A Thermo-Structural Model For Assessment Of Material Removal And Tool Erosion In Electrical Discharge Machining

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Present work proposes a methodology using thermo-numerical model for accurate prediction of craters and crater dimensions on work piece and tool erosion in electrical discharge machining (EDM) process on AISI D2 tool steel. The data collected from the numerical analysis based on Box-Behnkin's experimental design, a popular response surface methodology (RSM) approach, is quite reasonable to study the behavior of the process parameters and responses with less number of runs.The proposed numerical model is validated by comparing experimental results on a die sinking EDM machine. A sequentially coupled thermo-structural model has also been proposed to estimate the residual stress distribution on the work piece. Analysis of variance is conducted to identify significant parameters. Finally, a non-dominated sorting genetic algorithm (NSGA II) has been adopted to obtain Pareto optimal solution for multi objective optimization of responses.

Keywords : AISI D2 TOOL Steel, EDM, RSM, Non-dominated Sorting Genetic Algorithm-II

8. Mechanical behavior of 5xxx series aluminum alloy under extreme loading conditions

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The material behavior under dynamic loading conditions differs from quasi-static loading due to significant inertial effects as well as domination of certain deformation mechanisms. Understanding of this behavior is useful in automotive crash-worthiness, high speed forming, armor and other impact loading applications. In this work, the effect of high strain rate compressive loading on mechanical response AA5052 (Al-Mg alloy) was determined and strain rate sensitivity of flow stress was studied in the wide range of strain rates from 10^{-4} s^{-1} to 10^{+5} s^{-1}. Two custom made split Hopkinson pressure bars (SHPB): conventional and miniaturized were used to conduct the experiments in the range of dynamic strain rate. While a UTM was used to conduct the experiments at quasi-static loading rates. The experimental data showed that the stress-strain behavior was a function of strain rate and temperature. Under dynamic loading the alloy showed positive strain rate sensitivity (SRS) however under quasi-static loading negative SRS was observed. Also, the SRS increased with strain rate under dynamic loading and showed a sharp upturn in flow stress after certain strain rate. The material showed two times higher flow stress under dynamic loading as compared to static loading. This phenomenal increase in flow stress can be used advantageously in various applications and better design criteria can be evolved.

Keywords : Strain rate sensitivity (SRS), high strain rate, split Hopkinson pressure bar (SHPB), 5xxx Al Alloy

9. Soil-Reinforcement Interface Characteristics

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Reinforced earth or soil structures (reinforced retaining walls, embankments, sub-grades beneath the pavements, etc.) are becoming increasingly popular in the present day. For proper design of any reinforced structure, it is important to study the soil-reinforcement interface properties. The interaction mechanism can broadly be classified into two types: direct shear mechanism and pullout mechanism. In this study, a large-size direct shear test apparatus (length, width and depth equal to 300mm, 300mm, and 200mm, respectively) is used to study the interface characteristics of two types of reinforcements commonly used in practice- geostrap and geogrid, with locally available soil. Effect of relative density of soil sample on the interface properties is studied by preparing soil samples at three relative densities- 70% and 90%. Sample preparation is done using Pluviation technique. This paper provides details on the sample preparation and interface properties of geostrap and geogrid reinforcements with locally available fill material.

Keywords : reinforced soil, interface properties, direct shear test.

10. Cryo-cross rolling of SS 304 stainless steel

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Cryo-cross rolling was done on SS 304L to enhance the mechanical properties of SS304, especially hardness and yield stress. Type 304L stainless steel is a Chromium-Nickel austenitic Stainless Steel with minimum 18% chromium and 8% nickel, combined with a maximum of 0.08% carbon. It finds extensive applications in severe corrosive environments and in a variety of commercial sectors, particularly in the chemical industry. Traditionally it has been subjected to cold rolling prior to sheet metal forming. In metal-working, rolling is a metal forming process in which metal stock is passed through a pair of rolls. Rolling is classified according to the temperature of the metal rolled. A cryogenic treatment is the process of treating work pieces to cryogenic temperatures (at -196 °C) to remove residual stresses and improve wear resistance on steels. Cross rolling is a process in which straightening of metal sheets is done by passing them through rolls at right angles to the principal direction of rolling. Cryo rolling, followed by short term

annealing, produces smaller grains while cross rolling helps to reduce the anisotropy. Cryo-Cross is the process of cross rolling at cryogenic temperature. Thus, combining the effects of both the processes will improve the mechanical properties of the material. Deformation by rolling caused increase in dislocation density making the sample brittle. Annealing caused release of strain and induces recrystallization. Measurements showed that the hardness increased with an increase in the rolling percentage. Hardness was observed to be a function of two competing factors- annealing and deformation caused by rolling and each factor dominates in its own domain This project was part of the course "Mechanical Properties of Materials" and we would like to thank our course instructor, Prof. N.P. Gurao and Mr. Chandrashekhar for helping us with our project.
Keywords: Stainless Steel, Rolling, Cryo-Cross

11. Board Characteristics and Firm Performance: A study of IT Sector in India

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This paper aimed at finding the relationship between various board characteristics measures like board composition, board size, leadership structure and board activity and accounting measures of performance in the listed Indian information technology firms. A system of simultaneous equations was employed on panel data to estimate the parameters, describing the relationship between various board characteristics measures and firm performance during the period 2005 to 2012 using R statistical package. Two stage least squares and three stage least squares estimation was employed based on their suitability. Independent directors on the board were not found to have any significant relationship with the firm performance measures. The Board size was found to have a significant and positive relationship with firm performance. Contrary to the widely held belief, separating CEO and chairman role and having an independent chairman was not found to have any impact on the firm performance. The number of board meetings was also not found to have any significant relationship with firm performance. However, the attendance in the board meeting had significant relationship with firm performance. This paper contributes to the literature by providing insights regarding the board characteristic variables specific to the Indian market that is characterised by large promoter and family led businesses. By using the data on 115 listed IT firms in India, this paper demonstrates that some of the widely used board characteristic measures show different results compared to the literature documented in the western contexts.
Keywords : Corporate Governance, Board Independence, Board Size, Leadership Structure, Board Activity

12. Simulating transmission electron microscope images from first principles

Arpit Agrawal, IIT Kanpur, Kanpur

Transmission electron microscope (TEM) is one of the most popular devices used for materials characterization, as it is capable of providing several informations such as topography, morphology, composition, crystal structure etc. A typical TEM has a very high resolution of the order of 1 nm. At higher resolutions, experimental artifacts can complicate image analysis to a great extent. Using computer simulations to overcome such difficulties have become a common practice now-a-days. In this project, we have calculated transmission electron microscope images from first principle calculations. A code has been developed, which can simulate TEM images and diffraction patterns, using atomic potentials (calculated from first principles density functional theory calculations). We have tested the code for Body Centered Cubic (Fe) using plane waves and focussed beam like Gaussian beam. Further, we have examined the propagation of recently discovered electron vortex beams through this material. We have focussed the beam on 36 different position on 1/8th portion of the unit cell. We have analyzed the behavior of angular momentum of the beams as they propagate through the crystal by their propagation through atomic potentials.
Keywords: Body Centered Cubic, Computer Simulations, TEM

