IIT Bombay Technologies

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IIT Bombay Technologies

Director's Message

IIT Bombay has been active in education and research in science, engineering and design over the last 53 years. The campus community of 516 faculty members, 7800 students and 800 research staff are focusing their efforts on ensuring that their research makes a difference. We are happy to present the second edition of this booklet that outlines some of the major technologies developed at the Institute. Several of these technologies have been patented and some have been licensed. We also have many technologies that have been licensed and are being commercialised by startup companies initiated by our faculty and students and supported by our Society for Innovation and Entrepreneurship (SINE).

I hope this booklet is useful to companies who are looking to commercialize new technologies and bring them to the market place as well as to attract researchers and students to the vibrant research atmosphere at the Institute.

(Devang Khakhar)

IIT Bombay

December 20, 2011

Deans' Message

In 2010 January, we compiled a list of IIT Bombay technologies and published the first edition of the IITB Technologies brochure. During the last two years, we have intensified our efforts to disseminate information related to technologies and intellectual property (IP) developed by faculty and students. The objective is to ensure that the products of our research are disseminated and useful to society. We have made efforts to pro-actively seek commercial partners for licensing of our IP and knowhow by creating a licensing website and placing advertisements in national newspapers. This has resulted in increased licensing activity.

We felt the need to bring out a revised edition of IITB Technologies since a number of new technologies have been developed since the last edition. The brochure has been re-designed and technologies have been classified into healthcare, energy and environment, information and communications technology (ICT), manufacturing, special needs, design, transportation, rural development and other technologies. We have included information about the status of deployment and licensing of each technology. This brochure provides an outline of some of the important technologies developed at the Institute. We profile 119 technologies, out of which about 50% (61 technologies) have been licensed or deployed.

We have attempted to improve readability by focusing on the key features and applications for each technology. We will be happy to provide additional technical details to companies and researchers who may be interested in specific technologies. We welcome your feedback and your involvement in working on these technologies.

Rangan Banerjee
Dean (R&D)

P. V. Balaji
Associate Dean (R&D)

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(▪ Licensed Technologies)

(▪ Licensed Technologies)

Healthcare

Biosensors for Health Monitoring

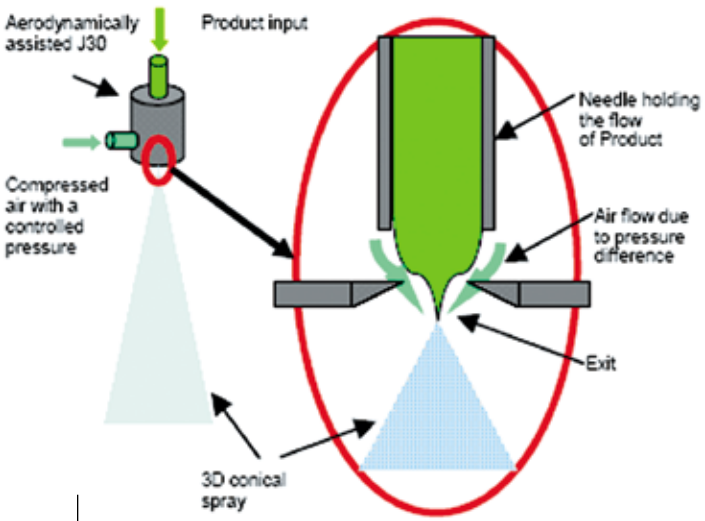
Inventors: R. Srivastava, A. Joshi, Department of Biosciences and Bioengineering

Patent application filed (US patent application number: 12/837,218)

Biosensors for detecting and measuring biological analytes like lactate, pyruvate, oxygen and hydrogen peroxide which are indicative of the metabolic status of an individual.

Features:

- biosensors can include nanoparticles, microparticles and nano-in-micro matrices
- minimally invasive biosensors (injected or inserted in the subject) can be used for continuous monitoring



Schematic example of production of a biosensing assay using an industrially feasible atomisation method, which can include dye loaded nanoparticles co-immobilised and conjugated with lactate oxidase enzyme in calcium alginate microspheres

Potential Applications:

- diagnosis and treatment of diseases
- fitness and health monitoring in sports
- space medicine
- food applications and the food industry
- pharmaceutical applications and the pharmaceutical industry
- fermentation monitoring
- polymer manufacturing applications

Status: Licensed to a US Corporation

Biosensors for Monitoring Diabetes

Glucose sensors can be implanted transdermally (beneath the skin) for monitoring diabetes and related ailments.

Implantable glucose sensors often elicit inflammatory responses in the body. To reduce these responses and maintain the functionality and longevity of the sensors, the glucose sensors are coupled with an anti-inflammatory agent.

Features:

- biosensors can include
  - alginate microspheres loaded with anti-inflammatory agents
  - a population of uncoated and polyelectrolyte coated alginate microspheres
  - a population of microspheres incorporating fluorophore –labeled glucose binding agents and fluorophore-labeled glucose analogues
- the fluorophore-labeled binding agents and analogues of glucose form a FRET pair (Fluorescence Resonance Energy Transfer pair)
- FRET pair could be a visible dye FRET pair or a near-infra red F RET pair

Method Used:

- detection of fluorescence emission from an implanted glucose sensor
- a change in the intensity of fluorescence emission compared to reference fluorescence is correlated to the blood glucose level of the subject

Principle:

In the absence of glucose, the donor fluorophore is bound to acceptor fluorophore, whereby the fluorescence of donor molecule is quenched. Glucose, when present, displaces the labeled glucose analogues, resulting in an increase in the donor fluorophore fluorescence. The change in fluorescence is correlated to the variation in the glucose levels.

Inventors: R. Srivastava, A. Chaudhary, R.D. Jayant, Department of Biosciences and Bioengineering

Patents applications filed (Indian Patent application number: 1319/MUM/2010, US Patent application number: 12/819,868)

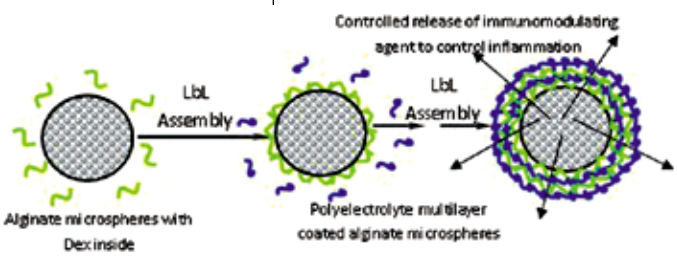


Image illustrating the mechanism of layer-by-layer assembly of microspheres for controlled release as well as co-encapsulation of sensing chemistry

Status: Licensed to a US Corporation

Designing Nano-in-Micro Particles

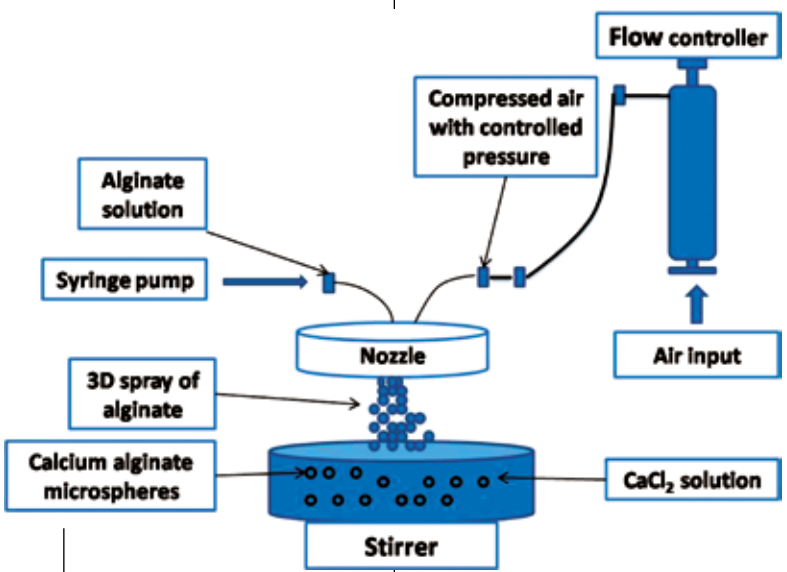
Inventors: R. Srivastava, A. Joshi, R.K. Prasad, Department of Biosciences and Bioengineering

Patent application filed (US Patent application number: 12/728,936)

A simple and efficient way of preparing microspheres with one or more entrapped nanoparticles.

Features:

- suspension comprising a polysachharide and one or more nanoparticles is atomised into a solution containing cross-linking agents
- nanoparticle could be a fluorescent or a therapeutic agent
- a chemical agent could further be added to the microsphere to remove entrapped nanoparticles and gel the microsphere internally
- suitable routes of administration include oral, rectal, topical, nasal, pulmonary, ocular, intestinal and parenteral



Schematic representation of production of multifunctional system using an industrially feasible method which comprises of biosensing, drug delivery, protein delivery and imaging assays entrapped in alginate microspheres.

Advantages:

- industrially more feasible compared to the conventional emulsification method
- atomisation provides advantages in scaling up including continuous processing, reduced instrumentation requirements, reduction in number of steps, reduced time and cost

Potential applications:

- imaging human or animal subjects or cells of an organism
- administering magnetic nanoparticles that would generate heat on application of an alternating magnetic field, thus killing cancerous cells
- delivery of therapeutic drugs
- diagnosis of analytes in biological samples
- tissue engineering - support tissue growth
- delivery of desired protein or gene

Status: Licensed to a US Corporation

Biomolecule Immobilisation on Epoxy Surfaces

Microsystem devices used in biological applications require immobilisation of biological molecules within the device. Conventionally, the substrate materials used in these devices have been silicon and noble metals (e.g. gold); however, such materials have been found to have shortcomings related to their high Young's modulus, biocompatibility and suitability for micro-fabrication.

A rapid and simple process for activation of epoxy surfaces such as SU-8 (glycidyl ether of bisphenol A) has been devised , to enable surface immobilisation of molecules bearing carboxyl and/or amino functional groups.

Steps involved in the surface modification of SU-8 are:

- grafting of NH_2^+ groups onto the epoxy surface using hotwire-induced pyrolytic decomposition of ammonia under vacuum
- antibody immobilisation on the treated SU-8 surface

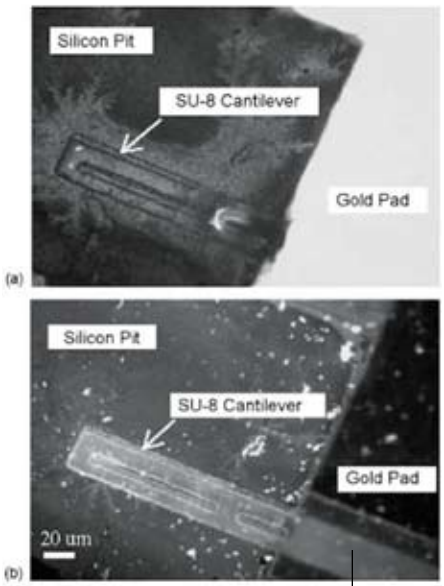
The technology has applications in the following fields:

- surface modification
- bio-microelectromechanical systems
- bio-molecule immobilisation related assays
- bio-sensors
- membrane bio-reactors
- clinical diagnostics
- molecular biology
- agriculture
- environmental science
- chemical and biochemical industries

The process enables single or multiple-step tailor-made bio-molecule immobilisation (e.g., antigens, antibodies, proteins, DNA, RNA and enzymes) on the modified epoxy surfaces.

Inventors: S. Mukherji, R. Lal, V. R. Rao, R.O. Dusane, and M. Joshi, N. Kale
Departments of Biosciences and Bioengineering, Electrical Engineering and Metallurgical Engineering and Materials Science

Patent granted (Application no. 1267/MUM/2004; grant no. 213504)



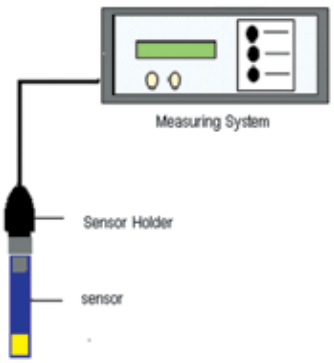
Micrographs of SU-8 cantilevers with gold pads treated with pyloritic dissociation of ammonia observed under (a) optical microscope, (b) fluorescent microscope

Status: Licensed to Nanosniff Technologies Pvt. Ltd., a company incubated at IIT Bombay

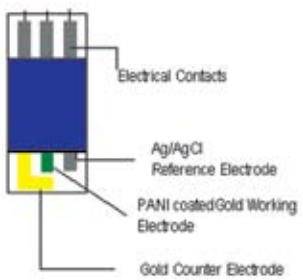
Portable Lab-on-a-Chip Biosensor

Inventors: A.Q. Contractor, Department of Chemistry

Patent granted (Application number: 89/BOM/94, grant number: 179848)



Schematic of biosensor measurement system



Biosensor magnified to show details of electrodes

Status: Exclusively licensed to Polymeric Sensors Pvt. Ltd., a company incubated at IIT Bombay

An electrical conductance-based biosensor that can be used to measure the concentration of biomolecules such as blood sugar, haemoglobin, cholesterol, urine sugar levels, soil urea in agriculture and fat levels in food.

Components of the unit:

- separated pair of electrodes located in an electrically inert insulating matrix with an electronically conducting polymer bridge deposited across the electrodes
- individual sensor set up with one enzyme/receptor (specific to the biomolecule being measured) that is immobilised in the array
- conductance measuring circuit connected to the electrode array

A reference sensor (that is, without the immobilised enzyme) can also be attached which would help to compare biomolecule levels among the samples to be tested. Biosensors constructed in this manner can be integrated into one unit, but are able to sense multiple analytes and give accurate results.

Benefits:

- cost effective
- compact and portable ('lab-on-a-chip' devices)
- allow digitised inputs
- outputs are computer compatible for quantitative analysis
- enables on-the-spot sample testing
- products can be easily enhanced to simultaneously test for several parameters (e.g. Polysense Aqua, a compact instrument which can assess several aspects of water potability)

Polymer-Based Sensor for Monitoring Water Quality

A portable polysensor device to monitor the quality of water.

Features:

- includes a transducer and an electronic system for monitoring the quality of drinking water
- based on a conducting polymer
- uses the potentiometric/conductometric technique for data measurement.

In the sensor, a receptor is immobilised in a polymer matrix. Interaction of the analyte with the receptor changes the chemical state of the polymer, which manifests as a change in the potential/conductivity of the polymer. This is monitored by applying an appropriate measurement signal to the sensor.

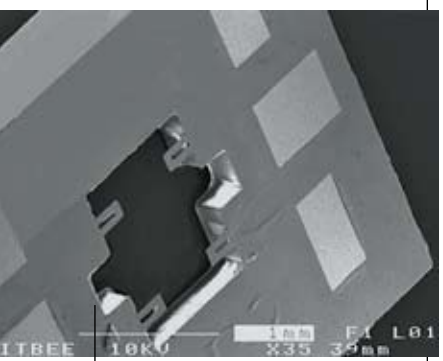
Inventors: A. Q. Contractor and team, Department of Chemistry

Polysensor used for determination of water quality

Status: Licensed to Polymeric Sensors Pvt. Ltd., a company incubated at IIT Bombay

A Point-of-care System for Cardiac Diagnostics

Inventors: V. R. Rao, S. Mukherji and team, Departments of Electrical Engineering, Biosciences and Bioengineering, Chemistry and Mechanical Engineering



A highly sensitive piezo-resistive polymeric cantilever platform for low-cost lab-on-chip applications

An integrated point- of- care system that is currently under hospital trials for detection of acute myocardial infarction

Status: Licensed to Nanosniff Technologies Pvt. Ltd., a company incubated at IIT Bombay

A low-cost, diagnostic aid for assessing cardiac dysfunctions. It is a piezo-resistive polymeric cantilever-based technology with embedded electrical readout schemes and electrical sensitivities in the range of a few parts per million per nanometre of deflection.

Features:

- identifies molecular markers that detect cardiac attacks especially incipient attacks that may go undetected before a major or fatal attack
- uses cantilever-based and affinity biosensor-based arrays ('infarcSens' or 'iSens') to detect a suite of molecular markers

Currently, the data management software for detecting molecular markers over time (data required for the creation of an epidemiological database) is being developed and the system is under hospital trials.

Use: provides an integrated system for point-of-care diagnostic support for cardiovascular diseases

Silicon Locket for Cardiac Monitoring

A toffee-sized, low-cost, silicon locket that could be used to monitor ECG.

Components:

- low-power microcomputer with an indigenously developed operating system
- custom-made analogue integrated circuit, designed and tested for accurate data acquisition and signal conditioning
- rechargeable battery with a built-in charger
- USB, IrDA and RS232 ports for integration with public networks, mobile phones and personal computers
- pluggable, ultra-small PSTN modem to transfer data to a remote computer or medical database

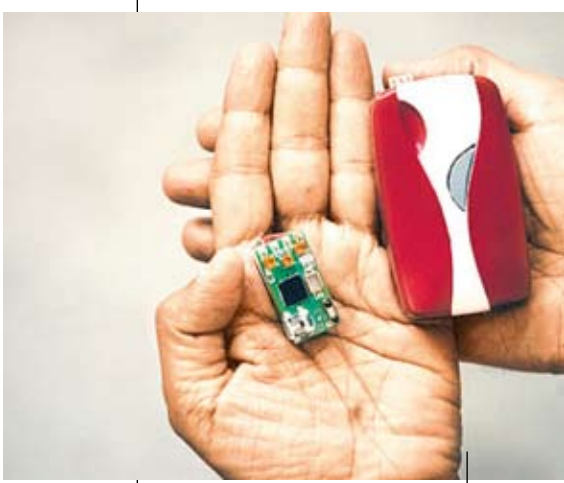
Features:

- locket has been optimised to acquire a three-lead simultaneous electrocardiogram (ECG)
- reconfigurable for up to 12-leads
- can correct for motion artefacts that may arise out of the physical activity of the patient
- ECG data can be stored in a micro-sized secure digital memory card or transmitted through a phone modem or via a GPRS network
- automatically informs a medical practitioner through an SMS in the event of an arrhythmia
- allows the practitioner to remotely login to the locket to view a patient's ECG in real-time or download the data

A 32-bit, system-on-chip base-station was developed as an accessory for the silicon locket. The base station is a handheld system with a high processing power and a colour TFT LCD panel. The base unit contains advanced built-in data management and analysis software for the locket-supplied ECG analysis.

The locket is the smallest wearable ECG recorder, for its features, in the world.

Inventors: D. K. Sharma and team, Departments of Electrical Engineering, Biosciences and Bioengineering, Tata Consultancy Services



Silicon locket for monitoring of ECG

Status: Technology has been transferred to industry

Orthopaedic Implants, Instruments and Surgery Planning

Inventors: B. Ravi, Department of Mechanical Engineering, in collaboration with Manish Agarwal, TMH/ Hinduja Hospital, and K. Balasubramanian, NFTDC Hyderabad

Patent filed (Application number: 2883/MUM/2010)

Tumour Knee Mega-Prosthesis

Femoral Jig

Status: Clinical trials are underway

A computer-integrated approach to rapidly develop and test modular orthopaedic implants; employed for a high-quality low-cost tumour knee mega-prosthesis for children affected by osteosarcoma.

Methodology used:

- anatomical study to determine the range of shapes and sizes of the bones (femur, tibia and knee joint)
- desired functionality achieved through a novel mechanism which was computer-simulated to verify the range of motions and to ensure that the stresses are within safe limits
- plastic prototype fabrication on a rapid prototyping machine and review of the same by surgeons to check for form, fit, functionality and surgical suitability
- components manufactured with biocompatible materials using casting, CNC machining and finishing to achieve the desired mechanical properties and surface finish
- prosthesis testing on a UTM using custom-built fixtures to ensure structural safety, followed by fatigue and wear testing on specially developed simulator machines to ensure long life
- novel surgical instruments (femur and tibia cutting jigs) based on studies of knee surgeries and discussions with surgeons, to make the procedure faster, easier and more accurate

Surgery planning software (OrthoSYS):

- Main input: CT or MRI images of the patient's anatomy, and a database of 3D CAD models of prosthesis components
- Features: identification of bone axes and anatomical landmarks, analysis of bone stock thickness, selection of prosthesis components and their positioning in the excised bone
- Applications: Results can be used for guiding the actual surgery; also useful for surgeon training and patient education

Carbogen Breathing Apparatus

The carbogen gas delivery system is for use by people who work in high noise areas and experience noise-related stress.

Features of carbogen gas:

- a mixture of oxygen (95%) and carbon dioxide (5%)
- plays a therapeutic role for those with impaired hearing
- relieves stress due to noise pollution
- when inhaled for 5 minutes, two to three times a day, the ill effects of noise-related stress from working in a severe noise environment can be reduced or eliminated

Thus far, systems with three capacities of 10, 50 and 300 litres have been developed. The 300 litre unit provides 10 inhalation stations and can accommodate up to 10 people for the simultaneous inhalation of carbogen gas.

Possible locations for use of carbogen inhalation stations:

- defence-related locations such as firing ranges, aircraft hangars and ship engine rooms
- civil locations such as traffic islands, fitness centres, workshops and factories.

Inventors: K. Munshi and team, Industrial Design Centre in association with the Defence Institute for Physiology and Allied Sciences, Delhi, a Defence Research & Development Organisation laboratory

Carbogen gas inhalation apparatus

Status: Design transferred to Defense Establishment for deployment. Prototypes developed were tested extensively by DRDO with the Indian Navy and has been approved by the Indian Navy for use by personnel working in severe noise environments.

Electrodiagnostics for the Neuromuscular System

Inventor: S. Devasahayam, Department of Bioscience and Bioengineering

Patent granted (Application number: 14/MUM/2001, grant number: 206022)

An electro-diagnostic instrument for the measurement of electromyography (EMG) and nerve conduction which can also analyse the collected data.

