Innovation | Technology | Business

FITT FORUM

Newsletter of Foundation for Innovation and Technology Transfer,
Indian Institute of Technology Delhi, New Delhi

ISSN-0972-2548
Vol. 19 No. 1, January 2013

Technology Salvation

Year 2012 saw the music sensation PSY's Gangnam Style go viral and create ripples *(the music video has already been viewed over a billion times!)* - demonstrating the power and reach of internet media. The power of mainstream TV and social 'internet' media was also evident in a different albeit, unfortunate circumstances when people from all walks of life in the country came out to express their anguish over a gory and horrendous occurrence – that of lethal violence *(symptomatic of a larger social malaise)* against an innocent girl in Delhi. The country was jolted by this sad event at the fag end of 2012. Wide ranging condemnation and strong calls for justice quite shook the nation out of some lethargy. The case may just serve as an inflexion point in public awareness and discourse, and hopefully catalyze affirmative action against atrocities and criminality in our society. In this context, it was ironical to have an editorial in New York Times (NYT), describing India as a country "which basks in its success as a growing business and technological mecca but tolerates shocking abuse of women". This and numerous other views speak eloquently about the incongruous issues amongst us - contributed in a large measure by a variety of factors that include social, governance or legal deficiencies and systemic failures. Fortunately, when ordinary looking yet intractable challenges confront us we do look towards technology for some salvation. If we can work towards developing / deploying technologies to detect malignant cells, prevent counterfeiting, detect enemy positions, create defensive ware and to address several other administrative challenges, we may as well, look towards developing credible and effective new technology based deterrents to ensure safety of people at large and the vulnerable amongst us, in particular! Let that be one of the priority challenges for the innovators. We may have to go beyond a few *Apps* and the *chili* powder! Hopefully, the innovation and techno-entrepreneurial ecosystem shall not be found wanting in addressing its share of responsibility!

FITT at IIT Delhi contributes in a small measure to enable meaningful partnerships to address technological challenges as we too are stakeholders in the growth and development agenda of the country. We have been at it for several years now. While our performance during the past year was steady, we hope to maintain the momentum in our multifarious activities more particularly towards fostering innovations, technology commercialization and start-up businesses. We hope the period from 2013 onwards heralds a new wave of high impact innovations.
Best!

Anil Wali

Content

i3 National Fair at IIT Delhi

International Conference - Towards a Better Innovation Eco-System, September 20-21, 2012, New Delhi

Wallonia Tech India Program (Belgium) November12, wherein FITT is partnering with AWEX; www.awex.in

Invited Articles

Enzyme Engineering for Enhanced Stability and Anti-leukemic Activity

Dr. Bishwajit Kundu
Associate Professor
Kusuma School of Biological Sciences,
Indian Institute of Technology, Delhi

Enzymes constitute one of the most crucial elements in biological systems. In view of their robustness, enzymes have been exploited in numerous areas that include medicine, research, food and dairy industry, paper industry, biofuel industry, etc. They have been widely used as therapeutics for treatment of several clinical conditions like cancers, anemia, cold, diarrhea, colitis, food allergies, etc. Their clinical application is however limited by one major drawback which is their lack of stability. Most enzymes have a very limited half life inside the human body and get degraded with time, necessitating their continued and prolonged application for a consistent effect. Such continued use may not only add to the cost of treatment but may also be accompanied by negative side effects on the body. It is therefore crucial to enhance their stability to develop an effective clinical treatment.

Owing to their ubiquitous presence in nature, enzymes have evolved to function under widely varying environmental conditions. Despite the environmentally sensitive proteomic nature of most enzymes, many have been found to be optimally active at temperatures as high as 90˚C to sub zero temperatures. These have been appropriately classified as thermophilic, mesophilic and psychrophilic enzymes. Thermophilic enzymes are well characterized for their stability and activity at high temperatures. These enzymes have been found to be potent in extremes of hot springs bringing about speedy, error free catalysis. By virtue of their stability, these could therefore serve as attractive targets for clinical application by manipulating them to work optimally at physiological temperatures.

Enzyme therapy for leukemia

Leukemia is a collection of diseases used to describe cancers of the blood and bone marrow. Wide varieties of treatments are currently in place to tackle the disease, with one of them being the administration of the enzyme asparaginase. The basis of this enzymatic therapy follows from the fact that cancer cells are defective in their ability to produce asparagine required for their survival and depend on blood for its supply. So application of asparaginase, that hydrolyzes asparagine in the blood, is an effective treatment since it starves the cancer cells of asparagine (Figure 1).

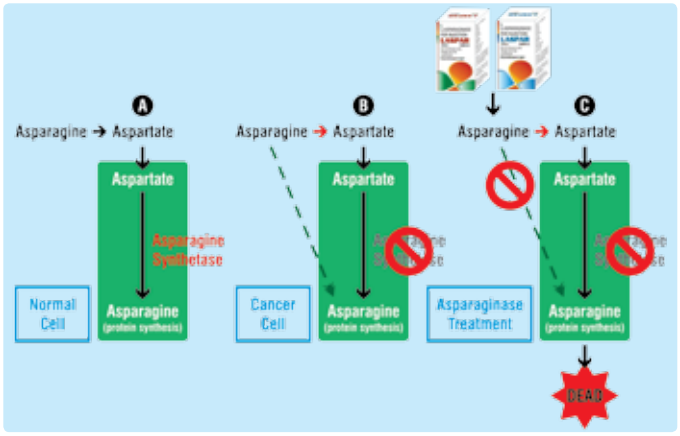

Figure 1: Antileukemic activity of Asparaginases; A - Normal cells can synthesize asparagine from aspartate. B - Cancer cells with very low asparagine synthesis capability, depends on blood asparaginase for survival. C - Asparaginase degrades the blood asparagine, rendering the cancer cells to die of asparagine starvation

Most of asparaginase based therapies utilize the mesophilic form of the enzyme, which works optimally at physiological temperatures. Although efficient, the enzyme has several drawbacks like low stability inside the body, an associated undesirable glutaminase activity and immuno-reactivity (Figure 2). Owing to its low stability the therapy requires multiple dose administration that further exacerbates its side effects on the body in addition to increasing the cost.

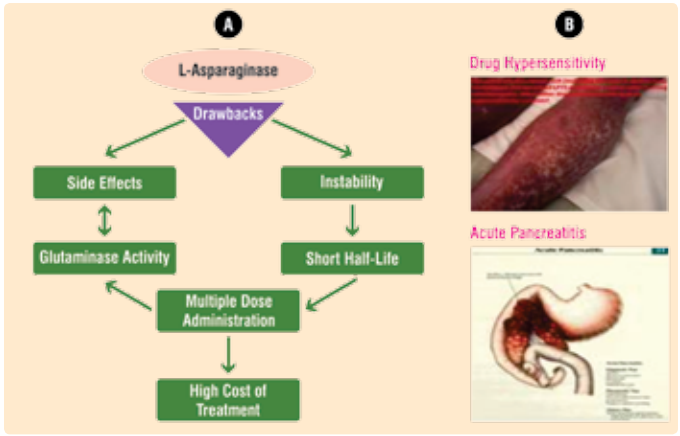

Figure 2: Drawbacks (A) and side effects (B) of treatment with less stable commercial asparaginases

We therefore, proposed a novel protein engineering strategy so as to counter this problem. Asparaginase from the organism *Pyrococcusfuriosus* is highly thermostable and displays efficient

catalytic activity albeit at high temperatures. Most of the protein engineering strategies till now have focused on engineering a mesophilic enzyme to enhance its stability. Taking the reverse approach, we propounded the engineering of a thermophilic enzyme to increase its mesoactivity, thereby, producing a catalyst that is stable and active at body temperatures.