13. Development of a Rainfall-Runoff simulation tool on a web GIS platform

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The objective of the study is to develop a simple rainfall-runoff tool which can be used by the field engineers to estimate runoff, indicate any channel overtopping/flooding in the catchment for a given rainfall event using internet based technologies. With this view, the present study has developed a distributed rainfall-runoff model which has been integrated with a web GIS server. The rainfall-runoff model consists of one-dimensional (1D) overland flow based on mass balance approach; the 1D channel flow model based on diffusion wave approximation solved using linear Finite Element Method. The tool is based on server-client framework where in a workspace is defined for each registered user and the basic inputs are read from the client interface while the balance inputs are read from the workspace. The basic model is coded in MATLAB and the application has been integrated within an indigenously developed web GIS sever at IIT Bombay namely Web GRAM Server.The model outputs are stage-discharge hydrographs at any point along the channel based on the mouse-click on the client side. Similarly, the water level profile along the channel can be viewed at any time of the simulation. The tool can be used to simulate flooding for given rainfall event.

Keywords : coastal urban flooding, mass balance, diffusion wave, finite element method, web GIS server

14. In Search Of Drugs For Helicobacter Pylori Infection

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Helicobacter pylori isa gram-negative bacterium often found in human stomach that is responsible for the majority of peptic ulcers, as well as several other acute gastrointestinal diseases. Currently more than 50% of the human population in the world are being infected with this bacterium. Poor compliance of the present-day drug therapy to treat H pylori infection not only seems futile but also has led to an increase in antibiotic resistance. Hitherto there has been no account of drugs which could eradicate this infection absolutely. Through our studies, we aim to develop effective drugs for treating H pylori infection. Here we discuss about a library of small molecules developed through in silico modelling using Structure Based Drug Design. Our docking results suggest the designed compounds to be more effective inhibitor molecules than the deemed standard drugs (in silico) owing to their greater binding affinity for the target protein.

Keywords : Helicobacterpylori, drug design,docking studies

15. Stress Corrosion Cracking Behavior of EV31A and Mg-Mn Magnesium Alloys

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Magnesium alloys are the lightest metallic engineering materials, and hence they are extremely attractive for light weight applications, such as automotive and aerospace industries. Magnesium also offers several other advantages, such as castability, damping capacity, electromagnetic interference shielding, relatively high thermal and electrical conductivities, and recyclability. However, their use has historically been restricted, largely due to their chemical reactivity, causing poor resistance to corrosion and stress corrosion cracking (SCC). SCC is one of the major failure mechanisms of Mg-alloys. To control this understanding of (a) SCC initiation and (b) subcritical crack growth are of paramount importance. EV31A, a relatively new alloy containing Zr, Nd, Gd and Zn (Al-free alloy) is versatile to manufacture components through sand casting and investment casting process, and becoming increasingly attractive for aerospace applications. Very little work has been done on the SCC resistance of the alloy in spite of this importance. Hence,

a detailed investigation on the SCC behavior of this alloy is warranted. AZ91E is taken as reference alloy for comparison. Study of the mechanism of SCC of cast Mg alloy is always difficult as it has inherent chemical heterogeneities. Study of SCC of wrought alloy is valuable in this respect. Hence, in the present case a wrought alloy (Mg-Mn) of composition Mg-0.1Al-0.3Zn-1.75Mn-0.25Ce-0.3(other rare earth), has been undertaken to investigate the role of chlorides. Based on the results of SSRT and CLT it is suggested that EV31A alloy possesses a superior resistance to SCC than AZ91E. The resistance of EV31A to SCC is attributed to the formation of a robust oxide layer on the alloy and sustenance of this film during CLT. Pitting was the main precursor event in the SCC initiation process. However, its main role lied in enhancing hydrogen evolution kinetics rather than to act as stress raisers. The main role of chloride was to damage the passive film (pitting) to create a bare surface and there by enhance hydrogen evolution kinetics. The K_{ISCC} in distilled water, and $Mg(OH)_2$ saturated solution of 0.1 M NaCl were determined for EV31A to be 10 and 8 MPa m, and for AZ91E to be 8 and 6 MPa m respectively, indicating better SCC resistance of EV31A than AZ91E. Slope, m of stage I regime increases and K_{ISCC} decreases with the aggressiveness of the environment. AZ91E shows lower stage II crack growth rate than EV31A in both the test environment, which is attributed to crack blunting. However, the same alloy exhibited an increase in stage II crack growth rate in chloride containing environment than in distilled water. Mg-Mn alloy was susceptible to hydrogen embrittlement in $Mg(OH)_2$ saturated solutions of 0.01 M and 0.1 M NaCl and much less susceptible in distilled water. Long transverse alignment was more susceptible than longitudinal alignment of specimens. Circumferential notch tensile technique was successfully used to determine the threshold stress intensity for stress corrosion cracking under plane strain condition (in spite of the insufficient thickness of the plate of the test material). It is believed that enhancing the pitting resistance can improve the resistance of Mg-alloy to hydrogen-embrittling environments. The SCC cracks propagated in transgranular manner with the evidence of flat parallel facets which indicate hydrogen assisted cracking.

Keywords: Stress, Corrosion, Tensile technique, Pitting

16. Design and analysis of patch repair of damaged CFRP laminate using 3-D finite element analysis

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Composite patches are used to repair damaged metallic as well as composite panels.Adhesively bonded patch repair has shown to be most efficient in extending the service life of the damaged part. Strength and life of repaired structure is mainly influenced by patch geometry and adhesive strength. In present study, a 3-D finite element analysis is carried out to optimize the various parameters like patch thickness, patch dimension, stacking sequence and overlaparea so that performance of repaired structure can be improved. Damaged CFRP laminate is repaired by single as well as double sided circular composite patch adhesively bonded over the damaged region. The stress fields in the repaired panel and the bonded patch are analyzed. The reduction in stress concentration factor before and after the repair is considered for optimizing patch dimension.

***Keywords**: Demaged CFRP, 3-D Finite Analysis, Stacking

17. School Leadership in Indian Secondary Schools

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This paper develops and empirically validates a model on the relationship between personal antecedents and leadership style of Principals and its effect on the work behavior of teachers in Indian secondary schools. The personal antecedents of a Principal are captured by his personal values. These set of values help the principal in prioritizing a unique mix of values for the school. These antecedents have an effect on the transformational leadership style of the principals, which have an indirect impact on the organizational citizenship behavior, job satisfaction and counterproductive work behavior of teachers. This indirect relationship is encoded by the effect of school climate as mediators. A cross-sectional survey comprising of 306 secondary schools in Kolkata and Delhi was carried out. The respondent list per school included one principal and five teachers. Structural equation modeling results support the hypothesis that values of

the principal have a direct impact on their leadership style, which in turn impacts the work behavior of teachers, mainly mediated by the school climate. It is believed that this study may aid policy makers and educational administrators in understanding the various crucial contextual factors necessary for a healthy and conducive learning environment in schools.
Keywords: Transformational Leadership, work behaviour, school climate, causal modelling