Features:

- equipped with signal pickup and stimulator channels that are connected through an audio jack to a PC multimedia card
- response-signal pickup channel electrodes are easily moveable and hence may be placed on the part of the body where tests are to be made
- electrodes are connected to a bio-potential amplifier, a frequency filter and an isolator
- stimulatory system electrodes are connected to an input jack and an isolator
- input from the response-signal pickup channels is processed by an analogue signal generator
- includes software that controls the base values of the input audio signals, collects stimulation and response signal data and analyses the data

Nanosurfactants for Neonatal Respiratory Distress Syndrome

Neonatal Respiratory Distress Syndrome (NRDS) is a condition in which infants do not produce natural surfactants and consequently, breathing and the associated exchange of gases becomes difficult due to the lung surfaces sticking together. Treating the condition with surfactants would aid in proper alveolar function.

A process and a formulation have been developed for the creation of a nanoparticulate exogenous micronutrient with an added protein-free surfactant composition for use in treating NRDS.

The formulation contains:

- nanovesicles of a phospholipid and a natural oil (either clove or eucalyptus oil)
- micronutrients selected from ascorbic acid and soluble calcium salts

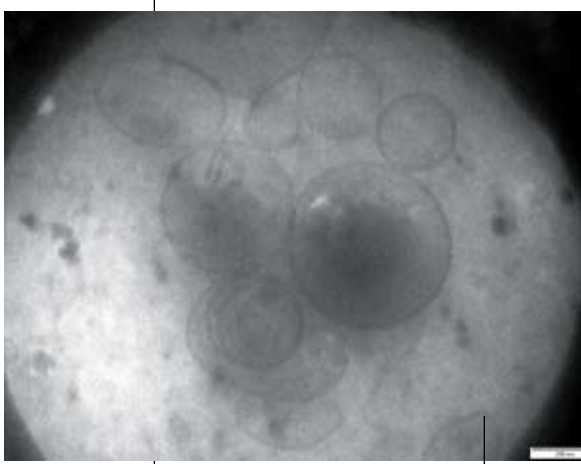
Benefits:

- can be inhaled easily
- disperses uniformly
- delivers micronutrients
- easy to prepare
- does not contain any animal derived foreign proteins
- superior surface activity as compared to existing surfactants
- cost-effective

The main parameters for a surfactant to be effective in NRDS are minimum surface tension on film compression (<5 mN/m), low surface tension on adsorption (25–30 mN/m) and low compressibility. These criteria were surpassed by the developed formulation.

Inventors: R. Banerjee, Rachana, J.Bellare, R.Puniyani, Department of Biosciences and Bioengineering

Patent granted (Application number: 1222/MUM/2005, grant number: 241271)



Nanovesicles of the invented surfactant which can be aerosolised in NRDS

Surfactant Composition for Adult Respiratory Distress Syndrome

Inventors: R. Banerjee, Rachana, J. Bellare, R. Puniyani, Department of Biosciences and Bioengineering

Patent granted (Application number: 1223/MUM/2005, grant number: 241272)

An exogenous protein free pulmonary surfactant composition that can be used for the treatment of Adult Respiratory Distress Syndrome (ARDS).

ARDS is a condition where the lung surface surfactants function poorly, due to interaction with inhibitory agents.

The formulation comprises of nanovesicles of phospholipids and eucalyptus oil. It can be used to treat the inhibition of surfactants related to haematological agents.

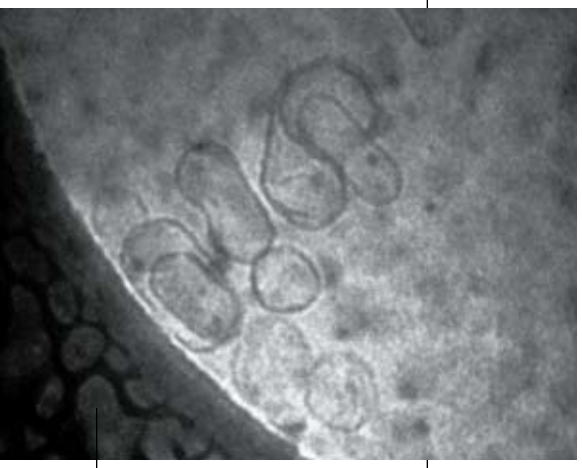


Image of surfactant showing intact nanoparticles in the presence of inhibitory agents

Features:

- prevents interaction between the surfactant and the haematological agents
- functions well as natural surfactants in the absence of inhibitors
- has higher efficacy than known artificial surfactants

The surfactant developed is effective in the presence of haematological inhibitors and will be effective in ARDS therapy. This is an unmet medical need and there are no effective surfactants presently available for ARDS.

Multi-layer Nanocomposites

Multi-functional nanocomposites which include multiple layers of hydrophobic and hydrophilic polymers held together by a surfactant material.

The different layers of the nanocomposite developed can be loaded with separate drugs.

Components of the nanocomposite:

- a negatively charged polymer layer comprising a first drug
- a positively charged polymer layer encapsulating the negatively charged polymer layer and comprising a second drug

Method of synthesising a nanocomposite:

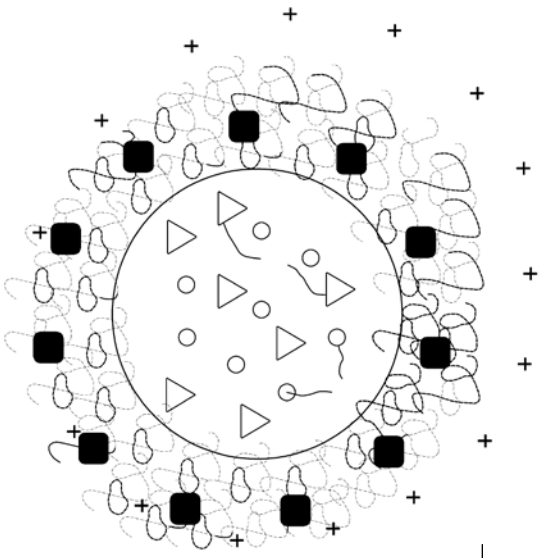
- preparation of a first layer of a negatively charged polymer
- emulsification of a first drug in the first layer
- preparation of a second layer of a positively charged polymer
- emulsification of a second drug in the second layer
- encapsulation of the first layer with the second layer to form the nanocomposite, wherein the first layer and the second layer are held together by electrostatic forces

Applications of magnetic nanoparticles loaded on to the hydrophobic layer:

- cell labeling/cell separation
- magnetofection to facilitate gene delivery
- contrast agents for magnetic resonance imaging (MRI)
- local hyperthermia in response to an external alternating magnetic field to selectively destroy cancer cells
- as magnetically targeted carrier system in drug delivery

Inventors: R. Srivastava, D. Bahadur, Department of Biosciences and Bioengineering, Department of Metallurgical Engineering and Materials Science

Patent filed (Application number: 811/MUM/2011)

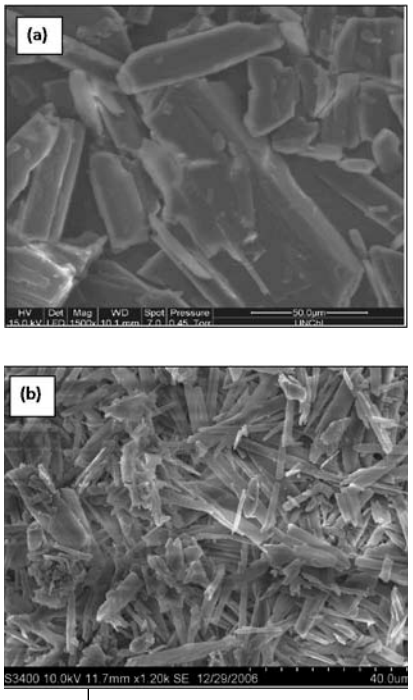


Schematic of nanocomposite including multiple layers

Subcritical CO_2 for Nanoparticle Production

Inventors: : M. Mukhopadhyay, S. Dalvi, Department of Chemical Engineering

Patent granted (Application number: 544/MUM/2004, grant number: 213605)



Scanning electron micrographs of (a) unprocessed cholesterol and (b) cholesterol processed using subcritical carbon dioxide process

A novel process for production of micronised drugs with narrow particle size distribution (PSD). These ultra-fine/nano particles provide a prolonged level of bio-activity, allow an enhanced rate of drug dissolution and eliminate repetitive or excessive dosage.

Conventional methods have several shortcomings like loss of bioactivity, poor controllability of particle size and requirements of relatively high-energy, high-pressure pumps and specially designed nozzles. The new process provides solutions to each of the above mentioned problems.

Features:

- utilisation of CO_2 at sub-critical pressure so as to avoid the use of high pressure pumps
- drastic and rapid lowering of temperature of the solution for attaining extremely low equilibrium solid solubility in a very short span of time
- very fast and easy removal of solvent for prevention of subsequent growth and agglomeration of the submicron particles formed
- extremely high, very rapid and uniform supersaturation in the solution and leading to crystallisation of the solid into nanoparticles with a narrow PSD

Method used:

- dissolution of the solid substance in an organic solvent
- pressurisation of the solution with CO_2 to 25–70 bar
- removal of CO_2 over the solution to produce a marked lowering of the solution temperature from near ambient temperature up to -40^0 C within 0.5 to 2.5 minutes

Benefits:

- process removes the need for use of equipment to generate high pressures and temperatures
- depressurisation of the solution is not required which eliminates the need for specially designed nozzles
- relatively lower pressure requirements when compared to methods using supercritical carbon dioxide
- targeted delivery and controlled release

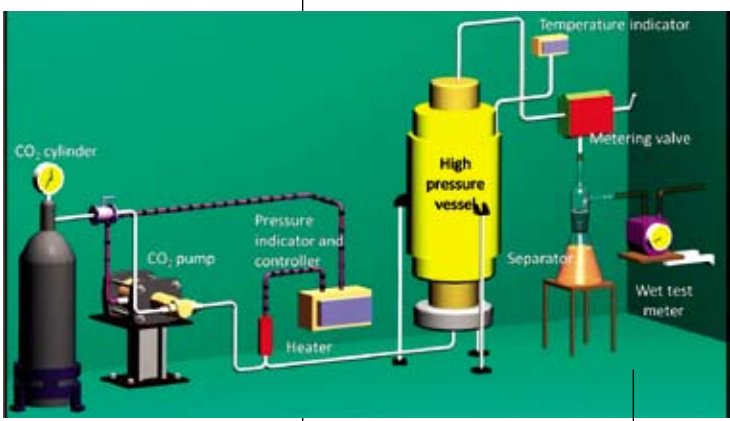
Extraction and Fractionation of Neem Oil

A new process for the production of neem oil enriched with active ingredients, such as azadirachtin, from neem kernels and leaves.

Method consists of:

- a sequence of static and dynamic extractions from neem kernels using supercritical CO_2 (SC CO_2)
- fractionation of neem oil enriched with azadirachtin, using SC CO_2
- collection of fractions at intervals by depressurisation of the extract-laden SC CO_2 for a predetermined time

The above sequence of static and dynamic extractions followed by depressurisation is repeated a number of times. Subsequently, the residual neem kernels in the extractor are treated with an alcohol and the sequence of static and dynamic extractions and depressurisations is repeated until the extraction is complete.



Experimental set up

Benefits:

- process produces neem oil that is enriched with azadirachtin in varying concentrations and contains other active components
- residual neem kernels are formed into a dry neem cake byproduct that can be used as a fertilizer
- efficient and economical
- has high stability and shelf life

Inventor: M. Mukhopadhyay, Department of Chemical Engineering

Patent granted (Application number: 428/BOM/97, grant number: 182587)

Hydrazinonitroalkenes: Novel Bioactive Molecules and Synthetic Building Blocks

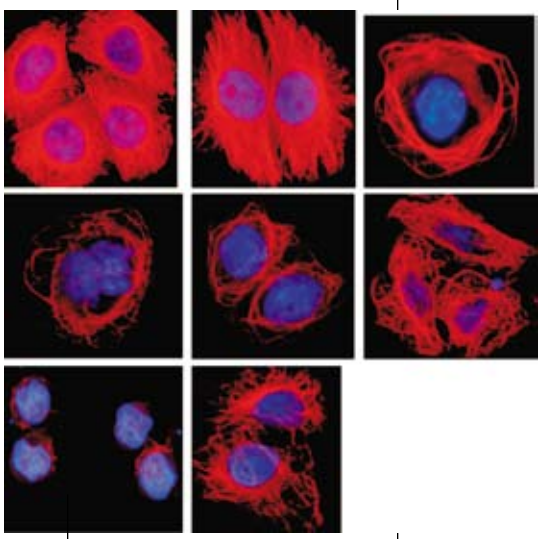
Inventors: : I. N. N. Namboothiri and M. Dadwal, Department of Chemistry

Patent granted (Application no. 1410/MUM/2005; Patent grant no. 226803)

A simple method for deriving C-N bond formation which offers access to natural and unnatural amino acids and other synthetically and biologically useful building blocks. This method is a single-pot process for the preparation of α-hydrazino-α,β-unsaturated nitro compounds from α,β-unsaturated nitro compounds in high yields.

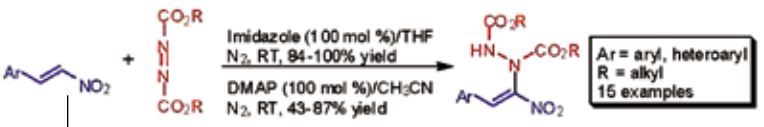
Method used:

- a conjugated nitroalkene is reacted with an azo compound in the presence of a cyclic or acyclic amine as the catalyst
- during a standard reaction procedure, a solution of nitroalkene and azo compound is stirred at room temperature until the reaction completes
- reaction mixture is then diluted with aqueous acid and aqueous layer subsequently extracted with a suitable organic solvent
- combined organic layers are concentrated to yield a substantially pure α-hydrazino-α, β-unsaturated nitro compound



Images showing the effect of created compounds on cellular microtubules

This reaction may be carried out in the presence or absence of solvents (e.g. methanol, chloroform, benzene and acetone) that do not react with either of the coupling partners.



Reaction used to produce α-hydrazino α, β-unsaturated nitro compounds

Several α-hydrazino-α,β-unsaturated nitro compounds have been prepared to establish the validity of the process.

This process has wide applications in the preparation of compounds which have been found to inhibit cervical cancer cell proliferation by binding to microtubules/tubulins.

Optical Support Device for the Visually Impaired

A camera-based device which provides verbal or text-based narrative descriptions of surroundings to visually impaired people.

Features:

- reflectively coated cap with an image capturing device mounted on the cap (non-calibrated digital camera or omnidirectional camera)
- computing platform connected to the image capturing device
- stored feature data attachment to a computing module
- output module connected to the computer module

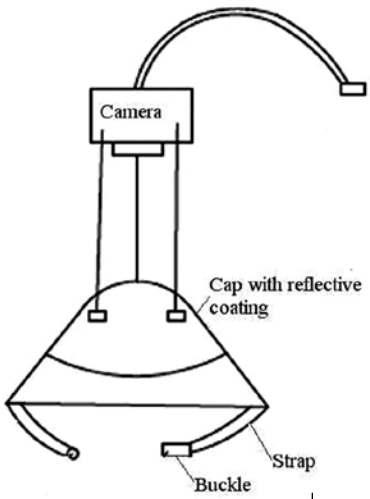
The computer extracts the colour components of the images taken by the camera, compares them with the stored reference features, and identifies the corresponding object in the image. A stored narrative description that was previously associated with the identified feature is fed either to the computer speakers or to an attached Braille board display. As a result, the user is able to obtain an idea of the surrounding objects.

Benefits:

- economical, light-weight, wearable (head-mounted)
- can be further expanded to allow application in a robotic navigation system, in which a remote operator can obtain a perception of the surroundings beings traversed by a robot

Inventors: S. Chaudhuri, Rajashekhar, A. Prabhudesai, Department of Electrical Engineering

Patent granted (Application number: 133/MUM/2006, grant number: 225370)



Camera-based device for visually impaired people

ParaDes (Paratope Design Software)

Inventors: R. R. Joshi, Department of Mathematics

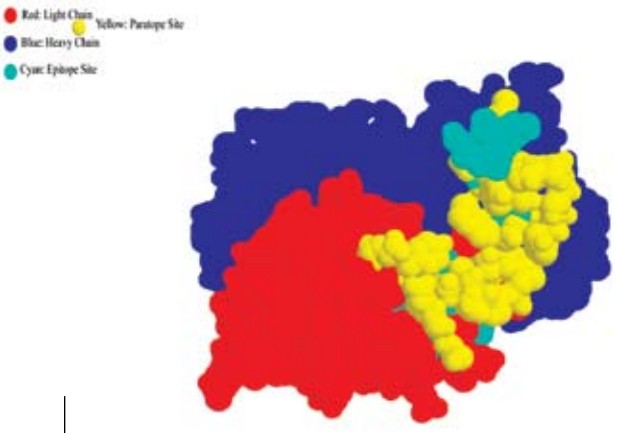
Copyright awarded (Application number: SW-698/2002)

ParaDes is a user-friendly Linux-based software that has potential applications in protein function recognition, drug design and vaccine synthesis.

The software has been tested on antigen-antibody complex data available in the protein data bank and has been found to have high accuracy.

Applications:

- to find paratopes for the epitopes of the envelope glycoprotein of the Japanese Encephalitis Virus
- to predict the immunogenic functions of proteins such as HSPI and an EF-hand Ca^{++} binding protein



An online graphics output of the software

Novel Method for Ferrofluids

Ferrofluids are colloidal mixtures of nanoparticles suspended in a fluid such as an organic solvent or water.

A superior novel, two-stage method to prepare ferrofluids.

Steps involved:

- precipitation in the presence of surface modifying agents which results in dried super-paramagnetic particles (SPP) that can be safely stored and transported
- dispersal of the particles (depending on their application) in a known volume of an appropriate carrier liquid to obtain a tailor-made ferrofluid

Features:

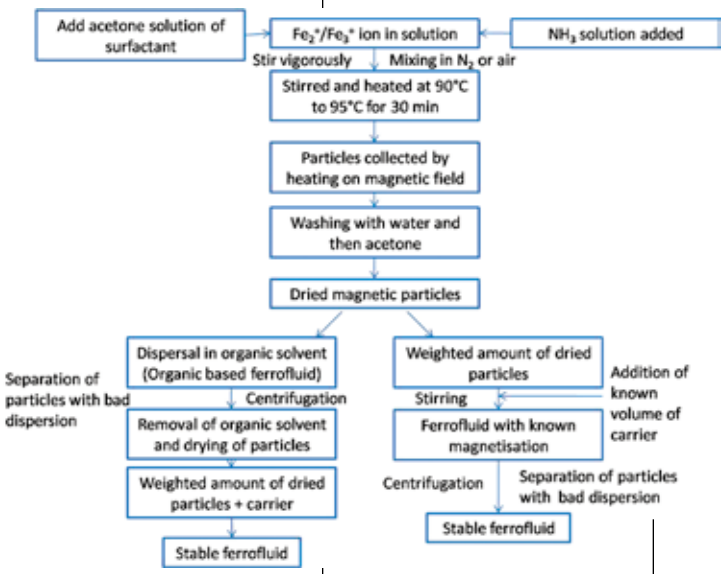
- bypasses the typical dilution process in the second stage of the method that may destabilise the fluid
- superior to conventional methods due to the achievable sizes of the super-paramagnetic particles
- ferrofluids created exhibit a range of magnetisation from 12 to 30 electromagnetic units per cubic centimetre at room temperature

Applications:

- electronic devices
- mechanical, military and aerospace fields
- friction-reduction seals
- to decrease the electromagnetic signal of aircrafts and spaceship controls
- medical instruments to assist doctors in detecting critical cancers

Inventors: D. Bahadur and J. Giri, Department of Metallurgical Engineering and Materials Science

Patent granted (Application number: 475/MUM/2004, grant number: 210641)



Novel method for ferrofluids

Improved Bioimplants

Inventors: M. Karanjay, B. P. Kashyap, T. R. R. Mohan, R. Sundaresan, Department of Metallurgical Engineering and Materials Science, International Advanced Centre for Powder Metallurgy and New Materials, Hyderabad

Patent granted (Application number: 2490/DEL/2005; grant number: 228353)

An improved material for bio-implants, which could be used as a substitute for bone.

Method used:

- a variety of bio-active phases, such as calcium hydroxyapatite, octacalcium phosphate, tricalcium phosphate and calcium titanate were generated in-situ when calcium carbonate and di-ammonium hydrogen orthophosphate were mixed with bio-inert titanium or its alloys and compounds (preferably in the form of titanium hydride)

- the powdered ingredients were mixed using ball and high-energy milling which results in close contact of the constituents

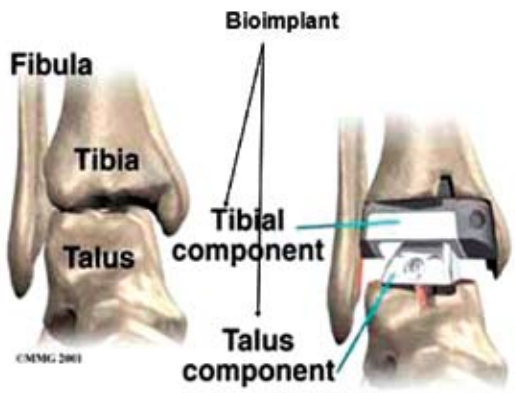


Figure represents actual product which can be developed using the method described in the patent

Benefits:

- resulting material had the desired mechanical strength, a high resistance to corrosion and was non-toxic

- the pore size of the material can be controlled to allow for natural tissue growth around and into the bio-implant

- raw materials are readily available and inexpensive

- does not loosen from or fracture the bone

- integrates with the undamaged portion of the bone and is not rejected by the human body

Ocular Drug Delivery Technology

A new method for drug delivery based on muco-adhesive nanoparticles and nanoparticulate inserts.