We therefore, developed three different mutants of the wild type, *Pyrococcusfuriosus*Asparaginase (PfA) that had mutations in the active site amino acid residues of the enzyme. These residues were selected by comparing the structures of PfA and EcAII (*E. coli*asparaginase type II) and choosing the residues which accounted for the difference in active site topology of the enzymes and resulting in an open configuration for easy substrate accessibility (Figure 3). Accordingly, two amino acids were identified as targets for mutation and were used to construct single as well as double mutants.

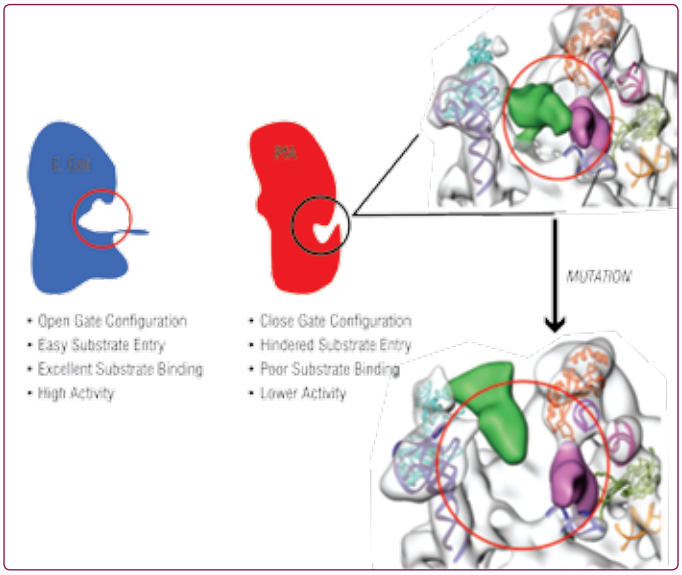

Figure 3: Modulation of PfA active site for higher activity

These mutants showed remarkable results when tested for different aspects of therapeutic use. Firstly, one of the mutants showed considerably high catalytic efficiency over the wild type and the other mutants at physiological temperature. Secondly, all of the mutants were devoid of any glutaminase activity, a highly desirable therapeutic property. Further, the same mutant showed significant resistance to trypsin digestion, suggesting increased stability of the enzyme inside the body since one of the reasons for ineffectiveness of mesophilicasparaginases is their proteolytic digestion and early removal from the system. Finally, these mutants were tested for their cytotoxic (cellular killing) effect against leukemic and non leukemic cell lines. All of them exhibited extremely potent cytotoxicity at very low concentrations as compared to those employed for presently used mesophilicasparaginases. Also, these mutants were highly specific in action, targeting only leukemic cells and displaying insignificant reactivity towards non leukemic cell lines.

These results demonstrate that by mutating the thermophilic enzyme PfA at one criticial active site residue, we can produce a protein that is stable, specific, potent and devoid of any unwanted side effects. In light of these attributes, this enzyme can serve as a favorable replacement for the currently used asparaginase to overcome the pitfalls of the existing therapy.

Not only did this approach help us in engineering a new enzyme, it also brought to light some very interesting mechanistic insights about asparaginase activity. Asparaginase enzymes generally have two active sites consisting of two different catalytic triads, i.e., three different amino acids at each active site. Close inspection of the PfA structure revealed that a critical tyrosine residue might be functioning in both the triads by flipping between both the active sites. This is different from known triads of other asparaginases that contain separate amino acid residues for the two triads.

Thus, protein engineering as a field empowers us with the ability to manipulate and play with protein structures. This not only helps us with construction of novel, useful molecules but also enhances our knowledge of the existing structures. It is only when we completely understand the biology of the available plethora of proteins that we can envision and embark upon the molding of different structures to yield innovative models. Proteins regulate and orchestrate the biology of life and it is therefore of utmost significance to explore these mystic structures to deepen our understanding of the functioning of life.

We Value Your Feedback

FITT seeks to explore various avenues to enhance the quantum of interaction between industrial units / end-users and IIT Delhi. Therefore, we keenly look forward to your feedback and suggestions on various issues that can help to meet our objectives.

Write: mdfitt@gmail.com

Regenerative Engineering

Dr. Sourabh Ghosh
Assistant Professor
Department of Textile Technology,
Indian Institute of Technology, Delhi

Concept of using textiles in simulating human body parts is not a "novel" idea. In 1543 famous European physician and anatomist Andreas Vesalius (1514–1564) wrote a textbook of human anatomy, named *'De humani corporis fabrica libri septem' (On the fabric of the human body),* where he depicted that most of the organs are made up of fibrous tissues. In our laboratory, we are trying to develop various architectures made from fibrous textile materials, to simulate shape, anatomical orientation and mechanics of human tissues.

During the last decade, Tissue Engineering research has made fascinating progress towards the fabrication of tissue constructs in laboratory to repair or replace lost morphology and functions in diseased or damaged organs, in an attempt to meet the demand of our increasingly aged society. As sant Kabir, who was also a weaver, mentioned life as a "jhini bini chadariya" (kahe ke tana kahe ke bharni, kauntaar se bini chadariya), we also wonder which polymeric fibres can be best suited to prepare fabric (scaffold) to engineer specific tissues. Proper selection of scaffold composition and architecture will allow cells to multiply to fill the scaffold and deposit new extra cellular matrix (ECM) to resemble native tissue.

The ideal scaffold should be biocompatible, biodegradable, porous, permeable. We use various biopolymers (alginate, chitosan, gelatin) or synthetic polymers for developing scaffolds, but Silk is our most favourite choice. Silk fibre can meet the growing need for highly specialized biomaterials due to their biocompatibility, stability and mechanical properties, ease of chemical modification, controlled degradability, nominal immunological response. The Silk Fibroin protein consists of a light chain (molwt~26 kDa) and a heavy chain (molwt~390 kDa) linked by a disulfide bond. Silk fibroin is a block copolymer rich in hydrophobic beta-sheet-containing blocks, linked by small hydrophilic moieties. The crystalline regions are primarily composed of Glycine-X repeats, where X could be alanine, serine, threonine or valine. Subdomains enriched in glycine, alanine, serine and tyrosine are placed within these domains. This arrangement results in a hydrophobic protein that self-assembles to form strong and resilient materials. This understanding enables us to develop large variety of three dimensional (3D) architectures of biomaterials, in the form of fibres, hydrogel, denatured porous geometry, fibre-hydrogel composites, textile structures (weaving, braiding, knitting, nonwoven) or patterned film. Electrospinning technique allows development of matrixes simulating nano-fibrous architecture of ECM of human tissues. Scaffolds can also serve as a vehicle for cell delivery and growth factor delivery, to guide the orderly development and differentiation of the neo-tissue. For controlled and targeted delivery of bioactive molecules pH-responsible polymers could be a fascinating choice (Ref 1).

Development of 3D tissue models for in vitro assays

For design of therapeutic options for human diseases it is mandatory to test candidate pharmaceutical compounds before applying in the clinic. Biologists culture cells on flat petri dishes to check efficacy of drugs. But in most cases, investigational drug molecules performing successfully in monolayer culture of diseased cells fail to respond in later stages during animal or human trial. Transgenic or genetically engineered animal models play crucial role for development of clinical protocols. But due to their specific physiology and differences in genomics, they cannot exactly predict the reaction of the human patient's metabolism, telomere regulation mechanism. Animal-based experiments are costly. After European Union's ban of using animal models for trials of cosmetic products pharmaceutical companies are desperately looking for better drug screening assays, preferably using human cell-based diseased models which would allow appropriate transferability of the results.