18. Automation of Microgrid Networks in an Urban Community for Real Time Monitoring and Control through Hardware In The Loop Test

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The researches on the microgrids are primarily motivated to provide the resources and technologies to meet the energy needs of the rural areas and/or the areas in which the utility power is not available. But due to the globalization of the world's economies, the rural communities in the world are moving towards urban communities. This project deals with the formation of microgrids at a community level in an urban environment. In an urban community environment, the facilities engineering and management of buildings involves Electrical (Utility grid / DG sets/DERs), HVAC (Heating, Ventilation, and Air Conditioning), Building operations, etc. Systems designed and developed for controlling these individual modules are independent with each other in terms of architecture and control philosophies. Therefore, the lack of an integrated system operation is one of the biggest challenges faced by building engineers to operate all the modules instantaneously to pass conditional based decisions. These challenges are further complicated with the introduction of environment dependent renewable energy sources into the system. Integrated building operations call for the integration of multiple systems to form a single system with common work processes that span across all the subsystems for better informed decisions. Automation of this integrated system helps in reducing human intervention under all these decisions for immediate response from each distributed modules. This helps in improving the system control and protection. And as per IEC 61850/870 and IEEE 1547 standards the retrofitting nature of the integration poses challenges in terms of the multiple technologies, different protocols, and operational philosophies in the system integration and automation.The proposal of this project is to design and develop an automated architecture for microgrids operated at a community level by addressing these challenges in integration and operation. Automation of microgrid system is a solution that enables the electric utility to remotely monitor, control and regulate its distribution assets and networks. This optimizes the flow of electricity from the utility to consumers and ensures that the service is delivered efficiently and reliably. The primary application areas of such architecture can be large scale residential buildings, universities, Greater communities, financial districts, and industrial zones.
Keyword: Microgrid Control Unit, Hardware In The Loop Test, Programmable Logic Controller, Supervisory Control And Data Acquisition, Grid Exchange Unit, Distributed Energy System Automation, Green Buildings

19. A Simple Process to Prepare Potato Starch Aerogel Microparticles for Drug Delivery

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Natural polymers such as polysaccharides are more preferred for drug delivery applications due to their inherent biocompatibility and biodegradability. In the present work, highly porous potato starch microparticles were prepared using water-in-oil emulsion and supercritical carbon dioxide drying. Effects of speed of agitation, aqueous starch solution-to-oil ratio, starch concentration, surfactant concentration on the physical properties of the aerogel microparticles were studied. Characterization of the particles was studied by adsorption-desorption studies, scanning electron microscopy analysis (SEM). SEM images show that potato starch aerogel microparticles are spherical and highly porous. BET specific surface area of 59 m^2/g was obtained.

Keywords : potato starch, aerogel microparticles, water-in-oil emulsion, supercritical carbon dioxide, drug delivery

20. Deformation and Stress Gradients in Rolled Zircaloy-4

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Zircaloy-4 sheets were cold rolled to 20%, 40% and 60% in the present study. The deformed samples were well electro-polished and observed with X-ray diffraction and electron backscattered diffraction (EBSD). The evolution of residual stress gradient in Zr-4 during deformation was measured by x-ray diffraction. The results showed a clear presence of residual stress gradient along thickness direction from t=0 to t= t/2 corresponding to different orientations. It increases corresponding to different orientations up to t=t/8 and then drop out up to t/2. Grazing incidence diffraction (GID) also shows the same trend. EBSD was used to observe the microstructure to evaluate the plastic strain in terms of boundary density (BD), kernel average misorientation (KAM) and grain average misorientation (GAM). It has observed that higher percentage of deformation has high misorientation. Also microstructure reveals that Kernel average misorientation, Grain average misorientation and boundary density decreases with thickness from t=0 to t=t/2. The study highlights the role of residual stress gradient during deformation in zirconium sheets. The finite element simulation could capture the stipulated trends of residual stress gradients and plastic strain along the thickness direction.

Keywords : Zirconium, Deformation, Cold Rolling, Residual stress, Microstructure, Misorientation, EBSD, X-ray diffraction

21. Quantifying quantumness via commutators: an application to quantum walks

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Nonclassical nature of the quantum phenomena can be quantified in ways. Since the accessible states in macro-world all comm utes with each other it regards to classical nature. Our approach is potentially simple and straight forward for quantification. It is done by removing the references to the dynamics and correlations. We extend the concept of incompatibility of pure states to mixed states by associating for a state defined by the ensemble $\{p_j, \psi_j\}$ the object $\sum_j p_j \Pi(\psi_j)$. In quantum mechanics, the density operator ρ naturally associates with a quantum state in the role of $\Pi(\{p_j, \psi_j\})$, and the non-vanishing of the commutator of density operators is a ready witness of incompatibility. Mohseni et al. proposes a continuous quantum walk formalism to understand the excitonic transport in Photosynthesis. Our motivation to probe Quantumness quantitatively comes from the need to understand the role of quantumness in photosynthesis.

Keywords : Quantumness, Commutator, Ensemble, Photosynthesis

22. A Ghost Fluid based Sharp Interface Level Set Method for Moving Evaporating Droplet

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Level set method coupled with a ghost fluid method (GFM) is presented here to capture the liquid-gas interface of the evaporating as well as moving liquid droplet. The numerical discretization for the above methodology is based on finite volume method. In GFM, the boundary conditions are applied across the interface in the form of jump conditions, i.e., jump in velocity, evaporative flux as well as diffusive flux for momentum, temperature and species transport equations, respectively. In order to avoid spurious currents and numerical diffusion across the interface, special implementation is done for the extension of discontinues variables across the interface. The above methodology is validated for static water droplet evaporation case in which both energy and species equations are solved. Simulations are also performed

for moving droplet case, where above formulation is coupled with momentum solver based on ghost fluid method.
Keywords : level set method, ghost fluid method, evaporation, jump conditions

23. Mainstreaming Alternative Technologies in Urban Waste Water Management in India

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The investment requirements associated generally with sewage networks, electricity, O&M are huge in urban water supply and sanitation sector (UWSS). Economies of scale, on short run, can be achieved for both cost of treatment and network in case of high density areas, however, networking cost escalates for smaller cities/towns and areas with low population density. There is an increased understanding among the development practitioners to explore and promote alternatives to current centralised practises in light of abovementioned challenges. Decentralised waste water management (DWWM) options are believed to be feasible for smaller cities/towns, housing societies, commercial complexes and for slums/ rehabilitation colonies/ peri-urban areas, which are often neglected by the civic agencies. The national policies such as National Urban Sanitation Policy-2008 (NUSP) call for adoption of decentralised management of sewage. In fact, NUSP emphasises on the importance of use of mixed technology and institutional models in order to achieve national goal of 100 per cent sanitation coverage. The conventional technology options with centralised management have become an obvious choice for public services agencies[1] . Although, decentralised waste water management projects based on non-conventional technologies are growing in both numbers and scale yet decision makers are reluctant and less responsive to these. The non-conventional and decentralised sewage management is perceived to be suited only for pilot and/or research projects and not for wider applications. The City Sanitation Plans attribute weak understanding of various technology options among public service providers as one of the reasons for poor response to and slow adoption of alternatives. Numbers of organisations, mostly non-government are initiators of decentralised systems based on non-conventional technologies in urban India. Most of the projects are funded through aid/grants from foreign agencies and have adopted variety of institutional models. Typically, project evaluation and approval agencies focus only on techno-economic efficiency of a project and do not consider affordability related issues in larger context of sustainable societies. The abovementioned issues were studied for non-conventional technologies established in decentralised mode in an urban setting. The 'exploratory case study method' was used as data collection method. A study was conducted with two fold objectives (a) are the investments made environmentally, economically and socially efficient? (b) to study institutional models. The paper presents key findings of the study.
Keywords : Urban Water Supply and Sanitation Sector, Affordability, Institutional Models