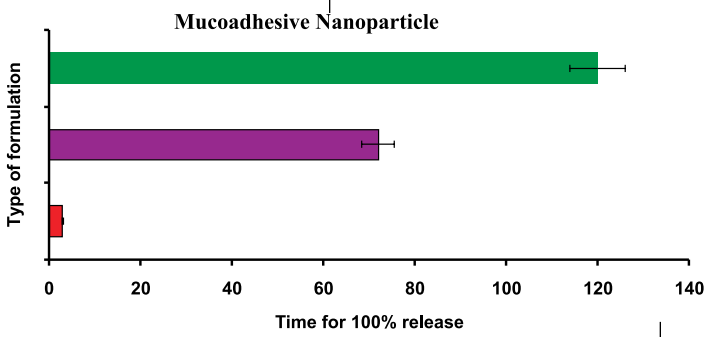
Benefits:

- nanoparticles and membrane inserts stick to the anterior surface of the eye, thus resisting tear fluid washout
- biodegradable
- nanoscale diameters allow for superior penetration of drugs into the posterior segments of the eye
- sustained release of a drug over a prolonged period
- can also be used to deliver growth factors or dual drugs
- serves as a platform technology for different drugs

Different materials can be used to design the nanoparticles and membranes depending on the nature of the drug to be delivered.

Applications: treatment of inflammatory, infectious and vasculopathic disorders of the posterior chamber of the eye and anterior segment diseases like glaucoma

Inventors: R. Banerjee and team, Department of Biosciences & Bioengineering



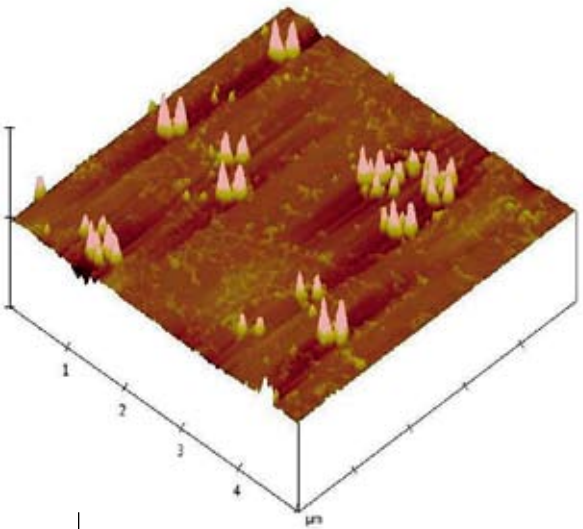
Sustained drug release using nanoparticles: The green and purple bars indicate different nanoparticles that show sustained release as compared to the free drug denoted by the red bar

Nanoparticulate Surfactants for Respiratory Diseases

Inventors: : R. Banerjee and team, Department of Biosciences and Bioengineering

Pulmonary surfactant is a complex lipoprotein-based substance that lines our lungs and reduces the work of breathing. Dysfunction of the pulmonary surfactant is present in many paediatric and adult respiratory diseases.

Nanoparticulate surfactants are artificial surfactants that can function as lung surfactants.



Atomic Force Microscopic Image of nanostructured surfactant domains in presence of protein inhibitors: The surfactant overcomes inhibition and is useful *in vivo* in lung injury models

Features:

- lipid-based
- has the desired level of surface activity
- superior reach in alveoli
- direct delivery of drugs in the lungs with low systemic toxicity
- biodegradable and safe for *in vivo* administration

Applications for :

- Acute Respiratory Distress Syndrome
- asthma
- chronic obstructive pulmonary disease
- drug induced respiratory distress
- occupationally related lung diseases

The surface active vesicles can be administered as an aerosol and can further be drug loaded for efficient treatment in many respiratory diseases.

Fibre-Optic Based Device for Surgery

A vertically integrated fibre-optic based device that is capable of producing both light-guide and image-guide fibres.

Inventors: J. Bellare and team, Department of Chemical Engineering

Features:

- occlusion device for transcathetral surgery
- fibres are created in bundles which have the maximum possible packing density
- bundles are fused at the ends into hexagonal, close-packed arrangements
- optically polished using an in-house developed gantry polisher

Uses:

- the fibres that have been developed can be used in a variety of end products for light-guide applications
- micro-device designs that could be used in operative procedures for the artificial closure of the ductus arteriosus (a communication between the aorta and pulmonary artery which is expected to close naturally at the time of birth)

Fiber optic light guides and adapting couplers for various endoscopes

Energy and Environment

Vermiculture Technology

Inventors: H. S. Shankar, B. R. Pattanaik and U. S. Bhawalkar, Department of Chemical Engineering

Patent granted
Indian patent application number: 384/MUM/2002,
Patent grant number: 203425
US Patent granted, number: 7,604,742 B2

Vermiculture technology is an engineered ecosystem for the treatment of solid waste.

The technology developed provides a solution to the problem of solid waste accumulation. It overcomes problems associated with conventional methods of solid waste treatment (solid waste composting, activated sludge and extended aeration) in which bio-energy becomes dissipated.

Components:

- soil
- plants
- soil micro and macro-organisms including geophagous earthworms

Vegetation based solid waste processing facility

Applications:

- urban farming
- animal husbandry
- agriculture
- wasteland development
- agro-industrial waste processing

The technology is able to obtain a synergy between photosynthesis and respiration, so that the bio-energy of the contained waste products is fully utilised.

Status: Licensed to Vision Earthcare Pvt. Ltd. (a company incubated at IIT Bombay) and Life Link Eco Technologies Pvt. Ltd.

Bio-reactor for Recycling of Waste Water

Engineered ecosystems can be used for the treatment of liquid wastes. A form of cultured soil filter technology developed for this purpose consists of an impervious containment area (typically 1.0–1.5 metres below ground) with soil, filtration media, plants and organisms such as earthworms.

Features:

- a cost-effective 'green' technology, suitable for all solid and liquid organic wastes
- very low energy consumption
- generates bio-mineral fertilisers and soil by-products
- no sludge production
- fulfils a self-sustaining revenue model

Applications:

- treatment of water for irrigation, construction and soil application purposes
- industrial effluent treatment
- non-chemical purification of swimming pool and drinking water

Inventors: H. S. Shankar, B. R. Pattanaik and U. S. Bhawalkar, Department of Chemical Engineering

Patent granted
Indian patent application number: 383/MUM/2002, grant number: 203744
US Patent granted, number: 6,890,432 B2

A 3000 cu.m sewage treatment plant set up at BMC, Worli, Mumbai

Status: Licensed to Vision Earthcare Pvt. Ltd. (a company incubated at IIT Bombay) and Life Link Eco Technologies Pvt. Ltd.

Tube-Tube Heat Exchanger

Inventors: M. V. Rane, M. S. Tandale, Department of Mechanical Engineering

Patent granted (Application number: 1082/MUM/2002, grant number: 205362)

Installation of tube-tube heat exchanger with piping

Status:
Various applications of the patented technology are being licensed to user industry.
Applications licensed to Mech World Eco, Nashik;

- Super Heat Recovery Water Heaters
- Evaporator/Water Chillers and Condensers in Multi-Utility Heat Pumps
- Potable Water Instant Prechillers

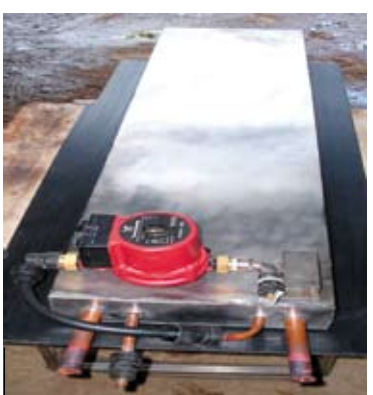
A vented, double-walled, tube-tube heat exchanger.

Features:

- uses a judicious combination of bent and straight tubes of different tube shapes, diameters, tube materials and thermal bonding techniques
- enables compact and cost effective solutions to various heat and/or mass transfer applications
- multi-stream, multi-phase heat and/or mass transfer can be catered to using single Tube-Tube Heat Exchanger to effectively encash benefits of Pinch Analysis
- reliable contamination free heat transfer is demonstrated in various appplications in hospitality, dairy, automotive industries.

Applications:

- methodology for minimising energy consumption in chemical processes
- allows the design of low-cost heat exchangers having a low life cycle cost and effective heat exchange with fast response times
- suitable for chemical, pharmaceutical, petrochemical, food processing and heating, ventilation and air conditioning industries.



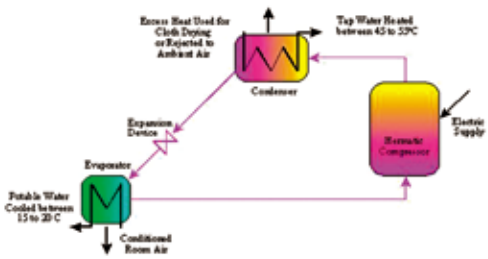
Tube-tube heat exchanger unit

Multi-Utility Heat Pumps

A novel design that can incorporate air conditioning, water heating, water chilling and clothes drying in a single unit.

Features:

- integrated system and simple to operate
- high heat transfer coefficients through novel tubular exchangers
- on-demand supply of hot and cold water; no storage required
- cools drinking water to 18°C and heats tap water to 45°C
- low operating costs
- lower initial cost compared to purchases of a conventional air conditioner, an electric water heater and a water cooler
- compact design with the same footprint as that of a window or split air conditioner



Four-in-one multi-utility heat pump: air conditioning and potable water cooling is possible along with tap water heating and low temperature drying of cloth/ agro produce

Applications:

- residential: simultaneous space cooling, water heating and provision of cold water for drinking
- commercial: hotels, restaurants, hospitals, etc.
- industrial: dairy, pharmaceutical, textile, chemical process, etc.

Inventors: M. V. Rane and A. Dasgupta, Department of Mechanical Engineering

Patent granted (Application number: 613/MUM/2003, grant number: 212316)

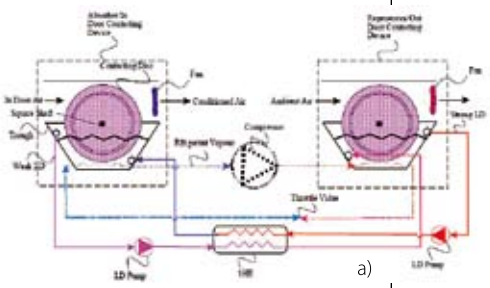
Multi-utility heat pump: heating cleaning solution for an industrial washing machine saving 66% electrical power while generating bonus cold utilities like air conditioning and potable chilled water

Status: Applications licensed to Mech World Eco, Nashik: Water To Water and Air to Water Multi-Utility Heat Pumps for 1 to 5 TR capacity

Hybrid Cooling System

Inventors: M. V. Rane and S. V. Kota Reddy, Department of Mechanical Engineering

Patent granted (Application number: 153/MUM/2002, Grant number: 203949)



a)

b)

Modular hybrid air conditioners: energy efficient air conditioning with improved indoor air quality
a) Schematic of cooling system
b) Actual unit

Energy efficient Hybrid Cooling System simultaneously controls air temperature and humidity using modular diabatic contacting device.

Features:

- cooling and dehumidification of air takes place in a single compact unit
- moisture from indoor air is absorbed by liquid desiccant instead of cooling below dew point
- carryover of liquid desiccant to indoor/outdoor air streams is eliminated
- low air side pressure drops
- reheating of air is not needed, thus reducing cooling load and operational costs
- limits on minimum irrigation rate and flooding are eliminated
- system can be Installed with greater flexibility; indoor and outdoor units can be located at desired elevations
- operation is silent, splashing or spraying noise are absent

Benefits:

- better indoor air quality as particulate matter suspended in the air and microbiological contaminants are removed
- energy efficient cooling system
- Coefficient of Performance increases by upto 45% due to lower pressure ratios
- cooling capacity increases by upto 60% due to higher evaporator pressure

Status: Application licensed to Opel HVAC, Mumbai, for Air Conditioning in pharma sector

Device for Improved Mass Transfer

An efficient modular diabatic mass transfer unit enables effective mass transfer between liquid and gaseous streams.

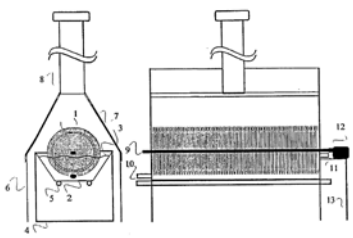
The device provides very large contacting surface area for effective mass transfer in a compact volume while ensuring very low pressure drops for contact between two fluids.

Applications:

- can be used to efficiently absorb or separate gases from liquid/ liquid desiccants
- used in distillation columns, rectification columns, absorption refrigeration systems
- can be used in combination with appropriate devices in applications such as humidifiers, dehumidifiers and air-conditioners
- chemical process industries

Benefits:

- modular, scalable, efficient and economical
- compact and sturdy
- low pressure drop of 10 to 30 to 60 Pa per stage
- low power consumption for rotor and fan/blower
- has no carryover of liquid in the stream of gas or air that flows out



Schematic of device

Inventors: M. V. Rane and S. V. Kota Reddy, Department of Mechanical Engineering

Patent granted (Application number: 154/MUM/2002, grant number: 221716)

Contacting device: liquid desiccant based modular industrial dryer for 120 kg/h moisture removal system

Status: Applications licensed to the following industries:

- Mech World Eco, Nashik:
  - Evaporative Condenser and Liquid Desiccant based Solar Multi-Utility Heat Pump for 3 TR fresh air dehumidifier
- Vector Technologies:
  - Direct and Indirect Evaporative Cooling for Telecom Shelters

Compact Adsorption Module

Inventors: M. V. Rane and Akhil Agarwal, Department of Mechanical Engineering

Patent granted (Application number: 155/MUM/2002, grant number: 241263)

Adsorption modules: solar refrigeration cum water heating using adsorption modules without moving parts which can be used for rural milk chilling and cold store applications

Status: Applications licensed to Godrej/Lawkim, Pune - Solar Refrigerator cum Water Heater

A unique adsorption module having a compact design.

Features:

- can be integrated with condensers, evaporators and other component systems with different cycles
- gives lower cycle time and hence gives higher coefficient of performance, higher specific cooling power
- allows ease of fabrication and operation

The design has been developed and demonstrated for Solar Refrigerator cum Water Heater and Adsorption Refrigeration System using engine waste heat.

Advantages:

- enables high rate of heat transfer while keeping the thermal mass of the module low
- shell wall of the module acts as a fin, eliminating use of separate fins, thus reducing weight, complexity and cost of the module
- overcomes the problem of low thermal conductivity of absorption bed

Applications:

- purification and separation of gases
- removal of contaminants
- pressure swing adsorption
- catalytic reactions
- removal and supply of heat to reaction chambers
- storage of compressed biogas or natural gas

V-Trough Solar Photovoltaic Modules

A novel method to increase the light intensity on the surface of a solar cell in order to provide higher electrical output from the same solar cell area.

A prototype V-trough module of 40 Wp has been manufactured and tested under various conditions.

Features:

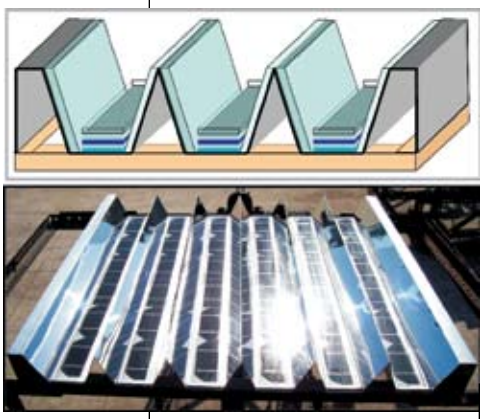
- about 60% higher power output
- commercially available solar cells can be used
- simple concentrator optics, V-troughs, are used to increase light intensity
- anodised aluminium, used for light concentration, acts as a reflector and as a heat dissipating material
- no regular sun tracking movements are required

The V-trough Photovoltaic modules can be manufactured for power ratings of 5 Wp to 100 Wp, which makes them suitable for most typical Photovoltaic applications, including home lighting, solar lanterns, and off-grid power generation.

The V-trough flat photovoltaic modules show a 20% to 30% cost reduction per unit of power output, compared to that of conventional silicon solar cell modules.

Inventors: C.S. Solanki, C.S. Sangani, Department of Energy Science and Engineering

Patent filed (Application number: 1051/MUM/2007)



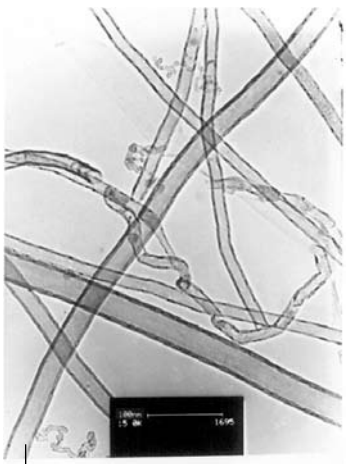
Photovoltaic cells assembled in a V-trough format

Status: Had been licensed to Electricks Solutions Pvt. Ltd.

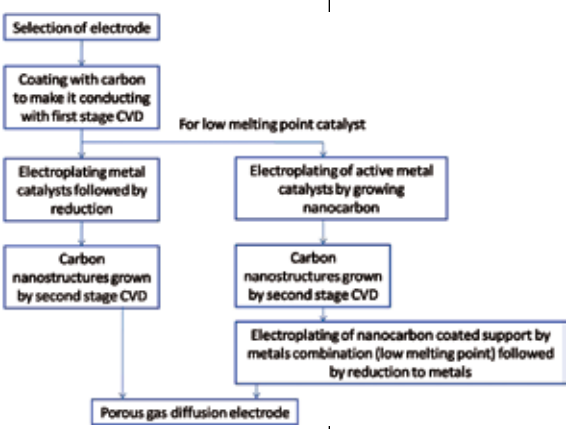
Porous Gas Diffusion for Fuel Cells

Inventors: A. K. Chatterjee, M. Sharon and R. Banerjee, Department of Energy Science and Engineering and Department of Chemistry

Patent granted (Application number: 959/MUM/2006, grant number: 239103)



Carbon nanotube material (Ni-Sn) used in hydrogen electrode



Schematic of process

A process for metal dispersion on porous substrates using a novel carbon coated material.

Carbon nanotube based metal dispersed hydrogen (Ni-Pt, Ni-Sn) and oxygen (Ag-Mg, Ag-Pt) electrodes developed with porous ceramic substrate as low cost electrodes for alkaline fuel cells with performance equivalent to conventional electrodes.

Method used:

- natural carbon precursors such as camphor, turpentine oil and cashew nut shell are vaporised through Chemical Vapour Deposition (CVD)
- CVD product is pyrolysed using different carrier gases
- pyrolysed carbon is deposited over selected porous ceramic substrates
- different metal catalysts are electroplated over the carbon coated porous substrate
- carbon nanoparticles are grown by a second stage CVD to obtain the desired end product

Advantages:

- can be used for large surfaces
- offers longer life and durability to the coated device without loss of performance

Applications:

- heterogeneous catalysts
- gas diffusion systems
- chromatographic applications
- fuel cell electrodes

Process for Renewable Carbon Nanomaterials

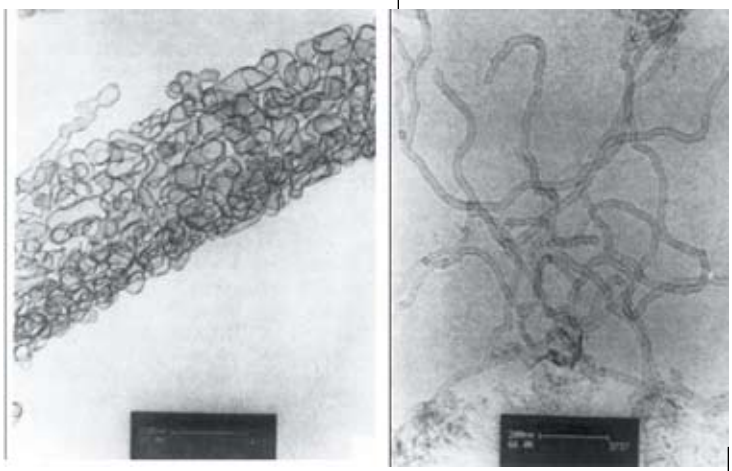
A process for the synthesis of carbon nanomaterials using cashew nut shell pyrolysis vapours.

Method:
Cracking the pyrolysis vapours at 750^{0}C to 900^{0}C over a supported bi-metallic catalyst and purifying the nanocarbon structures formed with an acid.

The combination of a suitably chosen catalyst and substrate has produced the structures, including nanotubes, nanofibres, nanorings and rope-like nanoplatelets. Each of the developed structures has different properties and applications such as reinforcement for biocomposites.

Inventors: A. Ganesh, S. M. Sabeena, P. Das, Department of Energy Science and Engineering

Patent filed (Application number: 899/MUM/2008)



Examples of nano-structures created from cashew nut shells

Solar Flat Plate Fluid Heating Device

Inventor: M. V. Rane
Department of Mechanical Engineering

Patent granted (Application no: 986/MUM/2004, grant number: 234778)

Light weight plastic solar collectors can be used for space heating and to generate hot air for low temperature drying of vegetables, fruits, herbs and spices.

Features:

- low-cost, approximately ₹ 5000/m^2 of aperture area
- light-weight, 5 to 7 kg/m^2
- heating of ambient air between 50 to 75°C with efficiency in the range of 40 to 60%
- low pressure drop
- air can be circulated using a photovoltaic operated fan

Benefits:

- suitable for space heating and low temperature drying applications including 'off-grid' applications
- grapes, tomatoes, onions or guavas can be dried with the heated air without exposing to direct sunlight
- low temperature drying usually provides better quality products resulting in a higher value realised from the dried product.

Solar flat plate fluid heating device

Liquid Dessicant Air conditioning

A process for energy efficient Conditioning of Air Using a Liquid Desiccant.