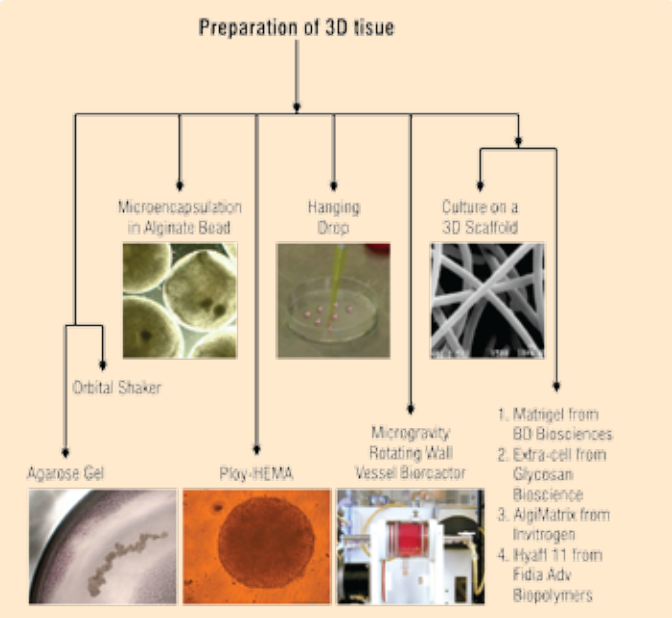

Figure 1: Methods of preparing 3D tissues

Accumulating evidences suggest that 3D cell culture models are fundamentally superior to monolayer systems with respect to mimicking physiologically relevant conditions. Aggregation of cells in 3D clusters can be achieved by using various strategies – e.g., culturing on non-adherent surface, using bioreactors, or upon various commercially available matrixes (Figure 1). We facilitate cell aggregation by culturing them over Poly-Hydroxy ethyl methacrylate coated dishes, or by growing cells in 3D textile scaffold matrixes (Figure 1). Based on knowledge of human genome, understanding of cell biology and insight into engineering aspects required to maintain 3D tissue systems we are trying to establish disease model systems for cancer or Osteoarthritis. Nonionic tethering of pro-inflammatory cytokines on chemically modified silk could modulate transcription profile of healthy human chondrocytes, which dramatically replicated gene expression profile of osteoarthritic cartilage tissue from patients.

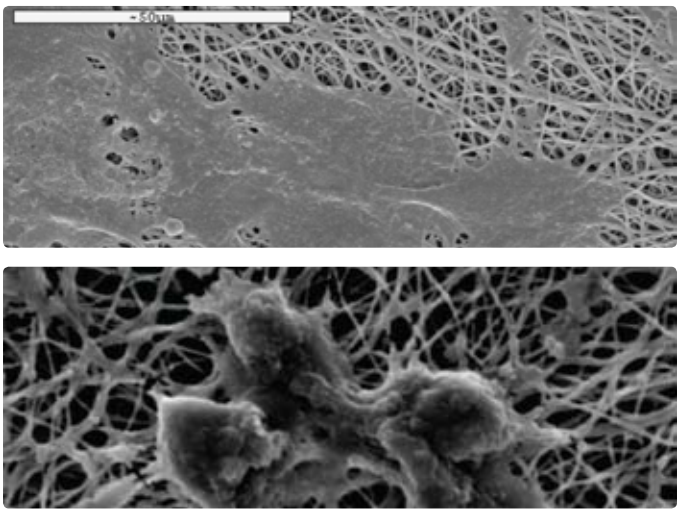

Figure 2: Subtle difference in compliance of nano-fibrous matrix can guide stem cells to migrate and form aggregate

We have reported that bone marrow derived stem cells and embryonic stem cells can sense subtle difference in stiffness of underlying nanofibrous matrixes, and start to self-aggregate to prepare tissues (Figure 2). This interesting finding could lead to establishment of in vitro model to simulate mesenchymal condensation mechanism of developmental biology (Ref 2).

Tissue engineering

Using Tissue engineering strategies we are trying to engineer cartilage, bone, intervertebral disc, cornea, muscle in the context of their specific 3D anatomical architecture and function. Intervertebral disc (IVD) makes the spine flexible to bend and twist in all directions. Ageing process or injury to IVD lead to dehydration of inner gel, cracks in Annulus tissue, disorientation of collagen fibres, resulting in protrusion of hard Nucleus Pulposus and application of pressure on spinal nerve, causing chronic back pain ("slipped disc"). The current approach for treating such degenerative disc problem is through reduction of inflammation and physiotherapy. Upon further degeneration, disc is surgically removed and ceramic or metallic discs are implanted, at the cost of reduced flexibility of the spine. Replacement of degenerated disc by a tissue engineered substitute could offer major advantages over arthroplasty or implantation of prosthetic disc, in terms of possibility of initial matching of biomechanical properties and adaptive remodeling in the long term.

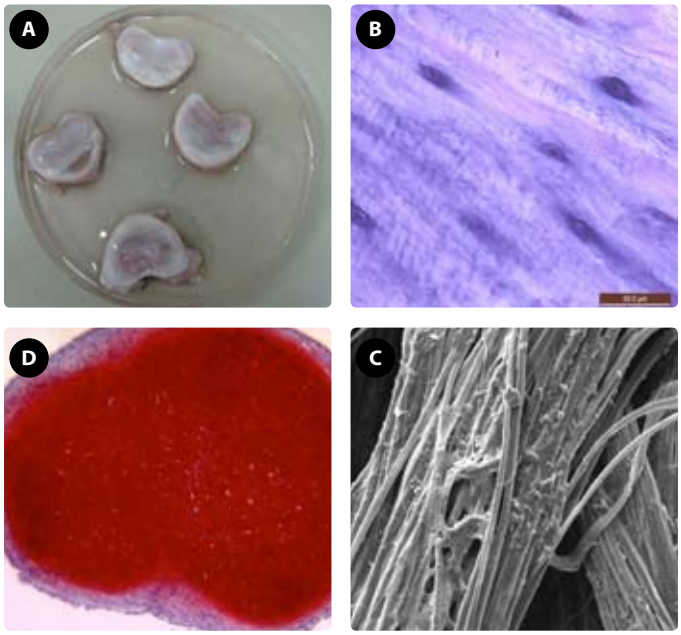

Figure 3: Tissue engineering of intervertebral disc (a. Goat IVD, b. Orientation of cells and ECM fibres in human Annulus tissue, c. Orientation of silk fibres and cells on scaffold, d. Tissue engineered disc)

Several research groups around the world are attempting to develop bioengineered IVD. But none of these studies could successfully simulate the precise anatomical orientation of collagen fibres in Annulus tissue in criss-cross lamellar fashion. As a result, mechanical properties of most of these engineered tissues are several orders of magnitude below the stiffness of IVD. We have developed a silk scaffold having custom-made fiber alignment, where silk fibres are aligned at 30-40 degree to the scaffold axis, and in alternate direction in successive layers. This fibrous alignment allowed cells to deposit fibrous ECM proteins at a desired orientation (Figure 3) and ultimately developed optimum biomechanical functions of the IVD tissue. Furthermore, silk fibres were chemically modified to attach chondritin sulfate, an important component of cartilage tissue, to prepare enhanced chondrogenic microenvironment. Taken together, combined effect of chemical composition and microstructural organization of scaffold gives rise to anisotropic and nonlinear mechanical behaviors replicating biomehanics of disc tissue.