24. A link between Himalayan exhumation and Asian monsoon based on thermometry and clay mineral study of rocks exposed at Main Boundary Thrust zone, western Himalaya

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Due to the frictional heat generated during thrusting, the fault zone rocks experience a higher deformation temperature than the rocks inside the faulted blocks. An elevated deformation temperature at the Main Boundary Thrust (MBT) zone, Western Himalayas, speaks for the movement along the thrust, i.e. exhumation of the Himalayas. The good correlation between high exhumation rate of the Himalayas and intensification of Asian monsoon is already a matter of concern. This idea is supported by the presence of syn-deformational clay minerals in the fault-zone rocks. Clay minerals, a product of interaction between deep percolating rain water and pelitic fault-zone-rock, accelerates the exhumation by decreasing the shear strength of fault-zone rocks.

[1]Water Supply and Sanitation is a State subject as per the Constitution of India and 74th Constitutional Amendment Act entrusts Urban Local Bodies with more power and authority

Keywords: quartz thermometry, clay, exhumation, monsoon

25. The Ideal of Equality: an Analysis towards Capability Approach

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As equality has always been a sight of struggle, similarly to abate the crises of society it has always been a progressive, universal, moral and legal principle. Though in a general parlance it seems a very simple concept but still it has been open to a vide spectrum of meanings, interpretations and practical applications. Different interpretations have exhausted its realm and endorse different concepts which serve to complementary and competing interests. Circumference the scope of the undertaken Endeavour, I have tried to put forth different versions of egalitarianism which have synergized both human cognition as well as societal resources in the pursuit of furnishing equality. In this humble submission, I will primarily converse about the four prominent versions of equality. First, the idea of natural inequality; second, claims of utilitarianism to promote parity in distribution; third, Rawlsian assertion of justice as fairness; and finally, the shift in debates towards the recognition of capabilities. Attempt has also been made to bring in the various debates associated with the above mentioned versions of equality and how they can reproduce each other in bringing equivalence. On the binding note, I have strived to critique Sen's approach by putting forth nuance arguments and conclude the ruptures in capability approach.
Keywords: Capability approach, Parity, Equality, Rawlsian assertion

15.2 Posters

1. Aperture-Coupled MS Patch Antenna with Ellipse-Shaped Slotted Ground

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This paper presents the technique for increasing the Bandwidth of a Microstrip patch antenna for GSM 900 MHz Band. Aperture couple feeding technique with Ellipse shaped slot etched in Ground Plane is used to achieve the Bandwidth and radiation performance. The optimization of radius and ratio of ellipse geometry is carried out to achieve much improved bandwidth (13.39%) and Uni-directional Radiation Pattern within VSWR$<$1.5. In the range of frequency where antenna is displaying broadband performance, the gain is almost constant. The simulation of this structure is carried out with Ansoft HFSS and the simulated results are presented in the paper. The antenna geometry is shown. The radiating ellipse-shaped slot is formed by the intersection of two ellipses in the manner of first cutting an inner ellipse from an outer ellipse and then cutting remaining portion from the ground plane. The major radius and ratio of this structure are optimized. It is realized that on making the major radius of the outer ellipse D_1 = 50 mm & inner ellipse D_2= 30mm and the ratio of the major diameter to the secondary diameter in the two ellipses R_1=1.5mm & R_2=2 mm, the performance of antenna greatly improves. The variation of return loss of antenna as a function of frequency is shown. It is observed that introducing an ellipse-shaped slot the antenna presents 13.39% impedance bandwidth corresponding to resonant frequency 911MHz. The return loss corresponding to this frequency is -40dB which suggest good matching between antenna and the feed network. The variation of input impedance of antenna as a function of frequency is shown which suggests that the input impedance of antenna at resonance frequency is very close to 50 Ω. The variations of gain of antenna as a function of frequency are shown. The variation in gain of antenna in the frequency range 823MHz to 942MHz, where the broadband behavior is observed is very small. The maximum gain of antenna is improved.
Keywords : Patch antenna, Broadband, Return Loss, Gain, Modified Ground Plane

2. Design & Development of Compact Microstrip Antenna

Shivraj Rathod[1], Mangesh Dhakane[2]and Priyanka Deosarkar[3],
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This paper describes the design of Microstrip antenna operating at resonant frequency 2.4 GHz using coaxial feeding. The antenna will be constructed on FR4 epoxy glass with a dielectric constant of 4.4. The advantages of MSA have made them a perfect candidate for use in the wireless local area network (WLAN) applications. Though bound by certain disadvantages, MSA can be tailored so we can be used in the new high-speed broadband WLAN systems. This paper concentrates on manufacture of High Gain and enhancement of bandwidth of MSA for the 2.4 GHz ISM band. Simulation is done using antenna designing software HFSSv13. Antenna is Right-hand circularly polarized & its input VSWR is obtained as 1.665.

Keywords : Bandwidth enhancement, Circular polarization, Micro strip antenna, Size reduction, High gain

3. Calculation of stacking fault energy through thermodynamic model and its verification with the methods available in literature

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High Mn steels have great plasticity when deformed due to twinning, known as TWIP effect (Twinning Induced Plasticity) or due to martensitic transformation, called as TRIP effect (Transformation Induced Plasticity). The stacking fault energy (SFE) controls the deformation mechanism. For twinning to occur, it is usually necessary for the steel stacking fault energy (SFE) to be in the range of 18-35 mJ/m^2. If the SFE is $<$18 mJ/m^2, twinning is replaced by martensitic transformation. However, if it is $>$35 mJ/m^2, then the slipping processing will be the only mechanism that contributes to the plastic deformation of steel. For alloys with Mn content between 15% and 25% the SFE is intermediate and then TRIP and TWIP effects coexist. In this work stacking fault energy of some TWIP steel compositions has been calculated through thermodynamic model and its value is verified with the experimental methods available in literature. It was found that value of stacking fault energy calculated through thermodynamic model is found to be close with the value calculated through TEM node method and have large difference in values with comparison to X - ray diffraction method. Effect of alloying element on stacking fault energy is also studied through themodynamic model and found to have same effect as available in literature as with increase in the fraction of Mn, C and Al, stacking fault energy also increases but decreses with increase in Si content. Thus thermodynamic model is found to be suitable for calculation of stacking fault energy of High Magansese steels.