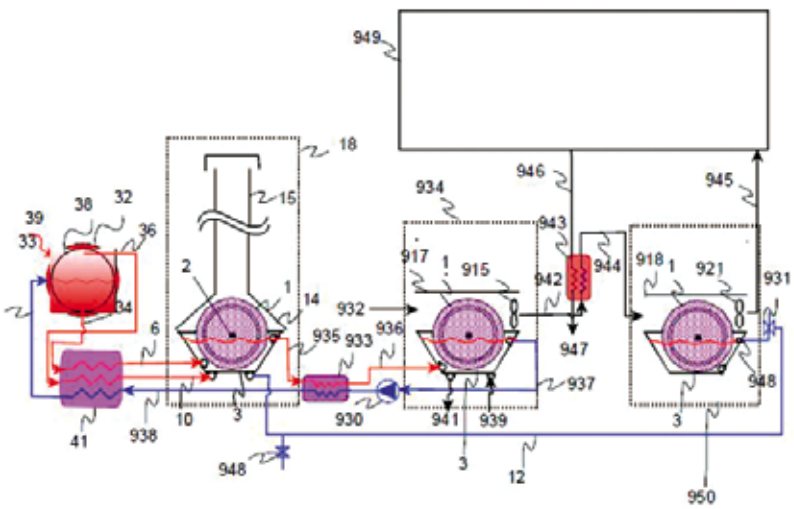
This is a liquid desiccant based air conditioning process producing air with improved indoor air quality without any traces of desiccant. This is achieved by dehumidification, direct and indirect evaporative cooling, while regenerating liquid desiccant in a two stage regeneration process.

Inventors: M. V. Rane, S. V. Kota Reddy and R. R. Easow, Department of Mechanical Engineering

Patent granted (Application number: 272/MUM/2003, grant number: 206320)

Advantages:

- compact structure, low-weight
- can be scaled up or down to meet different requirements
- economical
- outgoing air stream is desiccant-free
- system can use high and/or low grade heat sources, including engine exhaust heat, solar, steam turbine exhaust and engine cooling water
- corrosion issues are addressed by judicious selection of liquid desiccant and low cost materials including plastics in some components
- has the potential to recover water
- operates with lower pressure drops and lower desiccant flow rates than those in conventional desiccant flow rates
- lower electrical power consumption compared to that of a conventional vapour compression refrigeration system



Schematic of liquid desiccant based air conditioning process

Freeze Concentration System

Patents granted

1. Inventors: M. V. Rane and S. Jabade, Department of Mechanical Engineering (Application number: 1000/MUM/2002, grant number: 204956)

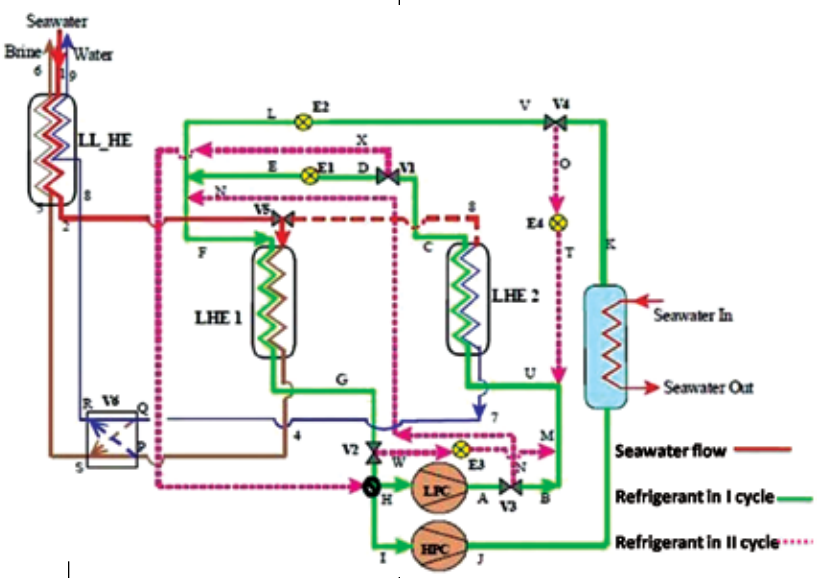
2. Inventors: M. V. Rane and Y. S. Padiya, Department of Mechanical Engineering (Application number: 1915/MUM/2010)

An energy efficient, simple and inexpensive freeze concentration system.

Freeze concentration technique is used for reducing the volume of products to be handled during storage, transportation and at the point of sale and has wide applications in the beverage industry.

Advantages:

- simple, energy-efficient and economical: reduced number of components, conduits, pumps and controls scraped surface heat exchanger, recrystalliser and wash column are not required
- water removal at freezing temperatures; ensures superior product quality
- simple operation: liquid can be introduced at the inlet and the concentrate can be collected at the outlet of the system without the need to re-circulate the solution



Schematic of freeze concentration system

Information and Communication Technology (ICT)

Indigenous Ultra-fast Carrier Ethernet Switch Router for Telecommunication Networks

Inventors: A. Gumaste and team, Gigabit Networking Laboratory, Department of Computer Science and Engineering

Patent pending

Indigenous router for metro and data-center environments

Indigenous router for core and regional transport environments

Single unified networking medium encompassing the lower three layers of the Internet – the physical, the data-link and the network layer. The current technology provides an excellent backward compatibility with existing systems using the common denominator of Ethernet while supporting carrier-class features and offering an ultra-fast routing fabric.

Features:

- Wavelength Division Multiplexing (WDM) fabric support to facilitate excellent fibre utilisation
- Optical Transport Network support for up to 1000km reach without regeneration of the optical signal, suitable for connecting metropolitan cities in India
- Carrier Ethernet support for between 1 Gbps and 10 Gbps traffic of Carrier Ethernet services. Scalable to provide a multi-100Gbps switch/router fabric
- each interface supports a multitude of services with each service supporting granularity from 1Mbps to 10 Gbps
- routing support: offers routing in domains
- low-cost, energy efficiency, very low latency, small foot-print and indigenous technology

Uses:

- in the data-center: fast interconnection between the computational servers and the rest of the network
- creation of data-centers of various sizes to support cloud networks – disparate data-centers connected across a metropolitan transport network
- in the metropolitan area as a WAN technology: supports carrier class managed routing and optical interfaces with WDM; reduces total cost as well as makes provider networks scale to meet emerging demands of the end-user
- as a broadband enabler: intended for the Indian market: uses broadband proliferation as a driver
- in the enterprise: replaces existing Ethernet switches and IP routers at lower cost-points while giving better functionality and ability to provision critical services
- potential to transform enterprises to very smart units with thick connection pipes and secure computation

Status: Licensed to ECIL, India

Communication Networks

An innovative routing technology for traffic engineering and optimisation in communication networks.

Applications:

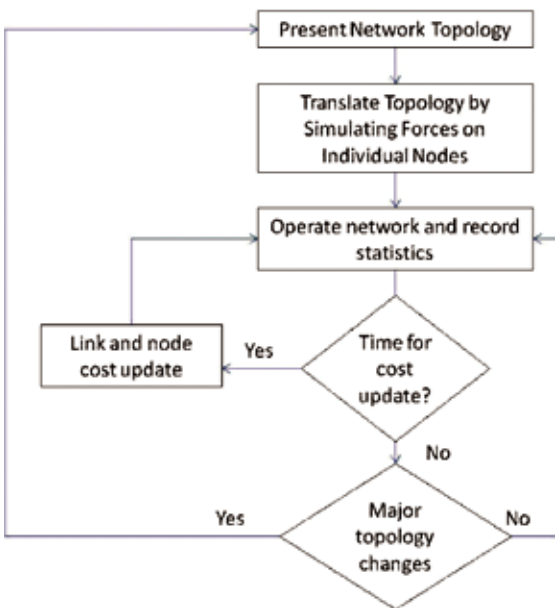
- delivery of the desired quality for various services while optimising utilisation of the available network resources
- applications in optimising multi-commodity flow or logistic problems

Features:

- technology enables selection of optimal route(s) in the network (also known as traffic engineering) to satisfy quality constraints and ensure efficient resource utilisation
- uses multi-dimensional virtual space representation of the network to select multiple optimal routes for an arbitrary source-destination pair within the network
- the solution broadly falls in the category of solution for Multi-commodity-flow optimisation or K-shortest-paths-first type of problems
- technology potentially has wide applications besides communication networks

Inventor: G. Saraph, Department of Electrical Engineering

Patent granted (US patent application number: 10/739, 655, grant number: 7, 231, 459B2)



Method of modeling and optimising a network

Status: Exclusively licensed to Vegayan Systems Pvt. Ltd., a company incubated at IIT Bombay

Speech Compression Method

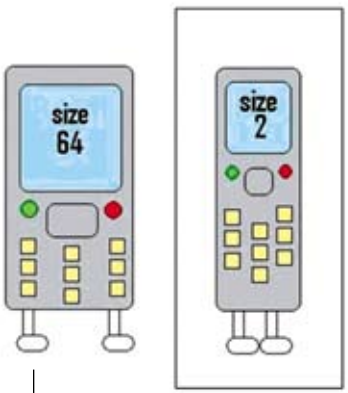
Inventor: Preeti Rao, Department of Electrical engineering

Patent granted (Application number: 273/MUM/2003, grant number: 205439)

A novel method to reduce voice data bit rate to a very low range (under 2 kbps as opposed to standard communications technology which uses between 4 and 64 kbps) without compromising speech quality.

The lower the bit rate, the higher is the compression. In the low (below 8 kbps) to very low (below 2 kbps) bit rate region, there is usually a distinct compromise of speech quality for a reduction in bit rate. However there are a number of applications where voice compression at very low bit rates is essential such as digital transmission, and voice storage and reproduction.

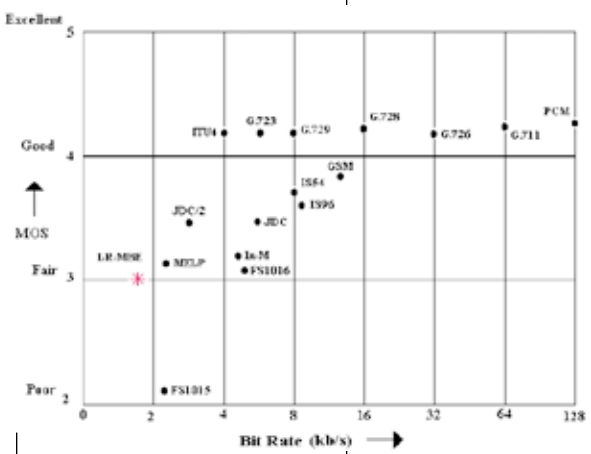
The technology developed combines predictive quantization with spectral interpolation in a multiband excitation framework to achieve intelligible and natural sounding speech with high compression.



Data reduction achieved by the new speech compression system over a standard system

Features:

- can be used for end-to-end voice communication over bandwidth-limited links
- can be used in combination with encryption in order to achieve secure voice transmission
- can be used for low-capacity call storage and retrieval
- can be used in text-to-speech systems with low overhead storage, and facilitating natural prosody synthesis



Speech quality with bit rate for various codecs

Automatic Address Segmentation

A software tool that can 'learn' to segment unseen addresses once trained with examples of already segmented addresses. Address segmentation involves extracting from the full address string, individual structured fields such as landmark, house number and state. This process finds use in large organisations which are required to handle massive postal address databases.

Features:

- handles new data robustly
- computationally efficient
- easy interpretation
- adjusts to rectify unexpected address segmentation problems
- high levels of accuracy obtained using nationwide, heterogeneous collections of actual addresses

Inventor: Sunita Sarawagi, Department of Computer Science and Engineering

An example segmentation of the address string:"36/307 S. V. Road Goregaon (W) Bombay 400079"

Status: Software licensed to a data cleaning company in India for commercial deployment

Hindi Wordnet

Inventors: P. Bhattacharyya and team, Department of Computer Science and Engineering

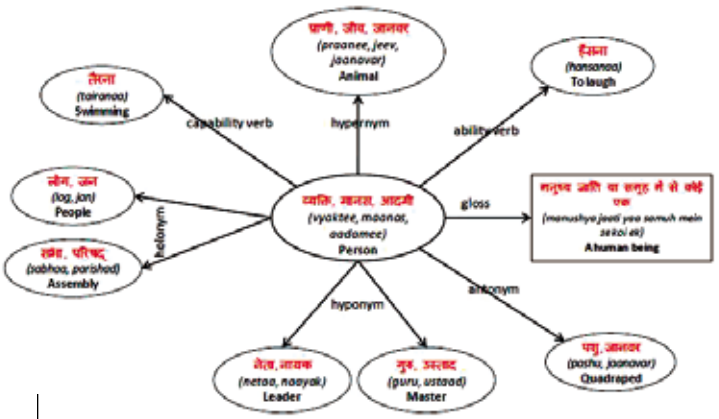
A rich, complex, large and widely used electronic resource along with associated tools for an Indian language developed for the first time.

Features:

- lexical structures composed of sets of synonyms (synsets) and semantic relations
- crucial resources within the field of natural language processing (NLP)
- important during translation of and word searching among Indian languages

The Hindi Wordnet resource and its application programming interfaces (APIs) are freely downloadable for research purposes from http://www.cfilt.iitb.ac.in/wordnet/webhwn. The resource has been downloaded by more than 5000 researchers around the world.

Construction of wordnets for a number of Indian languages is currently underway.



Wordnet sub-graph: Hindi

Status: Licensed to a multinational search engine company; a US based linguistic data consortium has procured Hindi wordnet and made it available through their catalogue (http://www.ldc.upenn.edu)

Efficient Technologies for Broadband Access

An innovative, ethernet-based architecture called EisoAccess, for broadband access technology in the converged telecom sector.

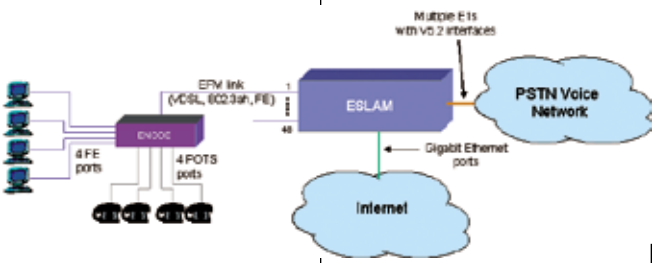
Features:

- a novel architecture that leverages the potential of the ethernet to provide Quality of Service (QoS) based triple-play services
- innovative method of transporting voice over packet-switched networks
- unique algorithms for enhancing the performance of packet voice communications using the Ethernet Adaptation Layer (EAL)

Benefits:

- considerable superiority in Capex as well in Opex costs, while at the same time it is able to offer new value-added services

Inventors: Abhay Karandikar and team, Department of Electrical Engineering



Typical deployment block diagram

Status: Exclusively licensed to Eisodus Networks, a company incubated at IIT Bombay

Artificial Intelligence for Business Analytics

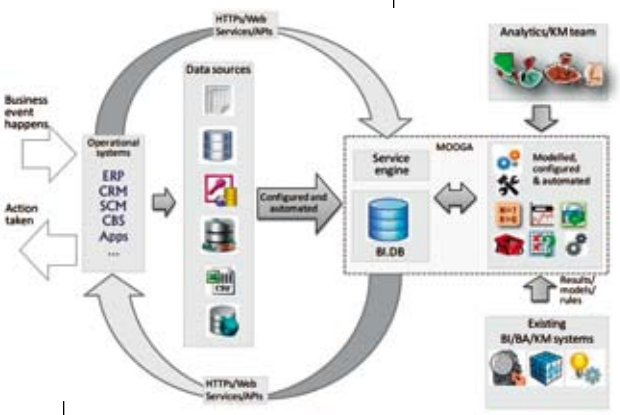
Inventor: R. M. Sonar, Shailesh J. Mehta School of Management

Business intelligence and analytics framework (Mooga) has been developed using the hybrid Artificial Intelligence approach.

Features:

- facilitates integrated, automated and operational intelligence using conventional intelligent systems and relational database management systems
- implements four basic filtering techniques and their hybrids: collaborative, content, demographic and knowledge-based. It offers personalisation and recommendation in various domains

Mooga has been successfully implemented, tested and deployed in telecom and internet domains.



Integrated and Operational Intelligence

Status: Licensed to iKen Solutions, a company incubated at IIT Bombay.

Ad Time

A device and method for advertising through video display systems

Features:

Image Analyser

- extracts characteristic features from the frames of the video sequence of a recorded scene, creates projective 3D reconstruction
- locates the planar regions in projective 3D reconstruction of the scene
- identifies areas within the planar regions in which the advertisement can be inserted

Parameter Evaluator

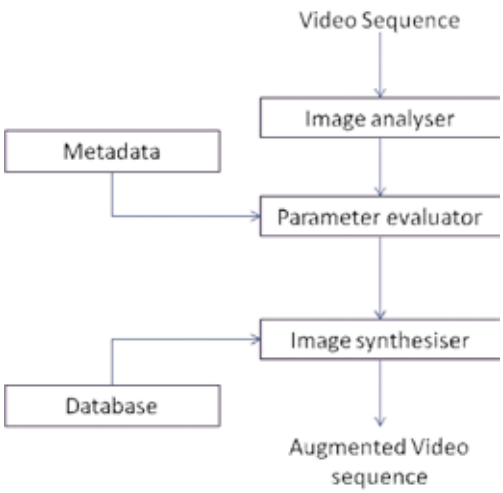
- locates the largest planar regions of the video sequence for insertion of the advertisements
- identifies the start and end times of the largest planar regions in each frame with metadata

Image Synthesiser

- augments the identified largest planar region in each frame of the video sequence with the advertisement from a database
- calculates the virtual space occupied by the representations in the video sequence
- determines the duration of the advertisement selected in the video sequence for billing

Inventors: S. Chaudhuri and Hitesh Shah, Department of Electrical Engineering

Patent granted (Application number: 1338/MUM/2006, grant number: 241268)



Schematic of Ad time

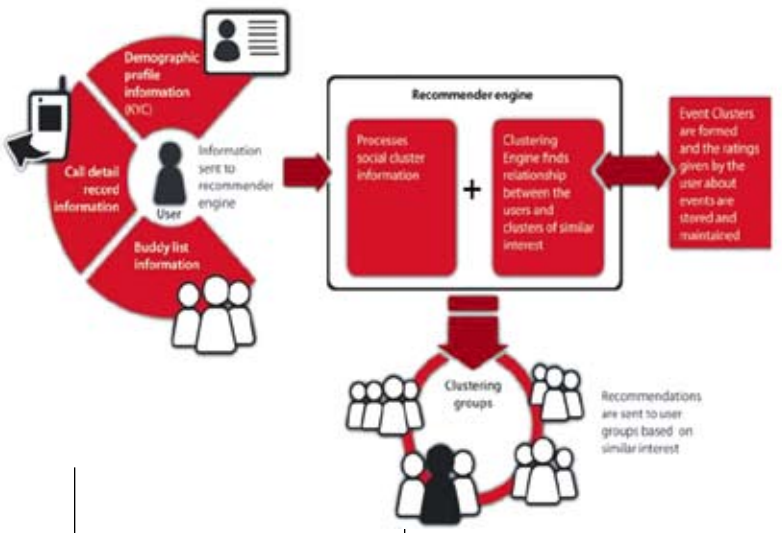
Mobile Social Networking Platform

Inventors: A. Karandikar, P. Kapadia, A. Kumar, S. Kumar, S. Sharma, D. Parakh, Department of Electrical Engineering

Patents granted
(Indian patent application number: 411/MUM/2010, US patent application number: 12/906,057)

An effective framework that enables telecom operators to develop personalised applications and send targeted promotions to users within the network.

The algorithm mines the call detail records available with the service provider to search for patterns in interaction between users. These patterns along with the information about a set of applications that a user is currently using, and what his friends like /dislike are analysed to narrow down on a specific set of users with similar interests. Anything that is popular in a user's "cluster" has a high probability of being liked by the users of that cluster and can be recommended to them.

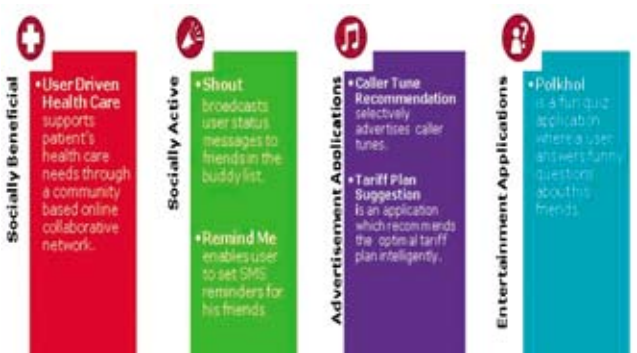


Mobile Social Networking Platform recommender engine

Features:

- no need to download any additional software on mobile
- does not require users to have a 3G phone and ensures wider penetration into the Indian market
- intelligence obtained can be used to give a better user experience
- can host SMS based applications
- can support 3G applications

Applications currently running on the platform are:



Status: Pilot has been deployed at TATA Teleservices Ltd.

An Eco-friendly Communication System

A cost-effective, wired communication system that uses a scalable intelligent multiple bit addressable bus (SIMBA).

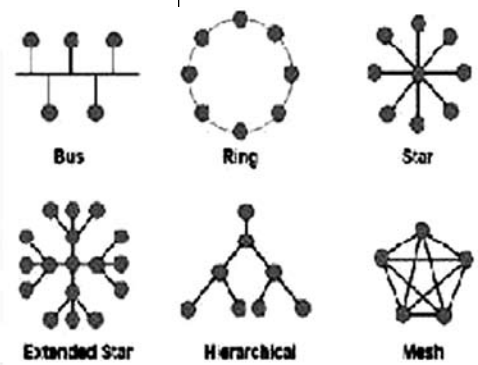
Features:

- can be used for inter-device, low speed (1-3Kb typical) serial communications related to industrial monitoring, control and automation
- ideally suited for monitoring and control of devices and equipment spread over large geographical terrain such as manufacturing businesses, road/railroad monitoring, pipeline monitoring and similar applications
- flexible networking topology of SIMBA
- financially attractive option for low budget applications
- can be interfaced with standard wide area networks

The self-powering capability of the device makes this invention particularly eco-friendly.