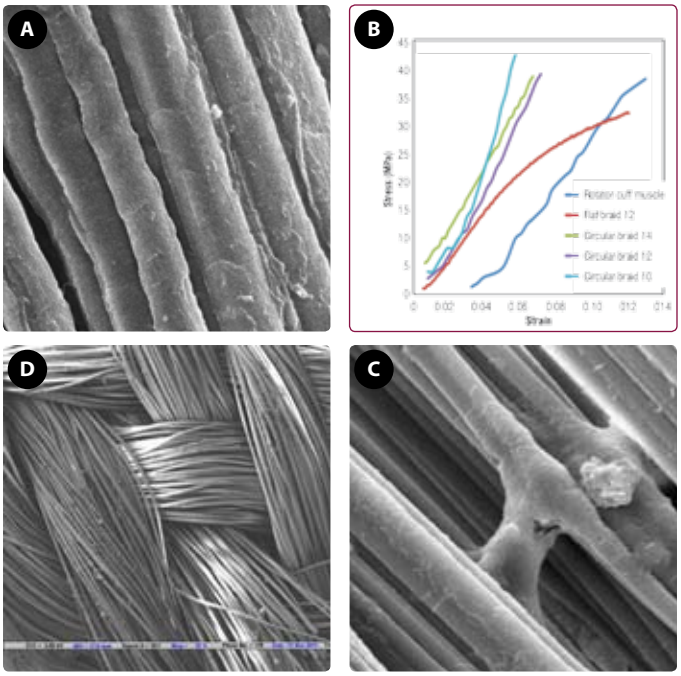

Figure 4: a. Myofibres of goat muscle, b. Comparison of mechanical property of muscle and textile braids, c. Myoblasts growing on silk scaffold and fusing together, d. Architecture of textile braid

Rotator cuff muscle tear is common problem in players as well as aged people, leading to debilitating pain, reduced shoulder function. We have developed braided silk tapes replicating elastic behaviour of human rotator cuff muscle (Figure 4). Structural integrity, durability, design flexibility and precision of braided textile structures make them highly potential for such challenging application.

Personalized approach

Tissue engineering studies are moving in the direction towards personalized therapeutic strategies, where scaffolds need to be fabricated in tissue-specific, patient-specific architecture. Direct-write technique, a miniaturized Rapid Prototyping, is one of the promising approaches to develop microperiodic complex architectured scaffolds. Clinical images captured from the area of defect in patient's body can be converted to virtual 3D architectures using CAD software. Using that image the computer-controlled translation stage of direct-write system can move a syringe barrel incorporated with ink deposition micro-nozzle in a layer-by-layer fashion, to form controlled and complex 3D construct. But proper selection of polymeric ink composition and tailor made viscoelastic properties are main challenges to ensure smooth deposition of ink and shape retention (Ref 4).

Obstacles remain

International community of tissue engineers is trying to design new generations of biomaterials with exciting new functionalities. Problems related to availability of funding, precise optimization of strategies to make scaffolds of specific chemistry, stiffness, architecture for directing cell behaviour, limited understanding of human physiology, ethical issues, controlled clinical trials are enthralling them. Material scientist, cell biologists, biotechnologists and clinicians are trying to learn from each other and to contribute to each other. Considerable progress has already been achieved resulting from interdisciplinary interaction among researchers of various fields. For example Prof. Farshid Guilak (Professor of Orthopedic surgery from Duke University) and Prof. Lisa Freed (a biologist from MIT) realized potential of textile technology and hired a mechanical engineering undergrad student to fabricate a 3D weaving loom, and developed cartilage tissue constructs (Ref 5). Such dynamic approach is still unthinkable in India, because multidisciplinary approach of problem solving is still not understood and appreciated by administrative authorities, biotechnology industries and even by the researchers. There is a saying that, it is difficult to insert new ideas in brain, but it is more difficult to take old ideas out. Hopefully pieces will fall into place, and Tissue engineering research in India will flourish in near future.

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New Approaches for Clustering Data

Dr. Ragesh Jaiswal
Assistant Professor
Department of Computer Science and Engineering,
Indian Institute of Technology, Delhi

Clustering data is one of the central problems in Machine Learning and Data Mining. Here, we will talk about new approaches for clustering data that are being developed at CSE, IIT Delhi.

Introduction

Clustering, in general, is the problem of grouping objects into separate classes such that similar objects are in the same class. For instance, given some news articles, we might want to group these articles into various classes like sports articles, political articles etc. Another example is clustering medical data into classes that represent diseases. Clustering is usually the first step in understanding large datasets that may be generated in scientific and social experiments.

To be able to tell how well a clustering algorithm performs, we need a measure of similarity or difference between pairs of objects. In most practical cases, objects are represented as points in some d dimensional Euclidean space and the popular difference measure in this setting is the squared Euclidean distance. The k-means problem is one of the most used and well-studied problems in this setting. The formal definition of this problem is: given n points in a d-dimensional Euclidean space, find k points (called *centers*) such that the sum of square of the distance of every point to its closest center is minimized. Note that these k centers give an implicit clustering of the data points, all points closest to a single center being in the same cluster (see Figure 1(d)). Mathematically, the problem can be written as:

Given $P = \{p_1,\ldots,p_n\} \in R^d$, find $C = \{c_1,\ldots,c_k\} \in R^d$ such that $\Phi(P,C)=\Sigma_{p\in P} \min_{c\in C} D(p,c)$ is minimized. Here $D(p,c)$ denotes squared Euclidean distance between points p and c.

This problem is believed to be a hard problem to solve efficiently. The most popular heuristic algorithm that is used to solve this problem in practice is the Lloyd's algorithm. The algorithm starts with k centers chosen arbitrarily, and in a sequence of steps, shifts these centers while improving the solution each time. Even though this algorithm performs well in practice, it does not have performance guarantees. This means that there are certain datasets for which this algorithm performs very badly. One of the main reasons for poor performance of the Lloyd's algorithm is poor choice of the initial k centers. To be able to fix this problem, one needs to come up with a fast and simple algorithm that picks the initial k centers in a cleverer manner. It turns out that a simple sampling based algorithm helps to quickly find k centers. Moreover, this sampling algorithm solves the k-means problem and there is a performance guarantee attached with it. This sampling algorithm is popularly called the k-means++ algorithm [Arthur and Vassilvitskii, 2007] and all it does is randomly sample k points in the following manner:

Pick the first center randomly from among the given points. For the i^{th} center ($i\geq 2$), pick a point with probability proportional to the square of the distance of this point to the nearest previously chosen center.