Keywords: Thermodynamical model, verification, TRIP, SFE

4. Assessment of water quality of river Daya

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Rivers are the most important resource of any country, and of the entire society as a whole, since no life is possible without water. Urbanization, Industrialization and population explosion adversely affected the water bodies due to the influx of large amounts of pollutants to the water making it polluted. One of the historically most important rivers, DAYA river in odisha takes off from river Kuakhai at Saradeipur (near Badahati) and runs a few miles, emptying itself into the north eastern corner of the Chilika lake 37 miles from its take off place whose water quality has been continuously exploited. In the present study the sampling and analysis of water of the River DAYA was conducted and a data base was generated to get a clear picture of the pollution status of the river water which will help to take appropriate measures to reduce, eliminate and prevent the pollution level of river water. Water samples were collected from different locations of River: From the origin point of the River, at the Daya bridge, near Village, Itipur and at the mixing point of Gangua-sewage water with the River. Various water quality parameters included in the analysis were pH, DO, BOD, TDS, E coli, Nitrite-Nitrogen, Ammonia-Nitrogen, Nitrate-Nitrogen, Phosphate-Phosphorus and Silicate and the results were interpreted for the pollution status of the river.

Keywords : DAYA River, Water quality, Pollution.

5. Effect of coconut oil treatment on Human Hair

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Human hair is composite biological microstructure. Knowledge of surface properties of hair is essential when we need to understand the effect of different treatments on hair. Since all the cosmetic chemicals interact with hairs surface, the nano mechanical and nano tribological properties of hair surface becomes important. Determining the surface properties of hairs at nano or micro level helps us to understand structure of hair and the way different chemicals may react with hairs. In this paper we study the effect of coconut oil on the human hairs using its nano mechanical properties like hardness, elastic modulus. The nano indentation is used for the characterization of the human hair samples. Change in the hardness, elastic modulus before and after the coconut oil treatment were studied using normal hair sample. Significant difference in the hardness and elastic modulus was noted before and after the coconut oil treatment on the human hair.

Keywords : Nano indentation, AFM, Human Hair, coconut oil

6. Micro-forming of SS 304 thin foils

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Micro-forming draws the attention of manufacturers and researchers rather than other available technology, due to its high precision, low energy consumption and low cost products with better mechanical properties. However, the conventional macro-forming process cannot be applied to micro-forming directly, due to the size effect. Therefore, manufacturing a micro-component by micro-forming process is a challenging field. When the parts are minimized, adhesive force and surface tension plays an important role. The micro-structure, grain orientation, grain boundary, surface integrity are significantly influence the micro-forming process. The manufacturing of micro-die, micro-punch, holding of micro-forming components and concentricity are also very difficult. The manufacturing of micro-forming components and micro-forming operation in a single setup can avoid the eccentricity problem. In the present work a FCC material, SS304 of 30μm, 50μm and 90μm thickness are taken as working material. The effects of thickness, surface grain, cross section grain size on mechanical behavior are investigated. The grain distribution through surface and cross section are described and found that the grain is not spherical in shape. The effect of thickness on YS and UTS at nearly same grain size is studied. It is observed that the strength decreases with increasing thickness from 30 to 90μm.

Keywords : Micro-forming; strength; elongation; thickness effect

7. Solution processable Aluminum doped zinc oxide (AZO) thin film for Organic Photovoltaics application

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Recently, ZnO based transparent conducting oxides has attracted many researchers because of its high optical transmittance, electrical conduction and low material cost. In contrary to indium tin oxide (ITO), it offers an additional advantage of being solution processable. Here in, a systematic study was carried out to optimize the Al doping concentration so as to accomplish good transmittance and conductivity of aluminum doped zinc oxide (AZO) thin film compared to ITO. The synthesis of AZO was carried out by sol-gel method. Thin films of AZO were deposited on glass substrates using spin coating techniques. The sheet resistance and transmittance measurements of the as deposited films were carried out for

studying their potential application as transparent conducting oxide (TCO) in organic solar cells. The fabrication of poly (3-hexylthiophene) (P3HT) and [6, 6]-phenyl C61 butyric acid methyl ester (PCBM) bulk-heterojunction organic photovoltaic devices on ITO and AZO are in process.
Keywords: High Optical Transmittance, TCO, Aluminum Doped Zinc

8. Late Neogene Planktic Foraminiferal Biochronology and Paleoceanography at ODP site 762B of Eastern Indian Ocean

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The Late Neogeneplanktic foraminifera at ODP site 762B, Exmouth Plateau, Eastern Indian Ocean, have been studied to understand the biochronology and paleoceanography. In the present study Globigerinoides, Globorotalia and Globigerina is the most dominant plankticforaminiferal genera, based on the stratigraphic ranges of significant plankticforaminiferal species the studied section has been divided into eight distinct biozones. The zones are similar to those of the tropical northern Indian and tropical western Pacific Oceans. The Late Neogeneplankticforaminiferal species diversity has been measured by using Alpha Index (α), Shannon-Weaver Index (H(S)) and Equitability (E') index. The interval of 3 Ma to 4 Ma has been marked by the continuous decrease of species diversity reflecting unstable oceanographic conditions; the high species diversity during ˜1.5 Ma to 0.2 Ma suggests the stability of the environments. Seven plankticforaminiferal species have been selected for palaeoclimatic interpretation due to their importance as proxy indicators of palaeo water masses, upwelling conditions and trophic levels in the ocean water column. These species are Globorotaliainflata, Globigerinabulloides, Globigerinitaglutinata, Globigerinoidesruber,Globigerinoidessacculifer, Globorotaliamenardii and Neogloboquadrinadutertrei. The dominant occurrences of more fertile species like G. bulloides and G. glutinata after ˜3.5 Ma reflect more productivity due to enhanced upwelling in this region. The closing of the Indonesian seaway was responsible for several palaeoceanographic changes in the eastern Indian Ocean. The final closure of the Indonesian seaway at about 4–3 Ma changed the source of the Indonesian Throughflow (ITF) from warm south Pacific to cold north Pacific waters, which resulted in the breakup of permanent El Nino-like conditions. These changes reduced the warm thermocline water flow into the eastern Indian Ocean and also started the development of upwelling led higher surface water productivity systems in this region. The flow of northern cold Pacific waters into the Indian Ocean may have lowered SSTs in upwelling regions, which caused the cooling of northern America through teleconnections and also initiated the late Pliocene glaciations in the Northern Hemisphere. The relative abundance of G. bulloidesand G. glutinataincreased considerably with much greater fluctuations during the Pleistocene. These faunal changes reflect prominent oscillations in the upwelling-led surface water productivity during the Pleistocene, possibly in response to the episodic nature of the changing strength of the Leeuwin Current.
Keywords : Neogene,planktic foraminifera,biochronology,paleoceanography