Inventors: N. K. Khosla, H. Ramamurthy, A. John, V. Shah, R. Aggarwal, P. Sahni, Departments of Metallurgical Engineering and Materials Science and Electrical Engineering

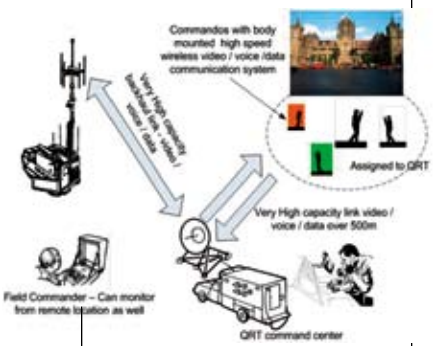
Patent granted (Application number: 386/MUM/2004, grant number: 212327)



Flexible network topology

Emergency Communication System for Public Safety (ETHERHAWK)

Inventors: A. Karandikar and team, Department of Electrical Engineering



Use case scenario, deployment of the system in an emergency response situation

The radio system consists of a field swappable battery that can provide a talk time of 7h. This wearable system weighs less than 1.2 kgs

A micro camera is integrated with the ballistic goggles which provides the commander with an un-obstructed view

The unit is mounted on the upper back of the commando supporting on the bullet proof vest

Status: Field trials have been conducted with the Maharashtra Police

An emergency communication system for public safety and disaster recovery.

Features:

- two-part system comprising of wearable/mountable clients and a portable base station
- system uses a 4G system as its base to provide for real-time video and audio communication
- enables group communication with high-resolution video sharing and video-calling
- traditional data services such as text messaging and optional internet access

The 4G Emergency Communications System uses a high capacity and secure radio communications link operating in the sub-GHz band. The lower frequency band offers better propagation characteristics and hence improved coverage in near line-of-sight conditions. This is a very important requirement for link reliability in dense urban topologies.

Benefits:

- applications in defense, maritime operations, fire and rescue operations and telemedicine
- reliable, portable and secure way of deploying high-speed wireless networks
- can enable emergency response teams on the ground to send and receive high quality video, voice and data transmissions to and from a distant command and control centre
- advanced systems using broadband, high speed, packet switched technology
- cost effective
- customised interface
- can easily be extended to meet the needs of different security systems that are deployed across the country

Cellular Backhaul for Rural Access (CeBRA)

Inventors: A. Karandikar and team Departments of Electrical Engineering

A novel mechanism for cellular deployment in rural areas.

Main challenges in a rural deployment: (a) Cost of deployment, (b) Absence of infrastructure, (c) Low population density, (d) Longer distances from central offices, (e) High maintenance cost.

Cellular Backhaul for Rural Access (CeBRA) solves this problem by:

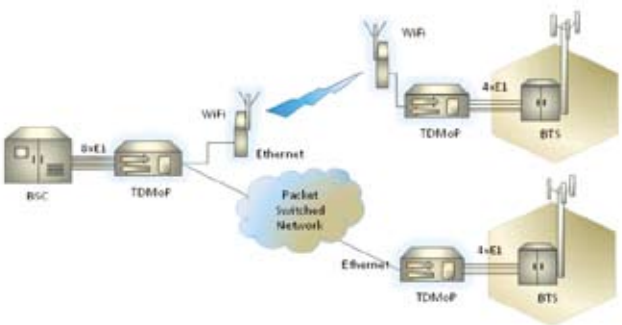
- enabling access beyond the twisted pair limitation of 1.5 kms
- using modified and efficient Wi-Fi (TDMA based)
- circuit emulation over optimised TDMA Wi-Fi
- enabling reach to rural areas

CeBRA has been developed for Ethernet and TDM Backhaul in mobile cellular networks over long distances. It is a cost effective and flexible solution. Two parts of the solution are:

- FRACTEL: Solution for efficient long distance wireless in unlicensed band;
- TDMoIP: Solution for carrying TDM data over Ethernet and thereby over the long distance wireless link.

Hardware/software (systems) solutions for the above have been designed and developed to address service providers' technical and commercial requirements.

The technology will pave way for significant reduction in capital expenditure making rural deployment a cost effective proposition.



Antenna + ODU – All weather equipment, optimally placed with the antenna

Manufacturing

Thermoelectrically Cooled Helmet

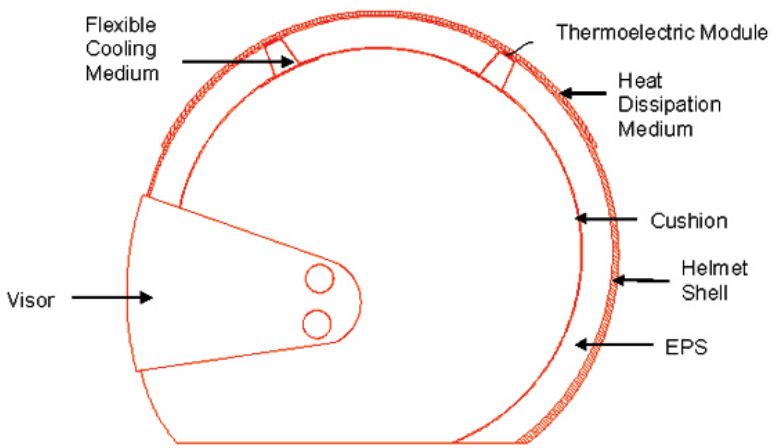
Inventors: M.V. Rane and George Koshy, Department of Mechanical Engineering, Latent Tech Pvt. Ltd.

Patent filed (Application number: 1377/MUM/2007)

A self-cooling two-wheeler helmet which complies with current quality standards in terms of dimension, weight and safety parameters.

Features:

- includes thermoelectric modules, a heat dissipation medium and a flexible cooling medium
- provides cooling of 8 to 10 degrees below ambient temperature
- requires no maintenance and is aesthetically pleasing
- provides both cooling and heating in the interior of the helmet



Helmet with heating and cooling abilities

Status: Licensed to Latent Tech Pvt. Ltd

Creating Harder Cutting Edges

A novel diamond coating method that improves the adhesive and hardness qualities of diamond-coated steel components.

Method:

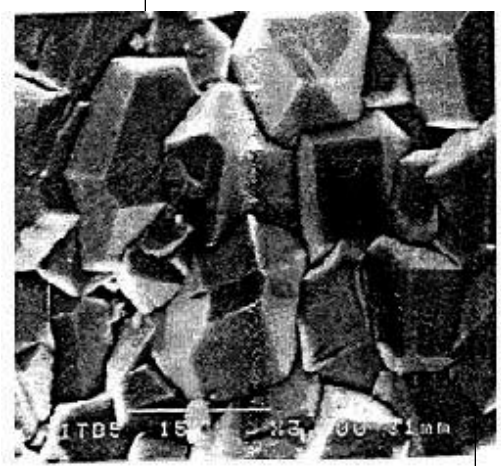
- steel surface is cleaned by washing the components with detergent followed by washing with deionised water
- components are washed with an aqueous alkali solution and again by deionised water
- electro-cleaning or anodic cleaning is performed on the outer layer of the washed steel, in a sulphuric acid bath to remove oxides
- the cleaned component is then electroplated with a nickel layer, a nickel-diamond composite layer and a chromium layer followed by Chemical Vapour Deposition (CVD) coating of diamonds

Features:

The three pre-CVD layers are thermally stable. The nickel layer enhances the second nickel-diamond layer and the chromium layer improves adherence of the diamonds. These three layers solve the problem of poor adhesion since carbon does not diffuse into the three-layer coated steel.

Inventors: D.S. Misra and A. K. Sikder, Department of Physics

Patent granted (Application number: 377/MUM/2000, grant number: 200842)



SEM image of diamond coated steel

Status: Licensed to an individual entrepreneur

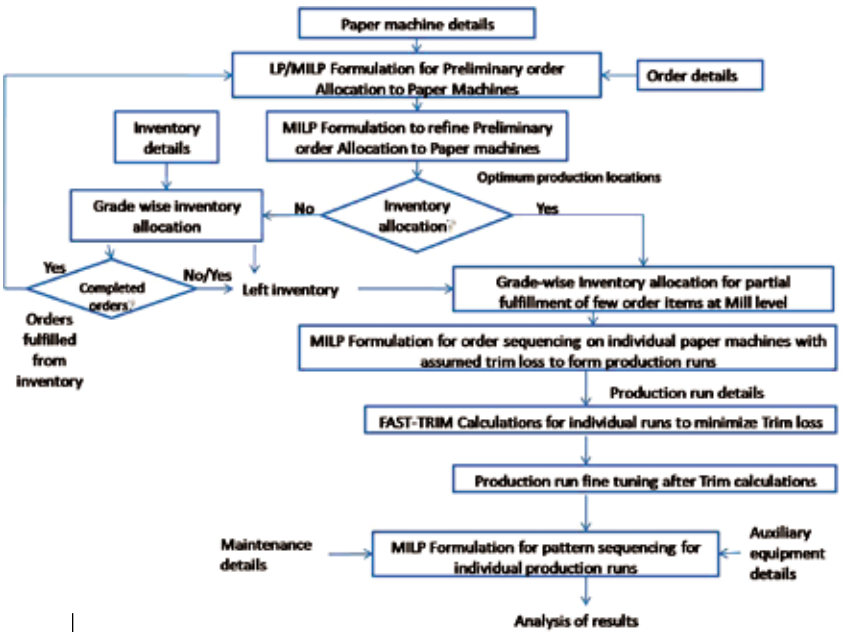
Planning Solutions for Pulp, Paper and Printing Industries

Inventors: S. Patwardhan and team, Department of Chemical Engineering

An approach for enterprise-wide planning and scheduling problems in paper, pulp and printing industries.

Method:

- problems are decomposed into an interconnected smaller set of sub-problems in space and time
- sub-problems can be solved with existing capabilities of available solvers and personal computers



Process flow of approach

Features:

- hierarchical structure
- algorithmic approach with minimal use of heuristics
- permits systematic analysis of the problem at various levels
- rolling horizon concept to handle changing future demands and possible disruptions
- resultant sub-problems solved using an ILOG CPLEX 7.1 Solver

Efficacy has been evaluated on a large industrial problem (3200 orders, 5 paper machines and a 3 month horizon, i.e., approximately 300,000 variables). Satisfactory solutions have been obtained over multiple scenarios in a reasonable time frame.

Applications:

- large-dimension enterprise-wide order allocation
- inventory allocation
- run formation
- trimming and pattern sequencing problems

Status: Technology transferred to Honeywell Technology Solution Ltd.

Supercritical Fluid Extraction Technology

A superior and economical Supercritical Fluid Extraction Technology (SCFE).

Inventors: M. Mukhopadhyay and team, Departments of Chemical Engineering and Mechanical Engineering

The current global trends show a growing preference for products from natural sources that use safe, eco-friendly and pollution-free manufacturing processes. SCFE technology can provide a total solution to these challenges.

SCFE is a highly versatile technology with a varied range of applications:

- extraction of natural products such as essential oils and oleoresins, flavours, fragrances, food colours, preservatives, pesticides and herbal medicines
- production of ultrafine/ nanoparticles, used for enhanced dissolution, controlled release or targeted drug delivery
- processing and preservation of food products
- de-cholesterolisation of food, de-caffeination of tea/coffee, de-nicotisation and removal of tar from tobacco and extraction of hops
- precision cleaning of electronic and optical components
- removal of residual solvent from solvent-extracted products

Commercial SCFE plant'

Improvements that have been incorporated in the conventional SCFE technology include pre-processing of natural materials prior to extraction, a sequential scheme of static and dynamic extractions and selective fractionations, intermittent processing of feed material for complete extraction, and also design of internals.

Status: Had been licensed to alumni entrepreneur for deployment

OptiLOM Software

Inventors: K.P. Karunakaran and team, Department of Mechanical Engineering and Daimler Chrysler AG, Germany

Laminated object manufacturing (LOM) is a rapid prototyping process used to produce less expensive and stronger prototypes. The main barrier to the use of this process is that it requires grid cutting and de-cubing, which requires extended time and skilled manpower.

The OptiLOM software alleviates the need for grid-cutting and de-cubing in Laminated Object Manufacturing (LOM).

Features of OptiLOM:

- allows pre-processing of the prototype geometry before using it on the LOM machine
- eliminates the need for grid cutting and de-cubing
- does not require any change in the hardware of the LOM machine and hence is readily adoptable
- additional geometries can be calculated

Output of a bracket processed by OptiLOM

Bracket made on an LOM machine after pre-processing using OptiLOM

Status: Launched during EuroMOLD 2002, Germany. Licensed to Materialise, Belgium, and sold as an optional module for its 'Magics' RP software

Electro Slag Remelting Technology

Electro slag remelting (ESR) plant design and ESR technology for high speed and other specialised steels.

Applications/Activities:

- new ultra-high strength steel for rocket motor casing
- turn-key supply of an ESR facility to the Vikram Sarabhai Space Centre
- complete automatic control system for an ESR pilot plant developed and installed
- inoculation of ESR steel to further improve the material's properties
- iron-aluminides use for high temperature applications

Inventors: N. B. Ballal and team, Department of Metallurgical Engineering and Materials Science

National award for ESR technology transfer

ESR Plant

Status: Licensed to M/s A.V Alloys, Hyderabad; high speed steel for tool manufacture design, commissioning and knowhow licensed to industries

Improved Paint for Underwater Applications

Inventors: A. S. Khanna, Department of Metallurgical Engineering and Materials Science

Underwater coatings

A fast-curing, corrosion resistant paint developed for underwater applications.

Features:

- two pack epoxy-amine chemistry applied
- bis-phenol-A epoxy resin was cured with cycloaliphatic amine hardeners in combination with tertiary amine accelerators
- various pigments and fillers were optimised along with dispersing, wetting and defoaming additives to solve the problem of achieving good hydrophobicity of paint to prevent its loss during underwater application
- glass flakes and various fibrous fillers used to overcome problems faced in achieving good flexibility and reinforcement
- power brush, a suitable underwater application tool
- developed coating had surface dry time of about 2 hours with thickness of around 300 microns
- excellent hydrophobicity, flexibility, strength and corrosion resistance properties observed in the coating

Applications:

- value in repair and maintenance of piers, swimming pools, and containment tanks
- can be used in areas exposed to dampness and water saturation like loading docks, marine vessels and sweating pipes, works well in locations with high humidity levels

Status: Licensed to EWAC Alloys Ltd., Mumbai

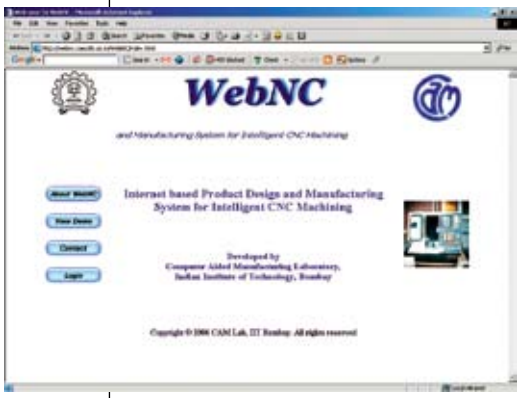
WebNC: Machining through the Internet

An internet-based software for intelligent product modelling and process planning.

Inventors: S. S. Pande and team, Department of Mechanical Engineering

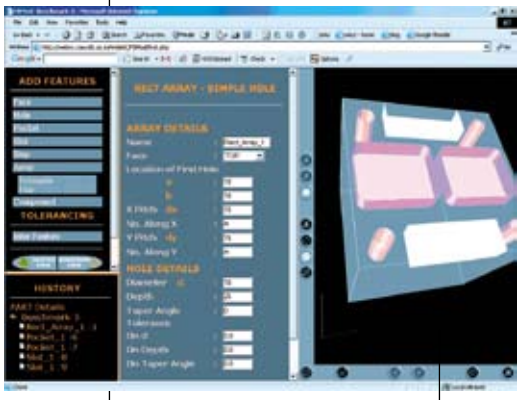
Features:

- distributed environment provides 'anywhere anytime' connectivity
- virtual design environment for synthesis, validation and visualisation of parts
- intelligent process planning for 3-axis CNC machining centres
- CNC program generation and graphical simulation
- collaboration with remote site CNC machines for tele-manufacturing



Applications:

- manufacturing of parts on three-axis computer numerical control (CNC) machines
- can be applied to prismatic part shapes which are common in the automobile, aerospace and electric parts manufacturing industries and in consumer goods



Web interface of WebNC software

Due to its client server-based architecture, WebNC enables integration of globally distributed product designers, process planners and remote CNC machines during collaborative product development and tele-manufacturing. In addition, it is an excellent didactic tool for training and virtual product development.

To use WebNC, a personal computer with an Internet connection is sufficient and there is no need for the user to have any proprietary CAD or CAM software.

Status: Had been licensed to HyTech Pvt. Ltd.

E-Foundry: Improved Casting Design and Simulation

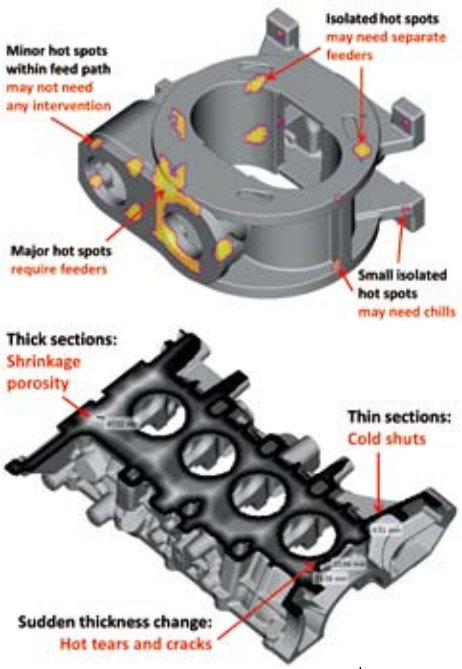
Inventors: B. Ravi and E-Foundry team, Department of Mechanical Engineering

Fast and reliable algorithms for 3D casting design, simulation and optimisations.

Metal casting is the most economical process for producing intricate parts with internal features. These are used in transport, energy, sanitary, machine tools, defense and other sectors. Most foundries, however, suffer from poor yield (as low as 50%) and quality (over 10% rejections). This can be significantly improved by computer simulation of casting process.

The E-Foundry Lab at IIT Bombay has developed advanced and intelligent algorithms for automatic methods design, simulation and optimisation of castings. This includes:

- part shape complexity analysis
- wall thickness visualisation
- reference radiograph
- hole feature recognition
- part-process compatibility evaluation
- mold parting line selection
- core print (support) design
- mold size and cavity layout
- metal-mold ratio optimisation
- feeder location, design, 3D model
- sleeve, chill design and model
- feed metal path simulation
- shrinkage defect prediction
- automatic feeder size optimisation
- 3D layout of sprue, gate, runner
- gating channel design and model
- mold filling simulation
- automatic gating optimisation
- tooling cost estimation



The algorithms have been implemented in the following software programmes:

- 3DHotSpot: for students and teachers
- AutoCAST-X: for foundry engineers
- LessMetal: for product designers

Status: Licensed to 3D Foundry Tech Pvt. Ltd., a company incubated at IIT Bombay, for development and marketing

Novel Insert Assembly

Unique insert assemblies with high specific strengths to reduce stress concentration at locations where multidirectional stresses act on sandwich structures.

A novel method of reliably mapping the distribution of the stresses, which helps predict failure initiation in sandwich structures with diverse geometrical configurations.

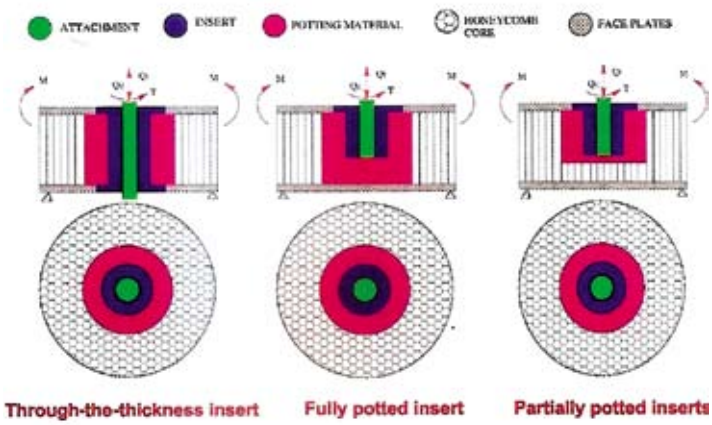
Light weight sandwich structures are used in a variety of applications such as vehicles, the aerospace industry and structural frameworks. Inserts are used to strengthen the sandwich structures so as to enable them to withstand localised loads. Inserts permit an interconnection between honeycomb sandwich structures and other structural parts.

The use of polymer matrix composite materials as inserts ensures high specific strength of the insert assesmbly.

Design and development of an array of 3D woven-composite insert assemblies with special geometrical and material characteristics for honeycomb sandwich structures have been carried out. The stress distribution in sandwich structures with new insert assemblies showed favourable results. The developed assemblies consist of through-the-thickness, fully-potted and partially potted geometrical configurations.

Inventors: N. K. Naik and N. Rao, Department of Aerospace Engineering

Patent granted (Application number: 496/MUM/2004, grant number: 211354)

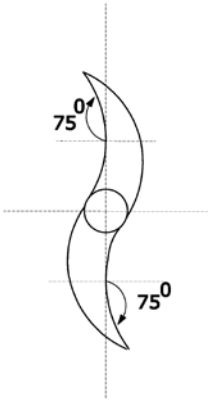


Types of inserts

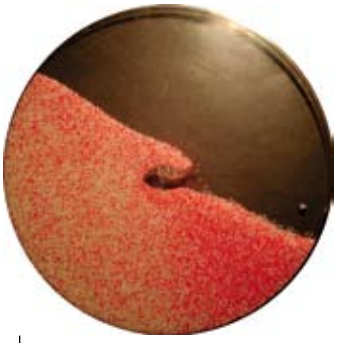
Impeller Designs for Enhanced Material Mixing

Inventors: D.V. Khakhar and S. Hajra Department of Chemical Engineering

Patent granted (Application number: 809/MUM/2003, grant number: 213856)



Schematic of impeller design



Transverse mixing of red colour glass beads within colourless glass beads in a cylinder with a rotating reverse 'S' shaped impeller at the centre

Specially designed impellers for use on the central shaft of the rotating drums used in industrial mixers.