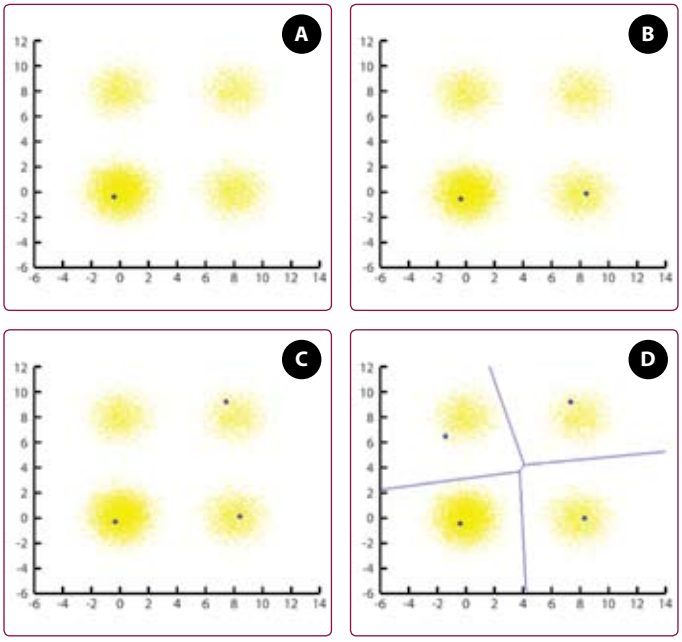

Figure 1: The figure shows a two dimensional dataset being clustered into four clusters using the sampling algorithm. The algorithm samples the centers in four simple steps. The first center is chosen randomly. For the second center, the points that are further away from the first center are given more priority and so on

The above sampling algorithm has extremely nice properties. It is simple to implement and runs very fast in practice. Moreover, there is a performance guarantee associated with the algorithm. This means that it gives solutions that are close to the optimal solution for every data input. We are trying to understand the behaviour of this simple sampling based approach for clustering at CSE, IIT Delhi. In the next section, we talk about some of our results.

Our results

Algorithms for streaming setting: The amount and speed of generation of data has increased a lot in recent times. Due to this, traditional model of data analysis where one assumes that the data fits and stays in the memory during the entire computation is becoming obsolete. The more relevant setting is the *streaming setting* where the algorithm is only allowed to make a pass (or few passes) over the data for analysis. So, in some sense, the algorithm should be able to analyse a *stream* of data. One such scenario is analysing stock prices on a light-weight machine such as a smart phone or PDA that has limited memory and gets access to a stream of data. In [Ailon, Jaiswal and Monteleoni, 2009] we design algorithms for clustering for the streaming setting using the sampling based approach. Our algorithm showed very good results on many datasets.

Behaviour for special datasets: Certain datasets have some nice properties that can be exploited to get better clustering results. One such property is that there is some degree of separation between the clusters. In [Jaiswal and Garg, 2012] and some on-going projects we show that the sampling based clustering algorithm give very good results for such datasets.

Near accurate clustering algorithms: Since the k-means clustering problem is believed to be hard, existence of efficient algorithms that produce optimal clustering is unlikely. However, there may be algorithms that produce clustering that is very close to the optimal. In [Jaiswal, Kumar and Sen, 2012], we design and analyse a very simple algorithm based on the sampling approach that provably gives solutions that are arbitrarily close to the optimal solution.

Hierarchical clustering: For certain data, the number of clusters is not known beforehand. For instance, consider finding clusters of friends in some social network dataset. In such scenarios, we would like to cluster the data at all levels of granularity so that if there is a query for producing varying number of clusters, one can do that quickly. This is known as *Hierarchical clustering*. In an on-going project, we are exploring how the techniques and algorithms developed in [Jaiswal, Kumar and Sen, 2012] can be used to give good Hierarchical clustering algorithms.

Concluding remarks

The sampling based approach has lot of potential in designing fast and accurate clustering algorithms. In various projects being conducted at CSE, IIT Delhi, we hope to understand the power of this approach and develop good clustering algorithms.

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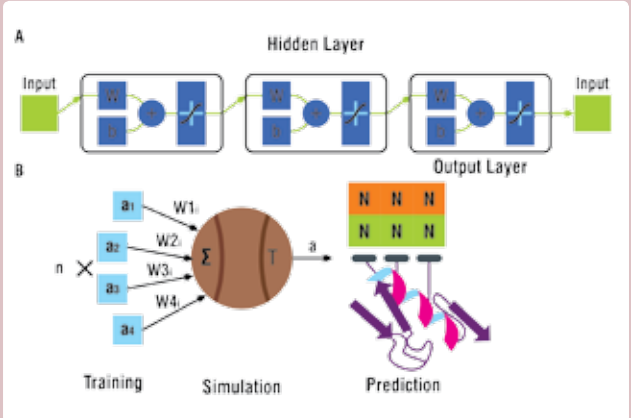
Research in Dr. Sundar's Lab

Sundar's lab has made significant contribution in developing strategies to evolve new DNA-binding specificity in zinc finger proteins, especially in the area of zinc finger transcription factor libraries, which has tremendous application in biomedicine. His work was highlighted by Nature India in January 2011. Further Sundar's computational biology research employs the structure and function prediction tools developed by his group to help guide experimentalists in manipulating proteins and extracting information about their function and structure, both at the single molecules as well as at the genomic / system levels.



Faculty Profiles

Prof. Vinod Chandra
Department of Electrical Engineering,
Indian Institute of Technology, Delhi

Professor Vinod Chandra completed his B. Tech in 1971 and PhD in 1978 from the department of Electrical Engineering at IIT Delhi. He was appointed as the Senior Research Assistant in 1971 in School of Radar Studies and Senior Scientific Officer of CARE in 1974. He joined as Lecturer in the department of Electrical Engineering at IITD in 1978 and was promoted as an Assistant Professor in 1981 and subsequently to the position of Professor in 1990. He was a Visiting Professor in department of Electrical and Computer Engineering at Florida Atlantic University, Boca Raton, Florida, USA during 1987-1988.

He has developed the following courses as part of his teaching contributions: Fault Diagnosis in Digital Systems, Testing and Fault Tolerance, Digital Communication and Information Systems, Broad Band Communication and Information Systems, Optical Communication Systems, Fiber Optics and Optical Communication Lab. Along with other faculty members he has been responsible for setting up a new Photonics Laboratory in the institute.

He has made significant research contributions in development of electronic systems for various industries in India. The innovative work has resulted in commercially viable know-how and regular commercial production of several microprocessor based electronic systems and instruments in the area of Railway Electronics and Signalling. The most significant contribution is the development of **AXLE COUNTING SYSTEMS** which are used for automatic signalling in railways. The design and development of this system led to the production of more than thousand equipments which are in actual operational use in Indian Railways. This has resulted in foreign exchange saving of approximately 75 crores. These axle counter systems have been exported to Zambian Railways against international competition. The successes of these axle counters have also inspired the creation of new R&D groups in safety electronics in Indian industry. Several companies like M/s Crompton Greaves, DCM Data Products, Central Electronics Limited have taken this know how. Recently RDSO has given a consultancy to IITD for improvement of reliability of Axle Counting Systems for Block Working and modifications have lead to significant performance of these systems in the field.

Axle Counter for Automatic Signalling in Railways
National Invention award 1979: Prof. P V Indiresan, Vinod Chandra, S Vedantham
Axle counter is used for detecting the presence or absence of trains on the railway track and is used for automatic signalling in railways. The system was developed at IIT Delhi in association with Research Design and Standards Organisation of India Railways. The system is currently being manufactured by Central Electronics Ltd., Sahibabad, who have installed over eight thousand systems in Indian Railways.

As part of Photonics Mission, Technology Development projects a **FIBER OPTIC LAN FOR RAILWAY SIGNALLING APPLICATIONS** has been developed by him and his team of students. This is a state of the art system for controlling movement of trains in a safe manner in railway yards via optic fiber. An agreement on **TECHNOLOGY TRANSFER** for the system developed by Prof. Vinod Chandra and his team has been signed with M/s HBL Power Systems Ltd., Secunderbad, for total value of Rs. 20 lacs and the technology transfer has been completed. The firm has received a development order from Indian Railways and the first system has been put on field trials at Falaknuma station in Hyderabad.