9. Sensitivity and Failure mode analysis of Adjustable Speed Drives (ASDs) due to RMS voltage Variations.

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The reliability requirement of Industrial processes is very high to remain competitive in the global market to reduce financial losses due to process disruption caused by failure /mal-function of variable frequency drives as result of voltage sag, swell, under voltage, over voltages, transients leading to huge financial losses due to loss of production and scrap .Repeated drive failure and malfunctions are seen over more than last decade .To resolve ASD failure and malfunction it is necessary to first identify failure modes of variable frequency drive by conducting industrial power quality and grounding and wiring studies and analyze failures and classify into various categories which will help to provide cost effective solution .It is necessary to carry out research to identify failure modes and study of Electrical environment in industry covering power quality , wiring and grounding studies . Based on the inputs of survey it is necessary to provide cost effective solution to make drive immune to Electro-magnetic variation and

develop installation guidelines as a standard practice considering EMI and EMC and wiring and grounding issues. Outcome of proposed research work will be very much useful to industrial consumer and even commercial consumer leading to minimize huge financial losses.
Keywords : Power Quality, VFDs,RMS voltage variations,Grounding, Harmonics

10. RCM-BR: An Efficient Rate Control Protocol for Multimedia Delivery in Wireless Internet

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Next Generation Wireless Internet (NGWI) is expected to provide real-time multimedia services like voice and video delivery. It is important to develop an efficient rate control protocol for the transmission of multimedia data over this wireless Internet in order to reduce congestion and maintain fairness, at the same time satisfying multimedia constraints such as delay and jitter while achieving a high transmission throughput. Moreover, it is desirable to develop energy efficient strategies since wireless devices are energy constrained. In this paper, an end-to-end loss differentiation algorithm and burst error detection and recovery using a new proposed communication protocol are integrated with an equation based mechanism for effective rate control while delivering multimedia data over the wireless networks. Simulation results indicate that the proposed rate control mechanism, RCM-BR, achieves a good throughput performance, smooth rate variation in a low loss scenario, high fairness and better energy efficiency. Moreover, the performance test results obtained over a miniature NGWI test bed validate the proposed rate control mechanism in terms of good throughput performance, smooth rate variations, low latency and minimum delay jitter.
Keywords :Wireless Internet, Multimedia delivery, Rate control protocol, Loss differentiation algorithm

11. Addition of CO2 to a Chemical Looping Reformer: A Theoretical Investigation of its Effects

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Fuel processing technologies are required for generation of syngas to be used in fuel cells. Chemical Looping Reforming (CLR) is one such new technology. CLR consists of a fuel reactor and an air reactor with a circulating oxygen carrier to produce Syngas from fuel (gasoline in this study) by means of indirect partial oxidation mode. Fuel Processors like CLR are known to operate at very high thermoneutral temperatures. Such high temperatures are not very facilitative working conditions[1]. In this paper, with a detailed process study, we successfully reduced the process thermoneutral temperatures by providing an extra feed of CO2 to the fuel reactor. This attempt also reduced the net CO2 generated in the fuel processor. Due its previously proven capability of maximum syngas generation at particular conditions, NiO was chosen as an oxygen carrier for this study. For different inputs of oxygen carrier (6 to 10 moles) and extra CO2 feed (0 to 5 moles) within the temperature range of 600–1,000 °C and 1 bar pressure, we determined the amount of Syngas generated, Syngas ratio (H2/CO), net CO2 emission, Carbon deposition etc. at the thermoneutral conditions. The thermoneutral temperatures for the dual reactor fuel processor were calculated using the hot product gas stream and exothermic CLR process enthalpy to completely balance the endothermic process requirements.
Keywords : Chemical Looping Reformer, Isooctane, Oxygen Carrier, Thermoneutral Temperature, CO2 production

12. Simulation and Analysis of Multimodal Cylindrical Horn for Offset Parabolic Reflector Antenna

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The paper describes the simulation and analysis of novel multimodal cylindrical horn antenna. The horn radiates hybrid mode pattern over the range of 11.5 to 13.12 dB with centre frequency of 10 GHz. The optimization parameters were length and output conical sections with cone angle of 30.5 degree.Nearly circularly symmetric radiation patterns and coincident phase centers in the principal planes with cross polarization better than -20 dB is obtained. An undesirable feature is differential dispersion between the modes which results in narrowing the -25 dB cross polarization bandwidth. of about 15%.

Keywords : Cylindrical Horn, Multimode, Symmetric Radiation Pattern

13. Refinement of inversely transformed austenite grain structure of Fe-0.45C Steel by Nb addition

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The refinement of as-cast austenite (γ) grain structure in continuous casting of carbon steels is an important subject to prevent the occurrence of surface cracking of the slabs. During continuous casting of steel, course columnar grains develop near the mold wall which leads to cracks and decrease in strength. Hence, the grains can be refined by decreasing the columnar region through the addition of Nb as it forms carbonitride precipitates in low to medium carbon steels. The precipitates are either completely or partially dissolved during reheating processes. During reheating, they effectively pin the γ grains as Nb(C,N) particles are located at the γ grain boundary and prevent the γ grain boundary from migrating, thus, resulting in the refinement of grains. Experiments were conducted on Fe-0.45C steel which was both annealed and quenched with Nb (0.3 w% Nb) and without Nb. Microstructures of all the four samples were observed and comparison of columnar and equiaxed region of the gamma grain and dendrite structure was done in both the sample. Comparison between short axis of the gamma grain was also done in both the samples. The results obtained were compared with Fe-0.2C Steel and considerable difference was found between the two. Reheating was also done on all the four samples at 900°C and 1000°C which resulted in grain refinement in both the columnar and equi-axed region. At 1000°C, pinning effect of Nb(C,N) was more prominent. Measurements showed significant increase in the strength of the material during reheating with 65% refinement and 62% refinement of γ grains being observed in the center side and mold side respectively.

Keywords: Refinement, Autenite Grain, Reheating

14. Hydrogen Storage Optimization

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The complex chemical hydride, Ammonia Borane (NH_3BH_3, AB) is a hydrogen rich compound. It holds adequate promise as hydrogen source for applications using PEMFCs. It has reasonably lower operating temperatures compared with other solid state materials. At present AB is an expensive disposable source which in its pure form releases one mole of hydrogen at around 110°C. This temperature is much higher than the operating temperature of PEMFC (˜80°C). At the operating temperatures of the fuel cell, the slow kinetics of pure AB is a deterrent which provides enough scope for experimentation. The research focuses on the experimental thermolysis effort by using Ni as a catalyst with neat AB. The neat and catalyzed AB isothermal decomposition and kinetic behavior are illustrated through the experimental results obtained under various conditions.

Keywords : Ammonia Borane, Catalytic Dehydrogenation, Isothermal Decomposition

15. Soy whey hydrolysate: Breaking insight into its radical scavenging activity through antioxidant peptide characterization

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Functional food enriched with protein hydrolysate has gained interest among consumers because of their health benefits more than intact protein. Before the hydrolysate to be labelled as bioactive, its resistance to the processing condition is vital. Like other biomolecules, activities of bioactive peptides, the functional component of protein hydrolysate are also vulnerable to the pre or post effect of processing conditions. Soy whey, proteineceous waste can be a potential target for peptide generation. Till now only one studies have been carried out were the exogenous enzyme supplementation for partial hydrolysis of soy whey proteins resulted in antihypertensive peptides (Yonekura and Yamamoto, 2004). The antihypertensive biofunctional properties of peptide was found in the soy whey digests of thermolysin and protease S The present investigation aims to study the quality characteristics of the soy whey hydrolysate prepared by food grade protease from Aspergillus awamori so that the hydrolyzed soybean process waste can be easily incorporated in food products as an antioxidant supplement.