Features:

- 'inverse S' shape
- capable of actively churning the material that is near the drum axis
- able to disperse the heavy materials that tend to accumulate near the central axis

The efficiency of the design was demonstrated through an experiment in which glass beads of two different sizes and colours (red and colourless) were loaded into horizontal drums, one with the novel impeller and one without. After rotation, the drum with the new impeller showed superior mixing in both the axial (along the length of the drum) and radial (across the circular cross section of the drum) directions, in comparison to the mixing obtained in the non-impeller based drum.

Advantages:

- high mixing index
- low segregation
- even mixing at the core
- no segregation into clumps

Supercritical Process for Extraction of Fragrances

A process for cyclic supercritical fluid (SCF) CO_2 extraction of fragrances from jasmine flowers.

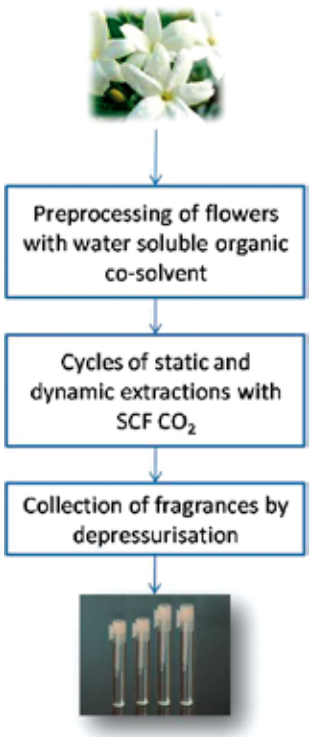
The single step process results in higher and more efficient recovery of fragrances than recoveries from conventional processes.

Method:

- the fluid is charged into an extractor loaded with jasmine flowers and kept for equilibration
- process strips the fragrances from the flowers by holding the SCF CO_2 in the extractor for a predetermined period of time
- a cycle of static and dynamic extractions from flowers using SCF CO_2
- dynamic collection of the fragrances by depressurisation
- optional pre- processing of flowers with a water soluble organic co-solvent for more efficient, better and higher recovery of fragrances
- simultaneous extraction with SCF CO_2 and fractionation of extracts for separation of "concrete" and "absolute" in a single step

Inventor: M. Mukhopadhyay, Department of Chemical Engineering

Patent granted (Application number: 72/BOM/96, grant number: 183454)



Process flow for extraction of fragrances

Supercritical Carbon dioxide-based Food Sterilisation

Inventors: M. Mukhopadhyay and A. Chakraborty, Department of Chemical Engineering

Patent granted (Application number: 543/MUM/2004, grant number: 211305)

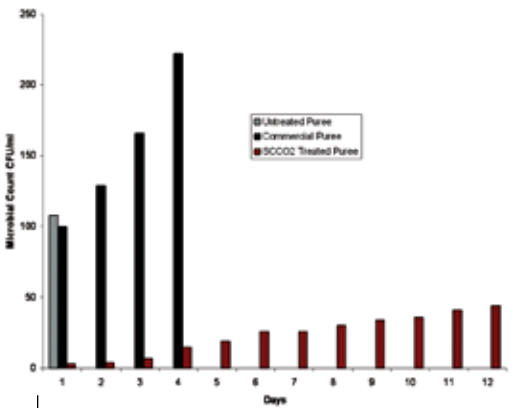
A novel process for sterilising and enhancing the shelf-life of biological materials.

Features:

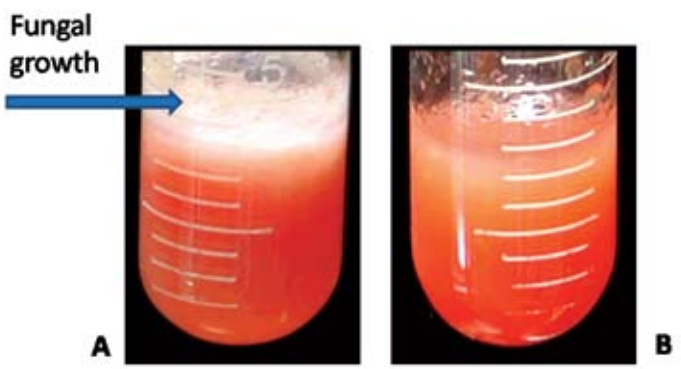
- process uses sequential pressurisation-depressurisation treatments with supercritical fluids
- sequences occur at specified pressures and treatment times that are based on the nature of the biological material being sterilised
    - product specific characteristics can be maintained while sterilisation is achieved
    - allows shelf-life enhancement of at least 90 days without any chemical preservatives
    - can sterilise liquid food such as milk, fruits and vegetable juices, coconut water

Advantage:

- retains natural flavours, aroma, colour, freshness and texture



Comparison of shelf lives of SC CO_2 treated, untreated, and commercially available tomato puree samples



A) Untreated tomato puree kept at room temperature showing fungal growth on 5th day. B) SC CO_2 treated tomato puree kept at room temperature without any growth on 90th day

Supercritical Process to Extract Nutraceutical Concentrates

A process for the extraction of nutraceutical concentrates enriched with bio-active ingredients through the use of supercritical fluid carbon dioxide.

Features

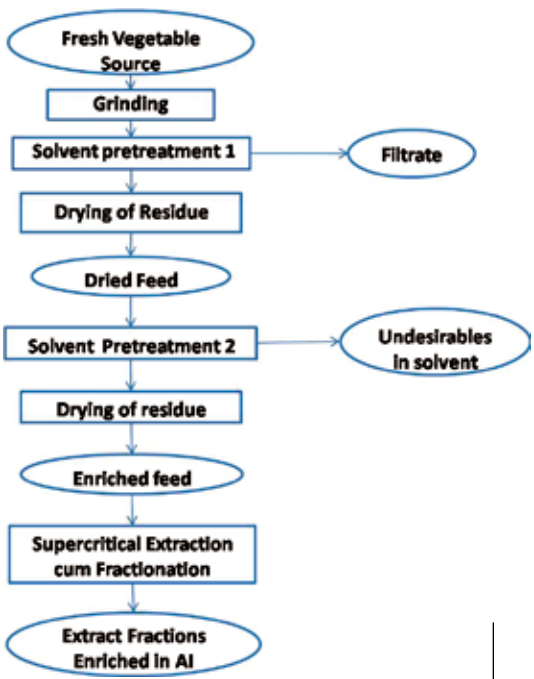
- pretreatment of the plant source by first washing with an organic solvent in which the desired active ingredient is insoluble
- selective leaching of the pretreated plant source to remove the undesired components
- supercritical fluid extraction of the prepared plant source , followed by fractionation
- recovery of nutraceutical concentrates enriched with the active ingredients, by collecting the fractions under ambient pressure using a single separator, with varying times

Advantage:

- allows easy and superior extraction of nutraceutical concentrates enriched with active ingredients

Inventors: M. Mukhopadhyay and H. Karamta, Department of Chemical Engineering

Patent granted (Application number: 545/MUM/2004, grant number: 213518)



Experimental methodology

High Molecular Weight Crystalline Polylactic Acids

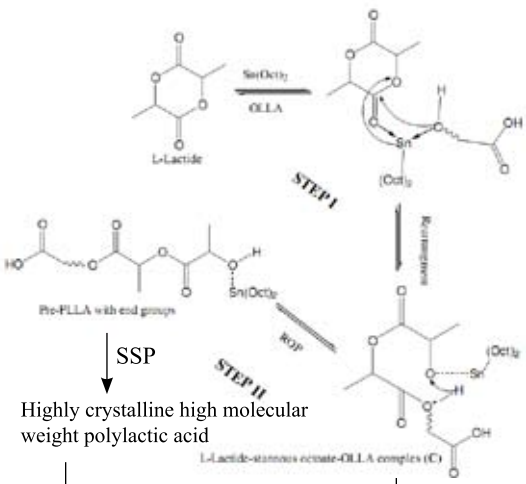
Inventors: H. Nanavati and Vimal Katiyar, Department of Chemical Engineering

Patents granted (Indian patent application number: 678/MUM/2007, grant number: 242801, Equivalent World patent number: WO2009007989A3)

A method to make high crystalline lactic acid polymers of high molecular weight.

Method:

- melt polymerisation of a lactide in the presence of a catalyst to form prepolymers having active end groups
- residual lactide after the melt polymerisation is removed by heating the reaction mixture in the temperature range of 98 °C
- solid state polymerisation of prepolymers



Proposed Reaction Pathway for Pre-PLLA synthesis: (STEP I) Synthesis of L-lactide-stannous octoate-OLLA coinitiator complex (STEP II) ROP of L-lactide, using the Complex. This Pre-PLLA can now undergo step-growth SSP and yields highly crystalline high molecular weight polylactic acid.

Yields of polylactic acid with molecular weight in the range of 100000 to around 200000 and crystallinity as high as 98% are achieved. The use of a metal complex catalyst system comprising a lactide, a metal octoate and a lactic acid oligomer gives rise to a highly crystalline high molecular weight polylactic acid.

Applications:

- textiles
- packaging purposes, medical applications, surgical sutures
- sustained-release capsules
- drug delivery systems
- reinforcing materials for bone fractures

Synthesising Poly Lactic Acid Clay Nanocomposites

A process for preparing polylactic acid-clay nanocomposites by monomer intercalation, followed by polymerisation of lactide in clay.

In case of lactic acid monomer, the process yields effective dispersion of polylactic acid prepolymer and clay, via intercalation and exfoliation of the clay with an oligomer and metal based catalyst followed by melt polymerization of lactic acid oligomer in clay.

Features:

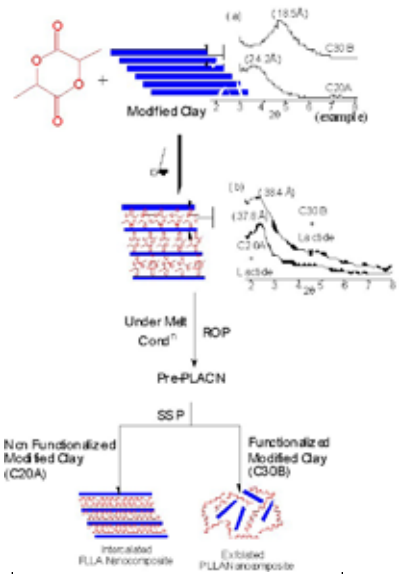
- biodegradable
- superior mechanical properties
- high molecular weight and crystallinity
- superior permeability
- suitable for automotive, electronic, film, fiber, biocompatible and biomedical applications

Method:

- lactic acid oligomer is utilized to prepare a dispersion of clay in medium Molecular weight (MW) lactic acid prepolymer by melt polymerization
- either intercalated or exfoliated medium MW lactic acid prepolymer will then undergo Solid State Polymerisation (SSP) to yield high molecular weight polylactic acid-clay nanocomposites

Inventors: H. Nanavati and V. Katiyar, Department of Chemical Engineering

Patents granted (Application numbers: 677/MUM/2007, 679/MUM/2007, grant numbers: 245297, 242277)



SSP-synthesized Poly Lactic acid Clay Nanocomposites (PLACN). Pre-PLACN formed by in situ Ring Opening Polymerisation (ROP) of L-lactide, in presence of catalyst. Comparing the d-spacings from SAXS patterns (a) and (b), indicates lactide has intercalated within the modified clay galleries. *PLLA: Poly L-lactic acid

Novel Electric-Motor-Powered Drive System

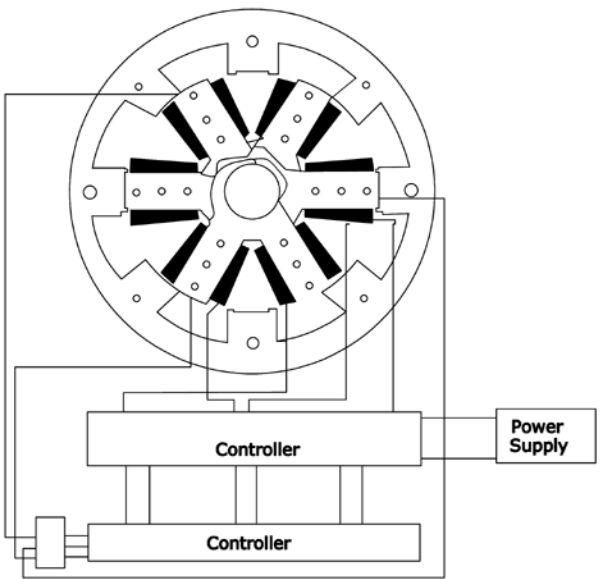
Inventors: B. G. Fernandes and D. P. Mahajan, Department of Electrical Engineering

Patent granted (Application number: 365/MUM/2007, grant number: 241923)

An electric-motor-powered, in-wheel drive system using an inverted switched reluctance motor drive to provide improved efficiency, greater compactness and maintenance free vehicle operation system.

Components:

- stator of the electric motor comprises a stack of ferromagnetic material laminations and includes outwardly extending poles
- coils are wound about the stator poles in such a way that for every stator pole of one polarity, there is a corresponding pole with an opposite polarity
- motor consists of several projecting poles and does not include coils or an energy source, such as permanent magnets
- converter-controller system



Schematic of electric-motor-powered drive system

Mechanism:

- motor has three phases (A, B and C) which are selectively and sequentially energised
- reluctance by the flux from the excited phase is a function of rotor position and the motor phase with the position of maximum reluctance must be energised first; instant of energising is determined by a position sensor and a controller
- during operation, the windings of the three phases are energised and de-energised in sequence and in response, the rotor experiences continuous unidirectional torque

Advantage:

- design ensures reliable, maintenance free operation and low cost

Yarn Flyer Design

A novel yarn flyer designed for jute spinning machines to reduce operator risks.

Jute fibre is spun into yarn on a spinning machine that also collects the yarn using bobbins. The bobbins are placed within flyers, which facilitate the yarn winding process. In addition to winding the yarn, flyers are used to maintain the required tension to the yarn.

The new design uses a new geometry in the flyer's lateral extension.

Features:

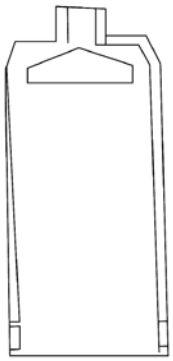
- due to the spinning movement and tension created, the yarn automatically slides towards the inner section of the flyer
- allows higher operating speeds, increasing the strength of the yarn
- provides economic advantages as deformation of the flyer during spinning is reduced

Benefits:

- increased usable life span
- lesser problems associated with the hairiness of jute yarn
- produces a lower noise level during operation thus reducing the health risks to the workers
- can increase economic productivity

Inventors: H. Hirani and S.S. Dani, Department of Mechanical Engineering

Patent granted (Application number: 661/MUM/2006, grant number: 234653)



Schematic of yarn flyer

Compact Drive Mechanism

Inventor: S. L. Bapat, Department of Mechanical Engineering

Patent granted (Application number: 480/MUM/2000, grant number: 200858)

A compact drive mechanism for reciprocating machines.

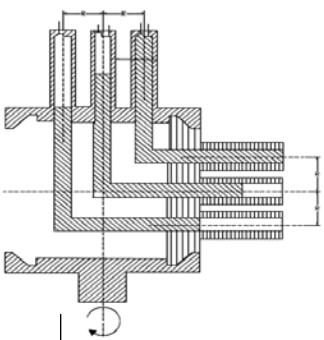
Components:

- two horizontal circular discs parallel to each other, both having a coinciding circumferential groove of the same size and shape. One of these discs is stationary while the other (the driving disc) is rotated using a prime mover
- a vertical disc with an external surface matching the curvature of the grooves is placed between two horizontal plates. The vertical disc rotates in the grooves about the central axis of the mechanism and also about its own horizontal axis, which results in a planetary motion

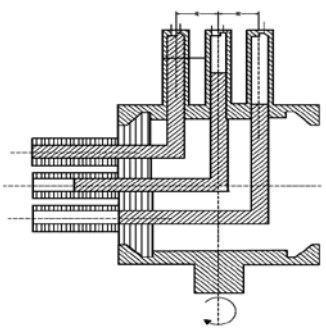
Operation of the drive mechanism:

- horizontal stationary disc has a number of holes, designed to hold tubes that act as cylinders. The driven disc also has the same number of holes to hold the guiding sleeves and on the same P.C.D.
- circular rods are coupled to each other at right angles to obtain L-shaped members. The vertical limbs act as pistons and they reciprocate (and simultaneously rotate) in the respective cylinders mounted on the horizontal stationary disc. Horizontal limbs are inserted through the guide sleeve mounted in the vertical disc. These act as load bearing limbs while undergoing rotating and reciprocating motion.
- one rotation of the vertical disc is equivalent to two strokes (one upward and one downward) of each piston

Alpha Stirling cryo-cooler developed using the drive mechanism



Position of piston after half revolution



Position of piston initially

Advantages:

- large stroke to diameter ratio
- orientation of the drive mechanism has no effect on the performance of the application for which it was used

Stirling Cooler

A unique Stirling cooler employing the Stirling cycle.

In Stirling cycle, a working fluid, such as helium or hydrogen, is compressed and then allowed to cool to the desired temperature while passing through a regenerator (a porous matrix). It is then expanded in order to cool further. The resultant cooling or refrigeration effect is used for cooling applications. The cold gas picks up heat from the regenerator while returning to the compression space again.

Components:

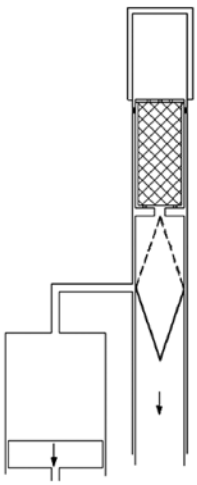
- compressor which has a piston disposed in the compressor cylinder
- expander with a rotating piston that is reciprocally disposed in the expander cylinder
- regenerator placed within a cavity formed in an extension at the top of the expander piston
- circumferential groove formed on the extension adjoining the bottom wall of the cavity and the top end of the expander piston
- a pair of helical grooves along the length of the expander piston with their ends meeting each other

Benefits:

- allows a cooler to be very compact and effective in cooling
- developed coolers will have long life, due to the use of non-contact running surfaces
- expected to maintain high performance over a wide range of temperature conditions
- uses an environmentally safe helium gas , as the working fluid
- performs well in harsh temperature environments, under high ambient temperatures that are limited only by the materials used to manufacture the cooler

Inventor: S. L. Bapat, Department of Mechanical Engineering

Patent granted (Application number: 299/MUM/2006, grant number: 225128)



Schematic of sterling cooler

Sheet Selection System

Inventors: P. P. Date and S. G. Desai, Department of Mechanical Engineering

Patent granted (Application number: 808 / MUM / 2006, grant number: 241812)

A system and a process of forming sheets to generate products of desired shapes conforming to user defined acceptance criteria.

Features:

- sheet metal selected based on parameters to avoid rejection
- helps avoid sheet being "mis-applied" when the 'demand' for sheet ductility is far too high
- the sheets can be tested quickly without the need for use of written standards

Formation of cup using ANN suggested material specification

Components:

- sheet deforming means comprising punch, blank holder and die
- strain measuring means provided on the sheet deforming means
- data acquisition
- processing means provided with Artificial Neural network (ANN) capabilities
- output device configured with the said sheet deforming and strain measuring mean

Strain data from the strain measuring means is fed into the data acquisition and processing means. The ANN architecture is developed and trained in the processing means to arrive at the sheet material specification to produce sheet products of desired shapes / geometries meeting user defined quality parameters. Changes in tool parameters and processing conditions on quality of the product irrespective of the material and shape of the product are possible.

Benefits:

- uses simulations and helps metal engineers choose the right sheet and helps predict the outcome by using the ANN enabled system
- reduction of wastage of time and material

Automated Windshield Wiper

An improved automated windshield wiper.

Features:

- user-friendly
- reliable
- cost effective
- can be adapted for use in a variety of vehicles
- available with a manual option that permits a change from intermittent to continuous wiper operation, as and when required
- available with a suitable combination of dwell time variations between two wiping cycles of the wiper and speed control of the wiper motor, allowing intermittent or continuous operation, with speed control, depending on the intensity and frequency of rainfall

Components:

- A rain sensor
- A detector selection control circuit
- A wiper operation circuit

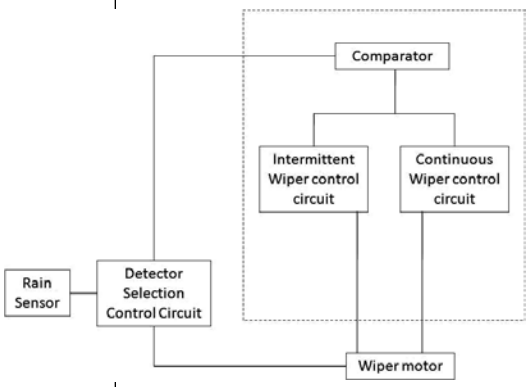
The rain sensor consists of a calibrated collection vessel with perforations at specific heights that enable the outflow of water collected in the collection vessel at a specific rate but at amounts that vary with the intensity of rainfall.

The detector selection circuit intermediates between the rain sensor and the wiper motor. According to the signal it receives from the rain sensor, it activates or deactivates the wiper motor directly or through the wiper operation circuit.

The wiper operation circuit consists of a comparator, an intermittent wiper control circuit and a continuous wiper control circuit.

Inventors: A. Lohokare, Department of Mechanical Engineering

Patent granted (Application number: 1152/MUM/2001, grant number: 198020)



Components of the automated windshield wiper system

Stirling Engine for 1.5 kW Electrical Output

Inventors: S.L. Bapat and S. B. Kedare, Departments of Mechanical Engineering and Energy Science and Engineering

A distributed power generation system for economical supply of electricity to rural areas and other locations where large distances are involved.