In addition to the above, several other electronic systems developed by him have resulted in technology transfer to the industry. Together with above systems these innovations have resulted in approximate production of about Rs. 100 crores so far. He has filed a dozen software copyright applications through FITT, IIT Delhi which have been approved to cover the technology transfers. He has also validated many railway signalling systems from the aspect of safety and reliability and these have been accepted by RDSO for giving approval to introduction of these systems in operational use in Indian Railways.

He has guided six PhD theses and about fifty M.Tech theses and has published over fifty papers in international journals and conference proceedings.

His current research is in the area of Optical Communication and Optical Networks. He is currently guiding four research scholars in this emerging area. Along with other faculty and

students, he has filed two Indian patents on Optical Data Vortex Interconnection Networks for applications in high performance computing. An application for US patent in this area with application in Bi-directional Optical Interconnection of high performance computing in a highly scalable and fault tolerant network, for connecting computers for sharing of data and processing capabilities has been filed.

Apart from academic work, he has taken up administrative responsibilities such as President, Board of Student Publications, Co-ordinator of Interdisciplinary Optoelectronics and Optical Communication program.

Prof. Vinod Chandra is recipient of the NRDC National Inventions Award and was awarded 5th Hari Ramji Toshniwal Memorial Award of the Institution of Electronics and Telecommunication Engineers in the area of Electronics for Application to Industry.

He has been actively participating in extension activities of the institute and has conducted several short courses in areas of Fault Tolerant Systems and Communication Systems. He has also been involved with the Phase-I audit of Delhi Metro along with other faculty colleagues from the institute. He was Member, Inter Departmental Technology Cooperation Expert Group for Railway Signalling and Telecommunication, DSIR, Ministry of Science and Technology. He was member of high power Railway Safety Review Committee constituted by Ministry of Railways, Government of India under the Chairmanship of Justice H R Khanna.

Prof. V. D. Vankar
Department of Physics,
Indian Institute of Technology,
Delhi

Professor V. D. Vankar was born in Varanasi. His entire education was in Varanasi / Banaras Hindu University. He got his PhD from B.H.U. in 1975 on Small Angle Diffraction from Thin Gold Films. He joined Thin Film Laboratory of IIT Delhi as a Research Associate in 1976 and later became the Lecturer in 1978, Assistant Professor in 1985, Associate Professor in 1991, Professor in 1995 and Professor HAG Scale in 2009.

He also had visiting assignments at Syracuse University, NY and has been visiting UCLA, University of California San Diego, Tokyo University etc.

Prof. Vankar has been teaching Electromagnetic Theory, Solid State Physics, Thin Films Technology, Characterisation of Materials etc. to undergraduate and Post Graduate students. His research interests are in Nano-technology, Carbon Nanotubes and Graphene Thin Films, Structure and Growth of Thin Films, Plasma Processing of Materials, Solid Solid Interfaces, Phase Change Materials for Optical Recording, Hard Coatings, Micro-crystalline Diamond, Diamond like Carbon and Surface Physics. In these areas of research he has published about more than 130 research papers in International Journals and one U.S. Patent on Boron Nitride and related coatings. He has also developed several types of sputtering systems including Planar Magnetron sputtering systems, Plasma Assisted Chemical Vapour Deposition systems in his laboratory.

Prof. Vankar has supervised 26 PhD students, 50 M.Tech and about 12 M.Sc / B.Tech students for their thesis work. His research work also presented in several National and International Conferences / Workshops. Six of his papers got Best Paper Awards too. At present six students are working with him for PhD degree.

Prof. Vankar has been actively involved in the development of various laboratories in Physics Department and has created important research facilities therein. He was Principal Investigator of several projects worth more than four crores. He has been actively collaborating with important industries such as Moserbear India Limited and other organization like NPL, SSPL, IUAC etc.

Prof. Vankar is life member of The Material Research Society of India. He was also a member of Electron Microscope Society of India, Indian Vaccum Society, Sigma Xi association of USA. He was conferred with Material Research Society of India (MRSI) Medal in 1997. He was invited to give several Invited Lectures in various institutes / research laboratories / Theme Conferences and workshop in India and abroad. He was member of several important committees of CSIR / UGC / DRDO / National Laboratories / Institutes.

Prof. Vankar is very popular among his students. His students have got prestigious jobs in India and all over the world, in industries, National Laboratories and institutes etc. He is known to be very conscientious person. He was a member of Society for Scientific Values for three years.

FITT / IIT Delhi Happenings

18th AGM of FITT

Annual General Meeting of FITT, October 31, 2012

i3 Fair on 3rd December 2012

The Indian Innovation Initiative, i3National fair was held at IIT Delhi on 3rd December, 2012. This annual flagship initiative of the Department of Science & Technology DST Government of India, Confederation of Indian Industry (CII) and Agilent Technologies Ltd. was inaugurated by Dr. Y S Rajan, Chairman of the National Board of Accreditation. i3 mainly aims to give the country an innovative eco-system at the same time providing innovators a unique platform with adequate funding, incubation, technology refinement and excellent marketing.

FITT in collaboration with the Government of Gujarat, National Science and Technology Entrepreneurship Development Board, CII Technology Development & Promotion Center (Tamil Nadu), WWF, Yi Young Indians, TIFAC and India Angel Network made this event a huge success.

Cell phone based Indoor Navigation System Roshni for visually impaired individuals developed by students of IIT, Delhi

Research and Views

1. N. Ramakrishnan and R. Bose, "Dipole entropy based techniques for segmentation of introns and exons in DNA" Applied Physics Letter, Vol. 101, Iss. 8, 083701, August 2012. This paper is currently featuring in APL website under "Top Stories".
   Link-http://apl.aip.org/features/top_stories
   Coverage in the web-
   http://www.eurekalert.org/pub_releases/2012-09/aiop-ith091112.php

2. Roy, S., Dutta, S., Khanna, K., Singla, S. and Sundar, D. (2012). Prediction of DNA-binding specificity in zinc finger proteins. J. Biosciences 37(3):483-491

POSOCO Power System Awards (PPSA) 2013–Announced

To recognize the outstanding contributions made in the field of power sector, Power System Operation Corporation (POSOCO), a wholly owned subsidiary of Power Grid Corporation of India Ltd. (POWERGRID) in collaboration with Foundation for Innovation & Technology Transfer (FITT) has taken the initiative to confer awards to innovations and research works within the IITs and NITs to motivate individuals and encourage further research activities in the area.

Under the Doctoral and Master's category a total of forty awards are instrumented. An independent committee consisting of representatives from industry, academia and research will evaluate the projects and make selection for recognition. The top ten projects under the Doctoral category will be awarded with cash prize of Rs. 75,000 and the remaining thirty under the Masters' category will receive cash of Rs. 35,000. Entries are open from 1st of January 2013 to 31st January 2013.

Innovation Contest by EDC

Another innovation contest was organized by *The Entrepreneurship Development Cell* in IIT Delhi on 29th November, 2012. There were ten teams in total, where each of the team was assigned with news items focusing on a particular issue. The task was to come up with solutions and idea of the various issues, keeping in consideration the sustainability, technical feasibility and easy implementation of the plan with general acceptance.