Keywords: Aspergillus awamori, Antioxidant peptide, Soy whey

16. Generation of quadrature squeezed light using phase conjugate mirror in optical fiber

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We propose to generate squeezed state at audio frequency range by implementing phase conjugate mirror by means of nearly degenerate four wave mixing in highly non-linear fiber. Simulation result shows that 13.4 dB of squeezing can be achieved with 1.28 km of nonlinear fiber with nonlinearity coefficient of 12.4/W-km.Our scheme is based on two pump based system that enables squeezing at low pump power.

Keywords: Four-wave mixing, Phase conjugation, Squeezing

17. Condensed Representation of Color Video with Scene Detection

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With the development in digital videotechnology, there is also increase in use of limited expensive resources. So condensed representation is the solution for this imperfection. Video consist of frames.So instead of all the frames,highlighted or key frames are extracted to achieve compression .The algorithm for this compression is scene change detection. In this algorithm, Euclidean distance difference of consecutive frames are taken into account. For Shot change detection ,weighted variance of difference of two consecutive frames is considered. Weighted variance can highlight the frame responsible for shot change.By this algorithm, not only compression is achieved, but also redundancy and irrelevance.

Keywords :Scene change detection, condensed, accessibility , weighted variance

18. Creating sustainable model for self-sufficiency of blood plasma products for India

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According to WHO each country must plan for its safe and consistent supply of blood and plasma products for regular clinical needs as well as in case of any disaster. It is estimated that for a country if 2 % citizens donate the blood, it should suffices the need of that country. Unfortunately in India it is just only 0.6%. India collects about 9 million units of blood annually while it is estimated demand is about 12 million units. This huge gap between demand and supply puts most needy patient at highly vulnerable situation and many times it also leads to transmission of HIV, Hepatitis B and C. It causes a huge public health-care burden and many social problems. This all can be prevented or minimized to a great extent by developing

a sustainable model of blood banking and plasma fractionation, which suits to the requirement of the country. We cannot use western model, as they are totally unviable and unsustainable in Indian conditions. After United States of America (USA) and China, India is at the third place in terms of collection of blood. In contrast to this fact, in terms of indigenous production of plasma products, India is way behind these two countries; USA and China processes about 11 and 4 million liters of plasma, respectively while India does practically nil. Therefore, for plasma products, India is a largely imported country. Import has issues of safety, timely availability and afford-ability of the products. India must work towards evolving and developing a sustainable model of Transfusion Medicine, where transfusion medicine specialist, regulators, industry and patient groups can work together and form a forum for public-private partnership. A sustained supply of safe blood and plasma products is just not economic necessity but it's a scientific obligation also, as these proteins are used as life saving medicines in the treatment of various clotting disorders, shock, trauma and many rare genetic disorders.

Keywords : Blood and plasma, Fractionation, Transfusion medicine

19. Handwritten Pattern Recognition using LIF and Izhikevich Neural Model

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In today's world image recognition by the computer is the most concern issue. This issue can be solved by the Neural Networks. For pattern classification and recognition Neural Networks are the most powerful tools. The paper depicts the strategies for hand written English characters (upper and lower case) digits and special characters. In this paper we focus on classification and recognition based on Leaky-Integrate-and fire neuron model and Izhikevich neuron model which are Spiking Neural Network models. In this paper we will describe the simulation of Leaky integrate and fire neuron model and Izhikevich neuron model , wherein we will compare the results in terms of accuracy, simulation time and firing rates for analysis with some further improvements. Recognition of handwriting has become very useful to make the machine learn to interact between human and computer.In the current work we adapt the successful simulation of few SNN models like LIF model and Izhikevich model for implementing an algorithm as a pattern classifier for English alphabets, numerics and special characters. We report on advantages of SNN such as Mathematical model computation, High Accuracy, Low Power, Less Area, Useful for real time applications for further enhancement and improvement in terms of cost effectiveness by maximising the output and minimising the error for pattern recognition application. Spiking Neural Network is the 3rd generation of artificial neural networks as it uses spikes to represent information flow.

Keywords : ANN (Artificial Neural Network), SNN (Spiking Neural Network), LIF (Leaky- Integrate-and fire neuron model), Izhikevich neuron model

20. Effect of supported Co-B catalyst on sodium borohydride hydrolysis for hydrogen production

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Hydrogen production is one of the main challenges towards development of hydrogen economy over fossil fuel economy. Hydrolysis of sodium borohydride generates an appreciable amount (storage capacity ~10.8wt%) of hydrogen at room temperature. But the reaction ($NaBH_4$ + $2H_2O$ $NaBO_2$+ $4H_2$) is not spontaneous due to the increase in pH of the solution, owing to the formation of byproduct $NaBO_2$. Therefore a suitable catalyst is required to facilitate the reaction. In the current work cobalt boride was used to catalyze the hydrolysis reaction and bentonite clay was used as a support of cobalt boride such that the surface area of the catalyst and the reaction interface can be increased to its maximum extent. Co-B doped bentonite catalyst was prepared by two step chemical impregnation and reduction method. The prepared catalyst was characterized by XRD, FTIR, FE-SEM, ICP-AES and N_2 adsorption-desorption (BET) isotherm. Hydrogen evolutions from stabilized alkaline (0.5 M NaOH) solution of sodium borohydride (0.02 M) were measured in an indigenously assembled hydrolysis set-up by water displacement method. Hydrolysis

reactions were performed at different temperature to calculate the activation energy of the reaction. The activation energy (33.67 kJ mol^{-1}) in presence of bentonite supported Co-B (Co-B/bentonite) is notably less compared to the activation energy (45 kJ mol^{-1}) with unsupported Co-B hydrolysis reaction.
Keyword: Sodium Borohydride, hydrolysis, catalysis, bentonite

21. Numerical simulation of flow in a disc and doughnut pulsed column extractor

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Solvent extraction is one of the key unit operations in the process industries. Among various types of solvent extraction units, the pulsed columns are emerging as one the best choices because of their much smaller footprints compared to the most commonly used mixer-settler type extraction units. The mass transfer efficiency enhances with the increase in the interfacial area which is controlled by the intensity of mixing in the pulsed column. A detailed understanding of the hydrodynamics of the liquids in a pulsed column is essential for optimal operation. Oscillatory fluid flow in baffled column has already been reported in the literature. In the present work, we have numerically investigated the hydrodynamics of a pulsatile flow in a disc and a doughnut column.
Keywords : Strouhal number, disc and doughnut pulsed column, pulsating flow, angular frequency