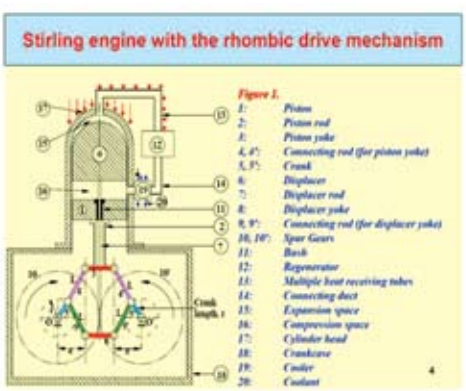
Features:

- has a rhombic drive mechanism which avoids the side thrusts on the cylinder
- provides a larger pressure ratio with the same piston and displacer diameters
- uses the second order of cyclic analysis for design of miniature as well as large capacity Stirling coolers
- weights are attached to the gears to reduce torque variation from the system and from the point of balancing, using a novel technique to provide the arrangement
- incorporates an annular regenerator and cooler using the axial slits for gas and circumferential passages for coolant

The assembled engine has been tested for a short duration of five minutes and further modifications are being carried out (for the heating section).

Stirling Engine (Flame Heating not shown)

Cylinder Head heat input tubes as modified



Special Needs

Low Cost Motorised Arm

Inventors: S. Devasahayam and team, Department of Biosciences and Bioengineering and Christian Medical College (CMC), Vellore

First successful, low-cost, indigenous, motorised artificial hand

Features:

- myoelectric and whistle-based controllers
- a motor for co-ordinated movements of the fingers and thumb, another motor to turn the hand at the forearm
- motors operated by switches placed in the socket of the artificial hand
- amputee able to control switches by slight movements in the residual limb

An amputee working with his motorised arm

Advantages:

- works better in a high-humidity climate
- sizes available for both children and adults

Status: Fabricated by WORTH and subjected to clinical trials

Communicator for Children with Cerebral Palsy

A special type of foot operated communicating tool based on a personal computer

Features:

- foot operated switches and associated software
- special sequence of keywords like 'Do', 'Go' and 'Drink' presented as images of the respective situation
- special type of support furniture to allow appropriate positioning of the monitor and the foot operated switches

Inventors: G. G. Ray and team, Industrial Design Centre and Department of Electrical Engineering

Toe operated communicator

Vestibulator for Cerebral palsy

Inventors: G.G. Ray and S.A. Hosseini, Industrial Design Centre

A new concept vestibulator for neuromuscular coordination and improved balance mechanisms in cerebral palsy children

- vestibular therapy is intended at helping the brain to quickly compensate for lost balance
- device highly effective; reduces the existing duration of vestibular therapy from six months to one and half months

LPG Kitchen Stove for the Visually Challenged

Novel LPG stoves based on conceptual designs, for the visually impaired

Features:

- low cost two-burner stainless steel gas stove with separate automatic igniters
- automatic flame failure detectors for each burner with different audible tones
- flame guard rings for each burner with five-prong pan supports
- drip disc around each burner and drip tray underneath the stove
- easily operated burner control knobs with three control positions
- two-step body for easy location of burner and control areas
- reference ridge along the body for easy location of burners and easy repositioning of pan supports and flame guards
- central groove on the front surface for keeping vessels
- uses replaceable battery
- aesthetically pleasing product form; safe and easily serviceable

Inventors: G. G. Ray and team, Industrial Design Centre

LPG stove for the visually impaired

Status: 30 stove units have been developed in association with M/s. P.K. Limited, Hyderabad, and distributed to the visually impaired for field trials.

Ascender: The Climbing Wheelchair

Inventors: V.P. Bapat and team, Industrial Design Centre

An innovative design of wheelchair for increased comfort, ease of operation and navigation of stairs.

Features:

- works on the principle of a ratchet attached to a traction belt
- user can navigate a flight of stairs by pulling the levers attached to the arm rest
- traction belt locks the wheels preventing slipping
- Dupont structural net on the back and seat reduces body sores
- higher level of operational freedom
- self-reliance to the user
- transfer of persons to and from the wheelchair easier
- public spaces made more accessible to the user
- greater operational independence
- mechanism eliminates intensive use of hands
- easy transportation and assembly of the parts
- approximate cost – ₹ 10,000 – 15,000

Ascender – a climbing wheelchair

Light Weight Prosthesis for Polio-affected Children

A lightweight prosthesis, employing novel materials

- clinical trials on over 1000 patients with lower limb paralysis have confirmed the superiority and acceptability of the product

Inventors: S. C. Lakkad, Department of Aerospace Engineering and team at SDM Hospital, Jaipur

Child wearing lightweight prosthesis

Design

Design for Board Games

Inventors: U. A. Athavankar and team, Industrial Design Centre

Board games for children aged 6+ and 8+ years.

Features:

- designed using education and creativity principles
- based on the use of spatial intelligence and mental imagery
- designed to instill a problem solving approach, such as the use of foresight and planning
- short games for entertainment purposes
- long games to teach children how to develop strategies

Design registrations for the board games:

Game Design	Registration No.
Bi-Pass	222968
Over the Top	222973
Brick Burst	222969
Delta Attack	222972
Pugploy	222974

Board games

Status: Licensed to Funskool (India) Ltd. and products are in the market.

A New Letterbox for India Post

The old rusty red letterbox, popularly known as 'Lal Dabba' in India has got a new look.

Features:

- stainless steel body mounted on a smaller base, making it easy to collect letters because of the overhang of the body
- keeps the letters from being soiled during rains
- red composite-plastic top with a beak-like aperture for posting letters
- rust free, does not require painting
- has a maintenance-free life expectancy of 20 years
- cap covers the top of the stainless steel body on all sides, preventing seepage of rainwater into the letterbox
- the slopes on the top fully drain water away from the box
- the wide opening accommodates large envelopes and has an easily moved sliding closer
- the flat top surface can be used for writing
- a common key can open all letterboxes in one region
- easy to install

As a strategic marketing initiative, the new letterbox has large spaces for advertisements on its sides and the revenue from such advertisements can pay for the cost of the box over a period of approximately 2 years—later becoming a revenue generating initiative. The new letterbox was launched on 18th October 2005 in New Delhi.

Inventors: B. K. Chakravarthy and team, Industrial Design Centre

Design registered in September 2005; No. 201789

Deployed letter box

Status: Deployed by Department of Post, Govt. of India

ATM Enclosure Design

Inventors: U. A. Athavankar and team, Industrial Design Centre

ASAN – a new ATM

Status: Licensed to NCR for installation in various banks

ASAN, a low cost, automated teller machine (ATM).

The design is based on surveys of current and potential users of ATMs.

ASAN has several advantageous features compared to currently deployed ATMs. These features have been incorporated to suit the desires of Indian customers and the needs of Indian ATM locations.

Features:

- attractive design incorporating elements from traditional Indian architecture (banks may further customise it based on their needs)
- small size makes it suitable for deployment in places with space constraints
- ergonomic design suits the typical Indian body dimensions with respect to the height of the keypad and the inclination angle of the screen
- has a provision for placing one's personal belongings and has protruding wings for ensuring privacy during transactions
- has a multi-coloured card reader and status indicator which guides unfamiliar users
- has intelligent, power-saving hardware and software
- an integrated pedestal accommodates an uninterrupted power supply, providing maximum availability during power outages
- trouble-free operation in hot, humid and dusty environments
- unique airflow system allows deployment at non-air conditioned sites
- 40-column, graphic thermal receipt printer

The ATM enclosure design obtained the Consultancy Development Centre National Award for Excellence in Consultancy Services in 2004.

K-Yan: The Compact Media Centre

A compact media product for community use which combines the functions of a multimedia and Internet-enabled PC, a large format television, a DVD/VCD/CD player and CD writer, a video-conference device, an LCD data projector and an audio system that facilitates shared viewing and participation by users.

K-Yan has since been demonstrated to several senior state and central government officials and ministers. K-Yan has evoked enthusiastic response and is on the way to becoming a major commercial success.

Features:

- easy to use
- has multilingual facilities
- eliminates the need for investing in other media hardware
- a single unit can cater to the teaching needs of an entire class and can substantially reduce the cost of computerising schools
- useful in group learning or information dissemination programs, such as healthcare, family planning, agricultural practices and civic awareness drives
- equipped with a solar energy portable power supply to enable its use in areas with no electricity
- can also function as a mobile communication centre for deployment to remote locations when mounted in a van
- with an Internet connection and a web-camera, it allows low-cost Web-conferencing from any location, making it useful in disaster management or when monitoring project progress
- useful in facilitating e-governance, as it will facilitate direct communication between various agencies and the administration's headquarters

Inventor: Kirti Trivedi, Industrial Design Centre

K-Yan

Status: Licensed to Infrastructure Leasing & Financial Services Ltd.; has been deployed at more than 250 schools, educational institutions, NGOs and rural communities

Electro-mobility Product Designs

Inventors: K. Munshi and team, Industrial Design Centre

Light-weight, micro-electric vehicles.

Features:

- light-weight structural material - glass reinforced plastics
- shape optimised to yield maximum strength to weight ratio
- battery capacity can be reduced due to reduction in weight of the structure
- the body is made as an integrated structure (monocoque) (obviates the need for steel structural members)
- driven by a hub-motor which is mounted on the wheel
- motors are controlled by electronic systems
- single seat two-wheeler and single seat three-wheeler with towing capabilities
- have a range of 25-30 km on one full charge
- speed restricted to 20km/hr
- battery pack is lead acid, but can be changed to NiMH or Li Ion
- designs can be taken up for batch or mass production in the shortest possible lead time

Single-seat 2-wheeler micro-electric vehicle

The structure of the vehicle has been developed with the help of digital modeling and FE analysis, and appropriate integration of aesthetics / styling and ergonomics. These two-wheeled / three-wheeled vehicles are meant for niche applications – airport interior transport, industrial parks and campuses, large malls, where range, speed, changing infrastructure is not an issue.

Advantages:

- lightweight
- efficient
- reliable
- does not require a mechanical transmission system

Status: Exclusively licensed to CTech Labs Pvt. Ltd., a company incubated at IIT Bombay

Modular Toilet Unit for trains

Improved modular toilets designed for Indian Railways.

Features and advantages:

- factory built, prefabricated product, 'ready to assemble' in A/C coaches
- unit consists of five modules
- can be erected in three to four hours
- three variations made to suit requirements of different types of coaches: includes three Oriental type WCs, one Western type WC and two units of Outside Panel with wash basin
- indian style WC special designed with ergonomic features for maximum comfort
- all plumbing and electrical wiring concealed
- visual clutter due to leakage, visible plumbing, loose wiring and rusting elements avoided to make the unit a clean and hygienic place for use
- modern efficient image given by choosing the right materials including colour and finish
- innovative designs incorporated to enhance aesthetics, convenience and safety

The prototypes were created by Hindustan Fibre Glass Works, Vadodara and the project was supported by the Advance Composite Mission of TIFAC, Department of Science and Technology, Government of India.

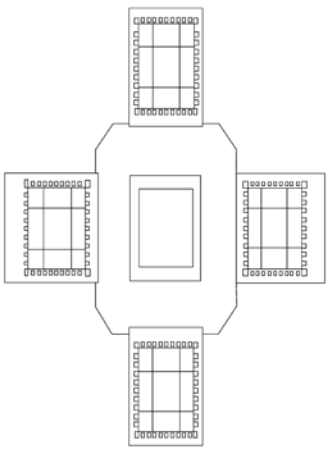
Inventors: K. Munshi and team, Industrial Design Centre, Department of Aerospace Engineering

Modular toilet units

A Novel Game for Learning Fractions and Mathematical Operations

Inventors: U. A. Athavankar and A. Agrahari, Industrial Design Centre

Patent granted (Application number: 1167/MUM/2003, grant number: 210463)



Schematic of game developed

An educational and entertainment device to assist in the learning of concepts related to fractions, addition, subtraction and equivalence for children, through games and other types of play.

Features:

- interactive
- increases learning through multiple challenge levels
- encourages creativity and strategic thinking
- requires 2-4 players
- self-packaged and therefore easy to carry from place to place

The game is in the form of a chequered board with areas demarked for the placement of playing tiles of various shapes. The tile pieces must be combined with one another to make a complete shape. A specially designed die is thrown during a person's turn to determine which fraction tile is to be used to complete the shape. The person who completes the final shape with the minimum number of fraction pieces and minimum throws of the dice wins.

Every time the dice is thrown, players pick up a new tile piece from the pack. The challenge level, learning process and sequence can be varied by using a variety of dice with different numbers, thereby producing diverse options for learning.

The device allows for presentation of flexible approaches to promote understanding of the basic concepts related to fractions and mathematics. Learning is accomplished through internalisation of an idea while playing a game.

Key-Lekh: Computer Keyboard for Indian Languages

A computer keyboard developed with the goal of enabling people familiar with Devnagiri to use it without instruction.

Features:

- underlying concept is based on the 'Varnamala' - a well structured Indian alphabetic system
- an efficient walk-up-and-use keyboard
- can also be used as a desktop keyboard

The prototype was subjected to extensive tests by users in various age-groups through road shows and campus-based competitions. The feedback indicates that the Key-Lekh is the easiest-to-learn keyboard that has been developed for Indian scripts.

Inventors: A. Joshi and A. Rathod, Industrial Design Centre

Patent granted (Application number: 720/MUM/2003, grant number: 213525)

Key-lekh keyboard

Remote Sensing Scanning Mirror Controller Design

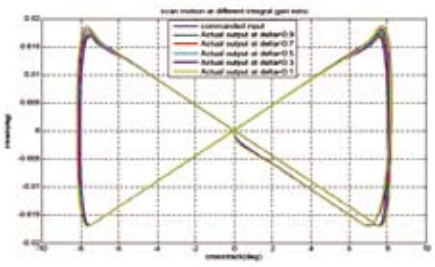
Inventors: H.B. Hablani and K. Sunil Kumar, Department of Aerospace Engineering

A design for the control of scan motion of a thematic mapper used for remote sensing of the earth.

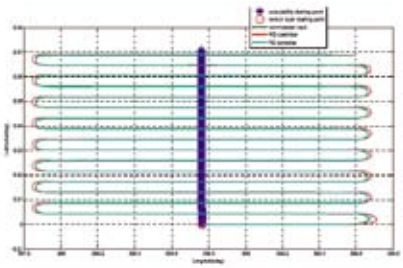
Features:

- cross-track and in-track angle profiles to scan successive rectangular strips of the ground, compensating for the forward motion of the satellite
- controllers designed to impart the desired scan motion to the thematic mapper
- controllers satisfy the specification of turn-around and settling of the instrument in 11 ms on a coasting rate with a tracking accuracy better than 1 millidegree
- a proportional-derivative (PD), a proportional-integral-derivative (PID), a PID with a rate estimate, and a lead-lag compensator are designed to meet performance specifications
- time-domain and the frequency-domain simulation developed
- sensor noise modeled as white noise with a standard deviation of 0.6 millidegree
- to achieve the specified scanning accuracy, the mapper scan angle is measured with a frequency of 5 kHz in cross-track and 10 kHz in in-track
- optical sensors, resolvers and Hall-Effect sensors provide the high frequency measurements

Matlab and Simulink softwares are used to simulate the scan motions and controllers.



In-track versus cross-track angular motion of the mirror



Rectangular strips of lat-lon scans on the ground, performed by the controllers

NATARAJ : The Walking Robot

NATARAJ – a six-legged walking robot

Features:

- can negotiate uneven terrain
- can undertake monitoring and maintenance activities in hazardous radioactive environments
- can climb steps and ramps, step across small obstacles and can manoeuvre in narrow spaces
- can lift up to 500 kg, with all of its legs on the ground

The innovative leg mechanism design has one Printed Circuit Board (PCB) along 6 PWM amplifiers for each leg. The robot can work on battery power for 20 minutes.

Inventors: C. Amarnath and team, Department of Mechanical Engineering

NATARAJ – a six-legged robot

Tools and Technologies for Cane and Bamboo Craft

Inventors: A. G. Rao and team, Industrial Design Centre

Technologies to bolster the unorganised craft sector by helping artisans produce value-added, contemporary bamboo products that can successfully compete with other materials in urban and international markets.

Technologies include:

- a tool-kit with nearly 100 product-specific hand tools needed to process bamboo
- small hand-operated machines for bamboo-processing, suitable for use in a remote area with an unreliable power supply
- jigs, fixtures and moulds to help control product sizes, shapes and produce better finishes
- a variety of treatments, such as the use of smoke and alum, to prevent fungal and insect attack of products
- various surface finishes using natural dyes
- new weaves and product designs for ergonomically, functionally and aesthetically improved products

These forms of technology assistance are disseminated to artisans by organising workshops at regular intervals.

Tools for cane and bamboo craft

Transportation

Aerostats and Airships

Inventor: R. S. Pant, Department of Aerospace Engineering

Aerial platforms or vehicles that use the buoyancy of a Lighter-Than-Air gas (e.g., Helium) generate the vertical force to overcome gravity and hence can be deployed even at zero forward speeds.

Aerostat

Aerostats are aerial platforms that consist of an aerodynamically shaped envelope which is tethered to the ground; while Airships are free flying aerial vehicles with a power-plant and a six-axis control system. They are most suitable to meet the requirement of long endurance with very little fuel consumption, noise and vibration levels.

Airship

R and D activities in Aerostats

- design of a high altitude aerostat for snow cover evaluation and data gathering
- design and fabrication of an aerostat based relocatable wireless communication system in remote/inaccessible areas
- design of a device for safe recovery of payload in case of accidental breakage of tether
- shape optimisation of aerostat envelopes

R and D activities in Airships

- design and fabrication of remotely controlled airships
- design of manned airships for aerial transportation of cargo and passengers to remote and far-flung areas
- design of environment friendly "Green" airships
- configuration design for high altitude – stratospheric airships

SkyBus

An elevated rail system positioned on a set of pillars and longitudinal members.

Features:

- innovative
- eco-friendly
- cost-effective
- provides a solution to the transportation problems of metropolitan cities

A regular bogie moves on the rail track and the coaches are suspended from bogies.

The concept of the SkyBus was initiated from the Konkan Railway Corporation Ltd. The structural design developed at IIT Bombay was fabricated by Kineco, Goa. The project was partly funded by Technology Information Forecasting and Assessment Council (TIFAC), Government of India.

Inventors: S. C. Lakkad, Department of Aerospace Engineering, and team from Konkan Railway Corporation Ltd.

The SkyBus

Status: Deployed to user agency

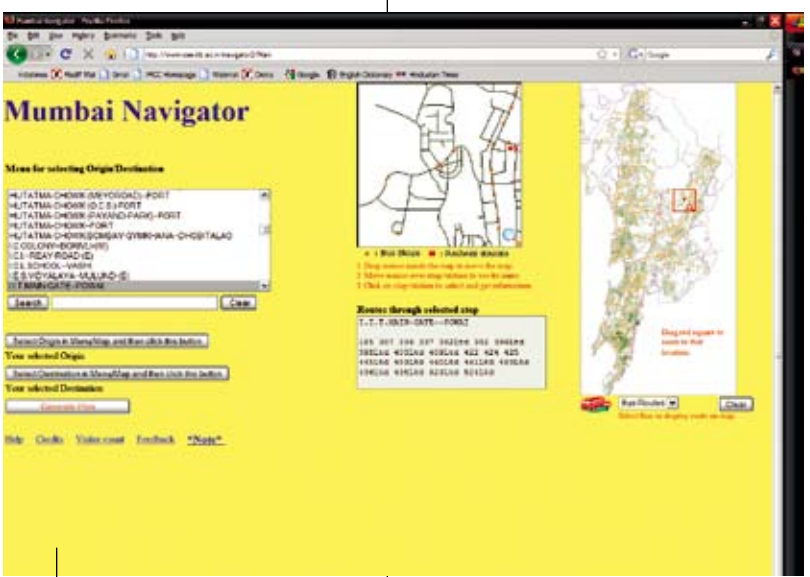
Mumbai Navigator

Inventors: A. Ranade and team, Department of Computer Science and Engineering

Mumbai Navigator is a software which helps commuters plan public bus and local train travel within Mumbai.

Features:

- the software takes as input, the starting point and desired destination of the journey and generates a description of which buses and/or trains to take and where to change transport modes
- the expected travel time, including the waiting time required for buses and trains, is also provided
- the generated plans are adaptive, i.e., they can prescribe a different set of transit selections depending upon which bus arrives first while waiting at a stop
- the plans generated by the program have been shown to provide minimum travel time solutions



A page from the Mumbai Navigator website

Status: Available at www.cse.iitb.ac.in/navigator

Low Cost Engine Management Systems

A fully-functional, low-cost Engine Management System (EMS) prototype that supports petrol-powered engines with port fuel-injection.

Engine Management Systems perform a variety of functions such as real-time engine control, enhancement of fuel economy, reduction of tailpipe emissions and improvement of overall durability. The EMS developed is the least expensive sensing configuration possible for small vehicle applications.

Features:

- minimal sensing architecture comprising three inexpensive sensors for fuel-injection EMS operation in petrol-powered, single-cylinder small vehicles
- economical
- lesser hydrocarbon, carbon monoxide and nitrogen oxide emission levels compared to that from a production-quality carburettor-based vehicle
- potential to improve the fuel economy of a production-quality carburetion solution by 5-10%
- novel control algorithms that exploit the small sizes of engine system components
- meets emission, fuel economy, and drivability performance specifications

Inventors:
S. Suryanarayanan and team, Department of Mechanical Engineering

Engine management system fitted on a two-wheeler vehicle

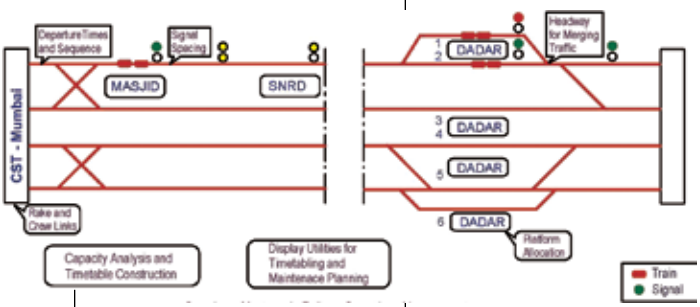
Software for Railway Operations Management

Inventors: N. Rangaraj and team, Industrial Engineering and Operations Research, Departments of Computer Science and Engineering and Chemical Engineering

Line Capacity Simulator software for the Indian Railways Institute of Signal Engineering and Telecommunications - represents the operational features of trains in selected track areas.