Students Activity during the 2nd Innovation Contest

Innovations

Opportunities for IP Licensing

Sl. No.	Title	PI / Dept.
1	A surgical stapler	Prof. Sneh Anand, CBME
2	An apparatus for measuring fabric hand value	Prof. Apurba Das, DTT
3	Wireless ECG patch and system for obtaining high definition mobile ECG	Prof. Sneh Anand, CBME
4	A novel device and mechanism for mixing of fluids	Prof. S N Singh, AM
5	Triple layer wound dressing material and mechanism for efficient drug release and healing thereby	Prof. Veena Koul, CBME
6	Contra lateral limb controlled prosthetic knee joint	Prof. Sneh Anand, CBME
7	Ionic liquid catalyst and a process for preparation thereof, and improved tertiary butylation of phenol / phenolic compounds for higher conversion of phenol and phenolic compounds	Prof. Sreedevi Upadhyayula, CHEM
8	A system of generating refreshable tactile text and graphic	Prof. P M V Rao, ME
9	A novel closed loop speed control using carrier space vector pulse width modulated direct torque control scheme for induction motor drive	Prof. J K Chatterjee, EE
10	Microbial process for removal of toxic phorbol esters from de-oiled Jatropha seed cake	Prof. S K Khare, Chemistry
11	Power factor correction base 4D flyback converter for permanent magnet brushless DC motor drives for fan application	Prof. Bhim Singh, EE
12	Mechanical arm for transfer of substrates under oxygen free ambience between an oxygen free chamber and a thin film coating system	Prof. Viresh Dutta, CES
13	Control strategy of optimum CNG fuel injection for BSEC improvement and emission (CO_2 and NO_x) reduction of a dual fuel stationary diesel engine	Prof. K A Subramanian, CES

Technology Profiles

Sustainable Power Generation with Green Environment using Diesel Engines with Hybrid Fuels (CNG and Diesel)

Dr. K A Subramanian
Center for Energy Studies,
Indian Institute of Technology, Delhi

Diesel engines emit high level of oxides of nitrogen (NOx) and particulate matter due to its combustion with heterogeneous air-fuel mixture. These emissions can be reduced significantly using compressed natural gas (CNG) which is injected into intake manifold of diesel engine where as diesel as pilot fuel is directly injected into engine cylinder using conventional injection system for initiating ignition of the air-fuel charge. NOx and CO_2 emissions decreased about 30% and 22% respectively with 34% CNG energy share (1/3rd CNG and 2/3rd Diesel). NOx emission can further be reduced up to 60% with 2/3rd CNG energy share but CO and HC emissions would increase. Brake thermal efficiency increased about 21% with 1/3rd of CNG share. IIT Delhi has developed a technology entitled "control strategy of CNG fuel injection for dual fuel diesel engine" which was funded by Department of Science and Technology (DST), Government of India. This technology is basically a retrofit gas injection system to inject accurate and optimum quantity of CNG share. This technology has an additional feature of system flexibility as it can be set the control strategy with optimum CNG window based on required emission limit. The developed electronic control unit (ECU) can also inject two gaseous fuels with independent control. The pilot fuel can also be replaced with renewable fuel such as biodiesel and main CNG fuel can be derived from variety of renewable source including biogas and producer gas resulting to sustainable power generation with green environment.

A Novel Purification Platform for Cost Effective Manufacturing of Therapeutic Proteins

Dr. Anurag S Rathore
Department of Chemical Engineering,
Indian Institute of Technology, Delhi

Effective and efficient manufacturing process is a critical element of biopharmaceutical product development cycle. In today's competitive market, besides being 'first to the market', quality and cost-effectiveness of the product are also key drivers for process development. Downstream processing is an integral part of any biopharmaceutical process which accounts for up to 80% of the total manufacturing cost. Developing the novel innovative processes is a key for the successful survival of the biopharmaceutical companies in a highly competitive market.

Present invention focus on the developing single step purification strategy for purification of cytokine class of the biotherapeutic proteins. Recombinant human granulocyte colony stimulating factor (rHu GCSF) was selected as a model protein for the study. Proposed invention makes use of the single step multimodal chromatographic purification for removal of critical product related as well as various process related impurities. Existing manufacturing process for GCSF involves a combination of refolding and various chromatography steps for removal of various product and process related impurities, i.e. oxidized and reduced variants of native GCSF and fMet variants. Conversion of multistep purification platform to the single step purification process significantly improved the process productivity by 30 %.

FITT in collaboration with BIRAC

FITT has been selected as one of the three BIG partners in the country for implementation of Biotechnology Ignition Grant (BIG) Scheme of Biotechnology Industry Research Assistance Council (BIRAC), a Government of India enterprise. The scheme is designed to help establish and validate proof of concept and enable creation of spins off. The proposals under this scheme can be submitted online from January, 2013.

Short Course: Financing of Renewable Energy Technologies, December12-15, 2012

Certificate Programme: Telecom Technology & Management, August 2012- January 2013

R&D Projects

Sl. No.	Title	PI / Dept.
1	Development of process of hardening for booster pump shaft – An alternative to hard chrome plating – Phase-I	Prof. J Bijwe, ITMMEC
2	A process for the preparation of polymeric materials or composites and composite polymer sheet and a sheet thereof	Prof. B L Deopura, TT
3	Study of grapheme as top layer contact material for silicon solar cells	Prof. B R Mehta, Physics
4	De-silting and rehabilitation of sewer barrels by CIPP technology along different line at Q point in New Delhi	Prof. A K Keshari, CE
5	De-silting and rehabilitation of sewer line from Bhai Veer Singh Marg to Sansad Marg	Prof. A K Keshari, CE
6	Research study on catalyst loading and its impact on the performances of trickle bed reactors	Prof. K D P Nigam, CHEM
7	Benchmarking of plasma polymerized modified hollow fibre membranes	Prof. A K Ghosh, CPSE
8	Design and development of 5-bit RF MEMS switched line phase shifter and LTCC package for DMTL phase shifter (Phase-II)	Prof. S K Koul, CARE
9	Graphite components in NAO friction material on NVH characteristics	Prof. J Bijwe, ITMMEC
10	Determination of Mode of Filed Diameter (MFD) theoretical cut-off wave length, zero dispersion wavelength (ZDW), macrobending loss, fiber cut-off wavelength and cable cut-off wavelength of a given fibre refractive index profile	Prof. B P Pal, Physics
11	Examination of a safety intravenous catheter vis-à-vis Patent No. 240086	Prof. A Chawla, ME
12	Optimal water allocation network synthesis	Dr. M A Shaik, CHEM
13	Basic design of pneumatic conveying system for flyash	Prof. V K Agarwal, ITMMEC
14	Technical inputs for pneumatic conveying of flyash	Prof. V K Agarwal, ITMMEC
15	Exploration in machine learning and optimization for market applications	Prof. Jayadeva, EE
16	Road safety political mapping in India	Prof. G Tiwari, TRIPP
17	Comparison of LLDPE samples	Prof. V Choudhary, CPSE
18	Dewatering scheme and design at additional building of Supreme Court	Prof. A K Keshari, CE
19	Development of some techniques / programs for educational software modules on fiber and integrated optics	Prof. R K Varshney, Physics
20	Development of small molecules targeting cancer proteins	Dr. N G Ramesh, Chemistry
21	Failure analysis of vibro-sieve and its re-design for extended life	Dr. R K Pandey, ME
22	Recommendation for precision manufacturing process control and optimization (Phase-II)	Dr. S Jha, ME
23	Structural proteomics of plasmodium vivax development of a three-dimensional structural dutubare of 500 soluble proteins in malaria paranite	Prof. B Jayaram, Chemistry
24	Development of software for underwater domain awareness (UDA) – Phase-II	Prof. R Bahl, CARE
25	Development of innovative fertilizers – Regulating Nitrogen Delivery (RND)	Prof. H M Chawla, Chemistry
26	Development of big-data analytics algorithms and models for mobile marketing	Prof. S Chaudhury, EE
27	Development of wear resident grades composites based on high performance polymers	Prof. J Bijwe, ITMMEC
28	Treatability study for the removal of chloride from gelatin industry waste waters	Prof. T R Sreekrishnan, DBEB
29	Image quality improvement for interventional X-ray imaging system	Dr. K B Khare, Physics
30	Design of barrages of Nikki Tawi and Waddi Tawi over Tawi River, Jammu	Prof. A K Keshari, CE
31	Estimation of sub-surface hydraulic parameters for dewatering design for construction of additional office complex for Supreme Court of India	Prof. A K Keshari, CE