22. Transportation of High Internal Phase Emulsions as Core-Annular Flow

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High internal phase emulsions (HIPEs) have complex rheological properties and behave differently at high and low shear rates. The huge viscosity and complex behavior of HIPEs makes them difficult to pump and transport over long distances. The transportation of these emulsions require huge pressure drop and it is almost impossible to simply pump even with pipes of large diameters. In the present work, an investigation is done on the suitability of pumping and transportation of HIPEs as core-annular flow (CAF). In this CAF regime, thin water film flows along the internal pipe wall and lubricates the internal core of highly concentrated emulsions; this reduces the pressure gradient along the flow. To investigate the rheological behavior, samples of HIPE have been prepared with standard composition. The CAF studies have been performed with a 2-dimensional, transient simulation using CFD software ANSYS FLUENT 14.5 with volume of fluid (VOF) model. The case of low Re is considered to generate the useful data in a horizontal pipe in terms of pressure drop and hydrodynamics of flow.
Keywords : Core-annular flow, non-Newtonian fluid, highly concentrated emulsion, rheology

23. Development of Algorithms for Model Simplification using feature information in thin-walled parts

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At an early stage of design, models created by Computer Aided Design (CAD) applications are not sent as-is for analysis in Computer Aided Engineering (CAE) applications, especially the non-trivial models. Analysis engineers use their domain expertise to simplify these models so that analysis gets performed with lesser resources without compromising much on accuracy of the results. Such Model Simplification involves suppressing small-irrelevant features, dimension reduction, use of symmetry-patterns etc. This process is still widely a manual process and has a lot of potential for automation. Most of the current automation approaches work on the final CAD geometry. Only a few attempts seem to have been made which use feature information effectively. CAD Feature information, which used to be hidden due to its

proprietary nature, has started becoming available in the contemporary CAD applications. Our research plans to leverage feature information for de-featuring and dimension reduction (generating connected midsurfaces) for which, high level algorithms are presented here.
Keywords : CAD, CAE, Model Simplification, Midsurface, Feature-based Design

24. Changing Demographic Profile Of India

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India, the second populous country in the world with a population that is equal to one sixth of the population of the world, has experienced dramatic changes in its demographic profile, following the independence of the country in 1947. In particular, its population has increased by three times, fertility level decreased by half and the life expectancy at birth almost doubled, in between the years 1947 and 2011. The purpose of the present study is to investigate changes in the demographic profile of India, with a particular reference to its population size, fertility and mortality. Efforts are also made to study changes in sex ratio and the percentage of people living in urban areas of the country. The study also compares the demographic profile of India with other populous countries in the world such as China, United States of America, Indonesia, etc. The study even forecasts the population size and the percentage of urban population in the country, for the two forth coming decades.
Keywords: Demographic Profile, Mortality, Population,Fertility

25. Analysis of Quality of Service of Cognitive Radio Systems

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Like all other natural resources, spectrum is also a natural resource and hence owned by the citizen of a country. The spectrum is auctioned by the government and collected sum is utilized for public welfare. In case, the spectrum is not utilized by the spectrum leaser, either partially or fully, full time or part time, the government or public has full authority to use them, provided the leaser is not disturbed. This type of spectrum utilization is dealt with Cognitive Radio technology and has been made legal in many countries. Efficient spectrum sharing schemes such as Game theory which promotes cooperation among conflicting decision makers, have been used for more flexible, efficient, and fair spectrum usage in an opportunistic manner ; to deal with opportunistic links which guarantees the Quality of Service (QoS) and efficient utilization of spectrum. The Cognitive radio is used by the business group through dynamic bidding or it can be a part of service for public utilities. Thus, for such unlicensed communication, the QoS parameters need to be considered. QoS can be defined as a set of specific requirements provided by a network of users, which are necessary in order to achieve the required functionality of a service. ITU-T E.800 definition of Quality of Service (QoS) includes:(i) Availability: Through real-time interaction with the radio environment, the portions of the spectrum that are unused at a specific time or location can be identified which can be made available for CR use; it consists of a static part which is mainly required by cognitive control channels (CCC) and cognitive pilot channels (CPC) and a dynamic part to serve the cognitive traffic demand, (ii) Accessibility: After the available spectrum bands are characterized, the best channel should be selected for use by CR without causing interference to the licensed users and the channel residual free time is greater than holding time of the CR user, (iii) Maintainability: After a CR captures the best available spectrum, PU activity on the selected spectrum may necessitate that the cognitive user change its operating spectrum band, which may necessitate spectrum handoff. Hence, continuous allocation of spectrum is a major challenge to maintain QoS in an environment.
Keywords : Cognitive Radio, spectrum band, Quality of Service

26. Synthesis and Characterization of a Novel Material for High Temperature Resistant Coating

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Much advance research is going on from the last few decades on the application of TBCs on the turbines in order to get rid of the temperature restriction on the turbine materials due to their melting point. The gas turbine engines of the aircrafts must withstand various kinds of stresses like mechanical, thermal etc. 7YSZ was preferred as the thermal barrier material for a long time due to its superior cycling life and established processability. But, they couldn't perform well at high temperatures due to two important degradation mechanisms resulting in decreased fatigue life of the coating. Research on the thermal barrier coatings mainly focussed on reducing thermal conductivity and improving microstructural stability at high temperatures. Zirconates were suitable as materials for thermal barrier coatings at operating temperatures $>1300^{\circ}$C due to their high melting point and low sintering activity. $La_2Zr_2O_7$ (LZ) is the most recent TBC among them. The present work shows the effect of initial powders on final phase formation and properties of Lanthanum zirconate material. Solid state sintering, even though, a preferred method for industrial applicability for bulk production but poor phase purity of starting powder results in poor sintering and subsequent characteristics. Co-precipitation even though being a low yield method provides phase pure powder and thereby results in better sinterability and microhardness properties. The density value of 82% at 1600? C shows that the powder is stable and could be a good TBC material in range of this temperature, since the density value matches with most of the plasma sprayed coatings with a high hardness value.
Keywords : Thermal Barrier Coatings; Zirconates; Sintering; Weibull

27. Corrosion of Welded 9Cr-1Mo steel & RAFMS in static Pb-17Li at 823 K

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P91(earlier) and RAFMS(now) are proposed for building coolant pipe(Coolant-Pb-17 atom% Li Eutectic) of the Fusion Reactor upcoming in France in 2020 viz. ITER(International Thermonuclear Experimental Reactor). The experiments mentioned below were carried out at BARC, Mumbai. The main objective was to study Corrosion effect of welded 9Cr-1Mo (P91) steel and Reduced Activation Ferritic Martensitic Steel (RAFMS) in static lead-17 atom% lithium eutectic at 823 K(coolant temperature in fusion reactor).We have applied a static corrosion test capsule for high temperature corrosion testing was successfully developed. Small specimens (mm) of P91 &RAFMS (Welded and Normal-for comparison) were fixed on Mo strip and inserted in the capsule with Solid Pb-17Li. The experimental capsule was evacuated and filled with Argon and kept at a temperature of 823K for 523 hrs. Characterization techniques employed were: Optical Microscopy, SEM & EDX, Microhardness. Our results showed mild weight loss and thickness reduction in the exposed sample. Gradual decrease of alloying elements was noted at a thin affected surface layer though there was no evidence of grain boundary attack. Microhardness difference between the exposed and unexposed specimens was insignificant.
Keywords : Corrosion Welded 9Cr-1Mo, RAFMS, Pb-17Li at 823K

Note: Abstracts have been suitably condensed for bravity.

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