Professional Development Programmes

Forthcoming HRD Programmes (early 2013)#

Sl. No.	Title	Date	Sponsored/ Participation Fee Based	Faculty / Dept.
1	"Standardization and Measurement of Custom Satisfaction" for ONGC Executive	January 7-8, 2013	ONGC, Vadodara	Dr. Harish Hirani, ME
2	CEP course on Underwater Superiority – "Technologies for Underwater Acoustic Surveillance"	January 17-19, 2013	INS Valsura	Prof. R Bahl, CARE Prof. Arun Kumar, CARE
3	Advances Bridge Construction Practices	January 28-30, 2013	Participation Fee Based	Dr. Kumar Neeraj Jha, CE
4	2nd High Noon Spring School – "Adaptation to Changing Water Resources Availability in Northern India with respect to Himalayan Glacier Retreat and Changing Monsoon Pattern"	February 4- 7, 2013	UKaid Department for International Development	Prof. A K Gosain, CE
5	Executive Development Programme on Project Management for IOCL Executive	February 11-16, 2013	IOCL, Gurgaon	Dr. S P Singh, DMS
6	Workshop on "Development in Renewable Energy Sources (Biomass, Solar etc.)"	February 27-28, 2013	Participation Fee Based	Prof. D K Sharma, CES
7	Training workshop – "Discovery Development and Commercialization of Biotech Therapeutics"	March 11-15, 2013	PATH, New Delhi	Prof. A K Gosain, CE

Professional Candidate Registration Programme

Applications are invited from qualified professionals working in industry and research organizations for a unique knowledge augmentation and skill enhancement programmes at IIT Delhi. This involves a semester-long registration for a regular PG course. Course fees ranges from Rs. 15,000/- to Rs. 20,000/- (industry professionals) and Rs. 6,000/- to Rs. 8,000 (academic / government personnel) for a 42 hour lecture course. In the case of a few selected courses, on-site course delivery using the two way audio-video link can be considered.

All major disciplines of Science and Engineering, and also relevant courses from the Humanities, Social Sciences and Management streams which are being conducted at IIT Delhi are covered. The course detail can be downloaded from FITT website www.fitt-iitd.org.

Eligibility: Degree in Engineering or Masters Degree in Science, Management or any other Post Graduate Degree with relevant industry experience. The two semester sessions in the academic year starts in the month of July and January, the exact dates being notified in advance.

Contact: uttamaswal@hotmail.com, kirityroy@yahoo.com.

Miscellaneous

Corporate Membership of FITT

FITT invites the industry / industry associations / R&D organizations and financial institutions to become corporate members of FITT at a nominal annual subscription. A corporate client can participate in technology transfer and joint R&D programmes of the Institute on a priority basis with FITT providing the interface. Membership form can be mailed on request or can be downloaded from www.fitt-iitd.org.

Techno-Entrepreneurship Supports

FITT extends supports for innovation / entrepreneurship under approved Government Schemes:

Technological Incubation and Development of Entrepreneurs (TIDE), DIT: to financially support technology ventures (IT and IT & ES) at incubators during early stages of their development (www.mit.gov.in).

Seed - Support to Incubatees, TDB: for addressing the varied development needs of the start-ups at incubators up to Rs. 25 lakhs (www.dsir.gov.in).

Biotechnology Ignition Grant (BIG) Scheme of BIRAC (DBT): to establish and validate proof of concept through financial support / mentoring to incubatees and new startups up to Rs. 50 lakhs (www.birapdbt.nic.in)

News and Views

IIT-D All Set to Open Design Innovation Centre

A spate of new projects will soon grace the campus of the Indian Institute of Technology (IIT Delhi). While the institute has already set up its Student Innovation Centre with seed funding provided by the batch of 1986, it is now ready to set up yet another centre. "The Government of India has approved an innovation centre to be set up at the IIT campus. This is going to be a design centre and will be different from the existing student innovation centre that already exists said," R. K. Shevgaonkar, Director, IIT (Delhi).

Sources: Hindustan Times, 26th October'12

Research at IIT-Delhi to get a booster dose: Director

"IIT-Delhi plans to increase collaborations with foreign universities. It wants to introduce fellowships for Ethiopian students who wish to pursue a PhD. IIT-Delhi is also helping the Mauritius government establish a research academy…."

Source: The Indian Express, 27th October'12

Transfer land for extension campus, IIT Delhi tells Haryana

"….The institute requested for an additional 100 acres in Jhajjar. A six-member team from IIT-Delhi visited plots in Jhajjar to identify the site for the second extension campus…"

Source: The Indian Express, 7th December'12

Roshni: Indoor navigation system….

"Students at IIT Delhi have created a navigation system based on Global Positioning System that can work well if floor plans of building are available."

Source: Hindustan Times, December'12

Giveter.com: ex-IITians' start-up helps people zero in on the perfect gift

Source: The Economic Times, 10th December'12

We spend only 0.9% of GDP on R&D

"Research and development (R&D) is the basic constituent of promoting innovation. The culture of research needs to be further augmented in our country. Only about 6,000 patent applications were filed by Indians in 2010, which is a mere 0.3 per cent of the total applications filed in the world…."

Source: Business Standard, 16th December'12

Nvidia, IIT Delhi collaborate on exascale computing

"The new Exascale Research Lab (ERL), co-developed by Nvidia and IIT Delhi, will help the nation achieve this goal by providing advanced ongoing research, testing, and technology development in a variety of areas, including processor architecture, circuits, memory architecture, high-speed signaling, programming models, algorithms, and applications."

Source: Times of India, 20th December'12

Team

Chairman, Governing Council: Prof. R K Shevgaonkar, Director, IIT Delhi

Managing Director: Dr. Anil Wali

Executive Team: Sh. K K Roy, Sh. M Mahajan

Staff: Mrs. S Lamba, Sh. R K Mehta, Sh. V Bhattacharya, Sh. J Singh, Sh. U Aswal, Sh. M K Rajoriya,

Consultant: Sh. G Kumar

Associates: Mr. D Sahu, Mr. N S Tomar, Ms. T Jain, Ms. S Bhuyan

Editing Desk: anilwali@fitt.iitd.ac.in, surekha.bhuyan@iitd.ac.in

Foundation for Innovation and Technology Transfer
Indian Institute of Technology, Delhi
Hauz Khas, New Delhi 110016
Phone: +91 – 11 – 26857762, 26597289, 26597153, 26597285, 26581013
Fax: +91 – 11- 26851169
Website: www.fitt-iitd.org
Email: anilwali@fitt.iitd.ac.in, mdfitt@gmail.com