Features:

- estimates the capacities of long-distance track segments within the railway network under complex traffic conditions
- analyses the effect of adding scheduled trains in a track section
- combines priority-based scheduling of trains with the operating constraints of track section and platform availability
- allows realistic analyses by reproducing the operational logic of railway movement and its related engineering details
- records train speeds that are dependent on track signal conditions, which in turn may depend on the status of several trains ahead of the signal
- displays train movements on a distance versus time graph and provide details on individual trains



Overview of features in railway operations management

Rake Management System (RMS) is another set of utilities and tools designed for analysis and decision-making on the overall use of rakes as it relates to their deployment, operation and maintenance cycles for suburban train services.

Steer by Wire Technology

A next generation automobile steering technology characterised by the absence of mechanical linkages between the hand wheel (or any other user interface) and the road wheels.

Motion is communicated to the steered-wheels through electronically-controlled actuators. The driver may be provided with an arbitrary steering feel through a force feedback interface.

Benefits:

For the driver:

- Passive Safety: In the absence of a steering column, the driver is less susceptible to grievous injury in the event of a front-end collision
- Better drivability: The steering "feel" can be arbitrarily tuned, hence guaranteeing concerns of high assist, good returnability and good on-centre handling performance of the steering system
- Better vehicle handling: SBW allows for independent steering of wheels which can be exploited to provide handling benefits such as roll stiffening on curves and better maneuverability in hazardous situations

For the steering system manufacturer:

- Ease of manufacture: No separate manufacturing lines are required for left/right hand drives
- Better steering product features: Provides added benefits that can feed into vehicle design

For the vehicle manufacturer:

- Space saving: The absence of mechanical interconnections provides more freedom to address under-the-hood packaging concerns
- Possible weight/fuel saving: due to lighter weights than conventional systems

A Mahindra Scorpio has been designed, built and retrofitted with a steer-by-wire system and is the first SBW vehicle to be built in India.

Inventors:
S. Suryanarayanan and team, Department of Mechanical Engineering

Tie rod actuator

Status: Licensed to Sona Koyo Steering Systems Ltd

Novel Hybrid Electric Vehicle Transmission

Inventors: B. Seth and Deepak Chachra, Department of Mechanical Engineering

Patent granted (US patent application number: 11/576,689, grant number: 7753816)

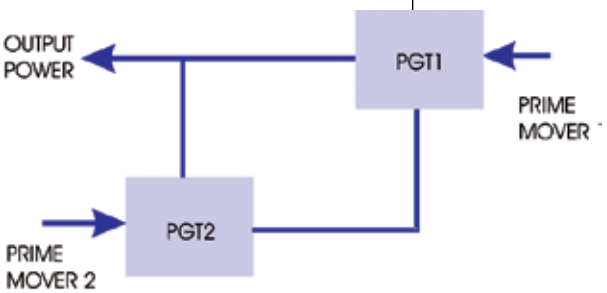
A compact Planetary Gear Train (PGT) which combines the power of electric and internal combustion (IC) engines.

Features:

- compound PGT with two interconnected PGTs
- compact gearbox
- recirculating power never increases to disastrous levels

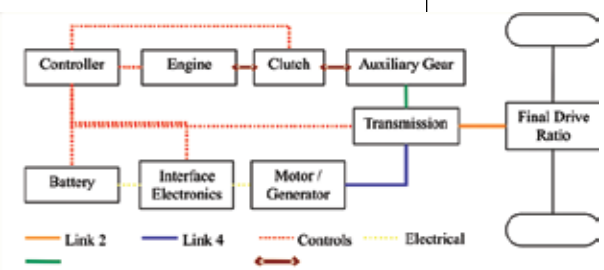
Advantages:

- simple control architecture
- operates in real-time
- decisions are based on measurable items such as battery state of charge, vehicle speed and throttle movement
- may be adapted to two-motor architecture fuel-cell vehicles



Schematic of Compound Gear HEV Transmission

The engine is connected to the transmission via an auxiliary gear set that has scalability for use in various types of engines (gasoline, diesel, etc.) and for various categories of vehicles (hatchbacks, SUVs etc.). Additionally, the auxiliary gear set ensures characteristics that are extremely important for current and future lean-burn SI Engines and common rail diesel engines.



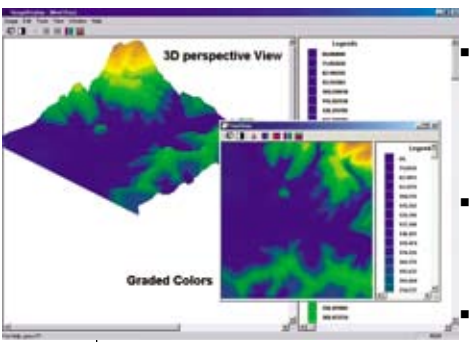
Block diagram of the overall system

Rural Development

GRAM++: A Geographic Information System

Inventors: P. Venkatachalam and team, Centre of Studies in Resources Engineering

Copyright registration granted: Gram++ SW-2629/2006 and SW-983/2002



3D display (Perspective View) of a hilly terrain using GRAM++

GRAM++ is a geographic information system (GIS) software.

Features:

- rich functionality
- supports spatial database preparation by importing data in popular GIS formats
- supports specific editing and onscreen digitisation of scanned documents
- provides analyses using tools such as vector analysis, TIN, network analysis enabling map displays, queries, statistical chart generation, distance calculations, thematic map generation, terrain modelling and contour generation, and shortest path and spatial allocation problems
- rich raster analysis which includes map algebra along with map overlay, buffering and regrouping that is useful during watershed analysis
- profile plotting and visualisation of slopes, aspects and relief based on building of digital elevation models from contours or spot heights from zonal/ focal/local analysis terrain modelling
- Image processing including image enhancement and filtering, principal component transformation, band arithmetic, a neural networking for analysis of remotely sensed images
- basic statistics utility that can derive several common statistical parameters- mean, median, mode, skewness and curtosis
- powerful map composition tools for composing cartographic quality maps of both raster and vector types
- software is designed to work on commonly available computer systems, making it accessible to a large number of users
- over 1000 licenses sold across the country

Status: Exclusively licensed to Bhugol GIS Pvt. Ltd., a company incubated at IIT Bombay

Extraction process for Herbal Oil

A low-cost extraction process for the production of herbal oil from leaf extracts of Nirgundi ***(Vitex negundo)***

Features:

- herbal oil prepared under vacuum in a water-jacketed extractor, fuelled by liquefied petroleum gas
- this reduces extraction time to about 8 hours, as compared to about 120 hours using conventional methods

Uses:

- relief from joint and muscle pain, inflammation

Inventors: N. G. Shah and team, Centre for Technology Alternatives for Rural Areas (CTARA) and Department of Chemical Engineering

Extraction unit for production of herbal oil

Status: A commercial-scale extractor has been designed, fabricated and commissioned at the Yusuf Meherally Centre, Tara village, Raigad district, Maharashtra.

aAQUA: Online Farmer Knowledge Exchange

Inventors: Krithi Ramamritham and team, Department of Computer Science and Engineering

aAQUA, (almost All QUestions Answered), is an online question answering website providing farm and veterinary advisory services to farmers over phone or internet.

Web interface of aAqua website

Sample image posted by farmers on aAQUA Q&A

Goals of aAQUA:

- to provide fast access to reliable agri information (both through artificial agents and human experts from all over the world)
- to support voice over phones, video over tablets and any affordable devices that can diffuse to the largest number of farmers
- to provide a searchable agri knowledge database
- to support all Indian languages
- to accommodate new users

Features:

A panel of experts assess the problem through a set of images or text posted by the affected farmer, work out feasible solutions and send back recommended solutions through the online forum. Phone help-lines augment the online service.

- SMS tips and alerts pertaining to crop diseases, tips on pest management, expanding dairy or poultry units, new forms of livelihood, livestock related tips and some general news on farmer-oriented schemes among other things.
- Voice aAQUA was initiated to reach farmers on their phones via voice calls. Short one minute voice clips with information tips on crop management are played out to the farmer on his cell phone or fixed line phone (land lines).

aAQUA has been operational since Dec 2003 and has seen over 37000 postings in about 14000 questions. It has about 20,000 registered members from across 450 districts in India.

Status: Exclusively licensed to Agrocom Software Technologies Pvt. Ltd. a company incubated at IIT Bombay

Bio-Char Unit for Low Cost Production of Charcoal

A simple to operate, non-polluting Bio-char Unit (BCU) to obtain charcoal from bamboo waste and other non-powdery biomass.

Features:

- biomass is partially combusted such that the heat evolved during combustion of the top layer is just enough to pyrolyse the layers of biomass below
- volatiles upon pyrolysis are all collected from one outlet instead of letting them diffuse into the atmosphere and pollute
- easy to operate; one person can operate the unit
- uniform quality and yield of charcoal (25%)
- eco-friendly

Applications:

- use of thermal energy from the burning of gases by retrofitting
- production of charcoal by households for supply to manufacturing industries

BCU is unique in using otherwise polluting gases as its thermal energy source. The devise is aimed at ensuring village energy security.

Inventors: A. Ganesh and team, Department of Energy Science and Engineering

Bio-char unit

Status: Several units have been deployed at various rural locations through the National Mission on Bamboo Applications, TIFAC, Govt. of India

Biofuel Processor for Engines

Inventors: A. Ganesh and team, Department of Energy Sciences and Engineering

A processor for compression-ignition engines to use straight vegetable oil (Karanj, Mahua, etc.) as fuel.

Features:

- viscosity of oil reduces upon heating thereby improving atomisation and reducing pumping power
- fuel processor heats the oil and also maintains the appropriate temperature at all loads
- engine performs at an optimum level even when load variations are very high

Advantages:

- sustainable technology
- does not depend on petroleum-based products
- does not require conversion to biodiesel
- emissions from the engine conform to the diesel engine emission standards

The fuel processor with engine set at Kohla village, Orissa for rural electrification

Applications:

- rural electrification of remote villages (where oil bearing seeds are available) as a business model
- providing electricity for water pumping, irrigation and local small scale industries like rice mills and flour mills
- powering the telecom towers at remote areas and improving the communication system
- standby power generation where waste vegetable oil is available such as hotels and hostels.

Status: Technology has been retrofitted to Cummins engines of the range of 15kVa

Technologies for Rural Industrialisation

Technologies particularly in the areas of agro-product and food processing, rural engineering and related to organic and natural products.

Major activities:

- development of simple pedal powered devices that can operate water pumps, battery charging units, potter's wheels, paddy threshers and flour/masala grinding units
- a process for making and storing chemical-free cane jaggery
- a simple, easy to operate and cost effective solar air heater unit for maintaining honey storage
- development of a potato puffing unit that employs a fluidised bed technique for oil-free ready to eat snacks

Inventors: N. G. Shah and team, Centre for Technology Alternatives for Rural Areas (CTARA)

Pedal-based power unit

Potato puffing unit

Riding Type Power Tiller

Inventors: N. Shah and team from Centre for Technology Alternatives for Rural Areas (CTARA)

A 10 HP riding type power tiller, well-suited for use by small land holders.

Features:

- a low-cost traction and haulage vehicle with easy, comfortable steering and a small turning radius
- two chain and sprocket drives, for agriculture and transportation purposes
- light-weight diesel engine
- easy maintenance and repair

Riding-type power tiller in operation

Applications

- ploughing and harrowing operations
- intercultural operations in field
- running irrigation pump, thresher, and other machinery
- transportation of goods of up to 1 ton

Other Technologies

Core Holder for Oil Well Performance Evaluation

Inventors: S. K. Mitra, M. Vinjamur, R. Singh, C. R. Maurya, Departments of Mechanical Engineering and Chemical Engineering and Oil and Natural Gas Corporation Ltd. (ONGC)

Patent granted (Application number: 1463/MUM/2005, grant number: 225118)

A novel three-dimensional core holder, used in determining oil recovery strategies, which allows placement of horizontal and vertical well configurations within the core.

Features of the holder:

- enables saturation of the core sample
- allows for multi-point pressure measurement
- permits fluid flow in a core under different well-configurations; thus enabling multiple performance evaluations and measurement of pressures at various locations on all faces of the core
- can be used for loose material (e.g., sand) and packed material (e.g., rock)
- injector and producer wells can be put at different locations in the core to enable oil recovery assessment using different well lengths
- can be positioned at any angle relative to the vertical axis to allow studies to be conducted on dip effects and multi-lateral wells

Core holder

Status: Licensed to Oil and Natural Gas Corporation Ltd. (ONGC)

Tools for Computational Fluid Dynamics

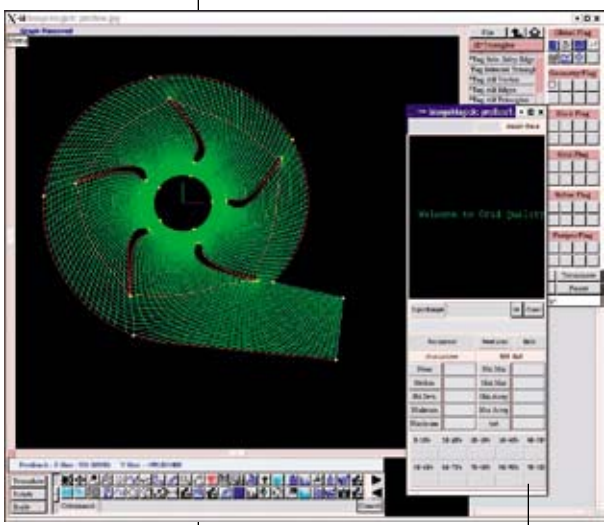
Software products for Computational Fluid Dynamics: CFDTutor and CFDExpert.

The software can be used for simulating flows of compressible and incompressible fluids.

CFDTutor can be used to train novice users in understanding Computational Fluid Dynamics (CFD) process.

CFDExpert can be used as a full-fledged three-dimensional CFD software capable of meshing, simulation and visualisation of real life problems.

Inventors: G. R. Shevare and team, Department of Aerospace Engineering



Meshes created in CFDExpert for simulating flow in radial compressor

Status: Exclusively licensed to Zeus Numerix Pvt Ltd., a company incubated at IIT Bombay

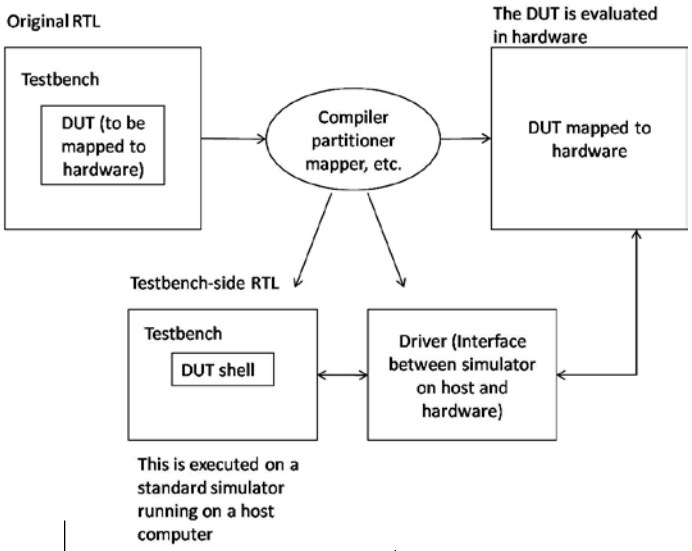
FPGA-Based RTL Simulation Acceleration

Inventors: M. P. Desai and team, Department of Electrical Engineering

An FPGA based RTL simulation accelerator speeds up certain kinds of logic simulation by mapping parts of the system being simulated onto programmable hardware.

Given an RTL description of a system (in Verilog, VHDL or a mixture of the two), this technology has the following components:

- analysis of the RTL description to build a netlist of process statements
- based on user-input, identification of the portion of the instance hierarchy to be mapped to hardware (called the device under test, or the DUT)
- partitioning of the netlist to be mapped to hardware across several boards, and within a board, across several FPGA's
- mapping of the DUT to the FPGA boards by taking care of timing constraints and by scheduling the evaluation of the netlist using the available routing resources
- provision of a seamless interface between the testbench simulator running on the host and the netlist simulation running on the FPGA hardware



FPGA based simulation accelerator

Typical acceleration ranges from 10X - 1000X depending on the level of detail in the original RTL.

Status: Licensed to Powai Labs which currently sells a simulation accelerator (IMAGE 2.5) using this technology

Cantilever-based e-nose for Explosive Detection

A detection device that uses an extremely sensitive and low-cost piezo-resistive polymer cantilever structure.

Features:

- RDX and TNT explosive detection at a parts-per-billion level of sensitivity
- vapour phase detection of explosive molecules
- designed with an integrated wireless transmission capability
- low cost of production

Method:

- selective chemical reaction on the surface of the cantilever on exposure to the explosive material
- creates surface stress resulting in the deflection of the cantilever
- cantilever surface can be regenerated after detection for use in obtaining subsequent measurements

Inventors: V. R. Rao, S. Mukherji and team, Departments of Electrical Engineering, Biosciences and Bioengineering and Chemistry

A hand held explosive for Nitro based explosive compounds. The system is currently under field trials.

Status: Exclusively licensed to Nanosniff Technologies Pvt. Ltd., a company incubated at IIT Bombay

Remotely Operated Vehicle for Handling IEDs

Inventors: C. Amarnath and team, Department of Mechanical Engineering, Sponsors: Army Technology Board (ATB), CME Pune, and Engineering by CIM Technologies, Hyderabad

The remotely operated vehicle RoVer carries a manipulator arm and is meant to handle and dispose off Improvised Explosive Devices (IEDs).

Features:

- can raise objects weighing up to 20 kilograms at a distance of about three meters ahead of the vehicle and raise them to a height of three meters
- can inspect below culverts
- capable of negotiating all terrains including built-up areas with stairs and obstacles
- has a maximum speed of 2 kmph per hour
- three hour operation for single recharge
- controlled remotely with the assistance of four on-board cameras
- can be easily operated and maintained

RoVer

Novel Method for Creating a Fluid Separation Material

A novel method for making fluid separation material using a membrane with a nanopore structure.

The material consists of a conducting porous polymer film that has a porosity of 0.01 to 50% in nanopore sizes of 0.05 to 17 nanometres, showing wide permeability and selectivity ranges.

Two methods have been developed:

Method I:

- chemical synthesis of a free standing conducting polymer membrane of 50µm to 10mm thickness
- nano-engineering of the pore structure to obtain the said porosity and size

Method II:

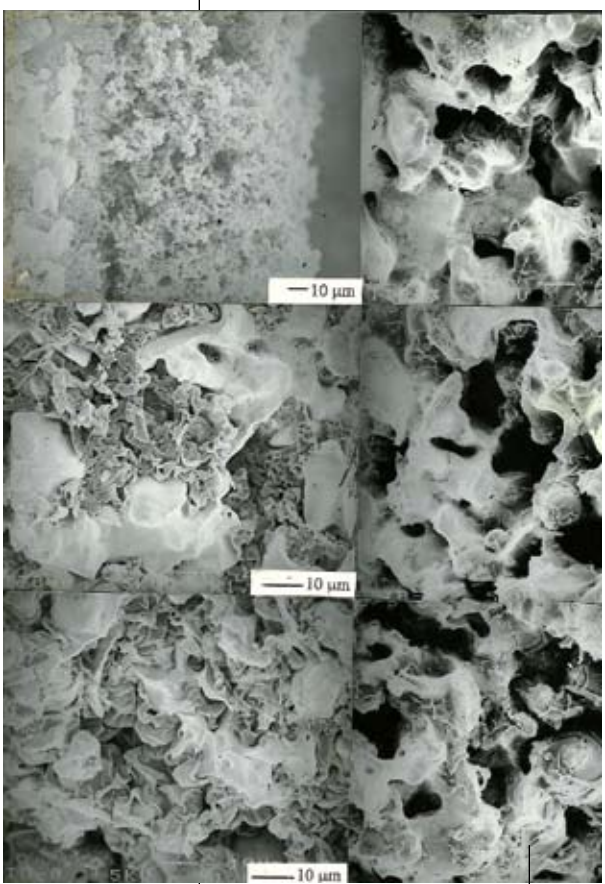
- casting a conducting polymer membrane of 0.01 to 100 micron thickness on a porous substrate of 10 to 70% porosity with an appropriate polymer solution
- nano-engineering of the pore structure

Advantages:

- simple, easy to carry out
- can be used for the separation of both liquids and gases

Inventors: J. Bellare, A. Q. Contractor and S. N. Dutta, Departments of Chemical Engineering and Chemistry

Patent granted (Application number: 12/MUM/2001, grant number: 197754



Structure of a membrane made by the patented process

An Efficient Method for Cleaning Clothes

Inventors: M. Sharon, Department of Chemistry

Patent Granted
Patent application no. 24/MUM/2001 (Patent grant no. 206020)

An environment and user-friendly, efficient method for cleaning cotton and synthetic clothes.

Features:

- eliminates the use of polluting and allergic non-soap detergents and bleaching compounds
- effective in the removal of so-called fast stains

Method:

- treatment with a mixture of soap and ceramic oxide of nano-sized particles
- irradiation of the clothes with a UV light

Ceramic oxides are biocompatible and include titanium dioxide (TiO_2) zinc oxide (ZnO), iron oxide (Fe_2O_3) and tungsten oxide (WO_3).

Process:

- nano-sized particles of ceramic oxides form electrically charged particles at the interface between the stained cloth and the detergent solution
- upon irradiating the stained cloth with UV light, photo-generated electrons and holes are formed at the interface, which convert the stains into gases (CO_2) and water soluble mineral acid salts (hydrochloric acid salts) which may be easily rinsed out. The gases escape into the atmosphere and need no separation.
- UV light may be from sunlight or from a UV light source; the duration of irradiation depends on the nature of the light and the nature and surface area of the stain. Typically for a 15 Watt UV light, an irradiation period of 20–30 minutes is required. If the cleaning is carried out in a washing machine, the UV light source may be fitted into the washing machine and operated by a control panel.

Benefit:

- environment and user-friendly

Vibration Protective Pendulum Isolators

Pendulum isolators which help in reducing severe vibrations due to earthquakes, heavy wind or machinery in buildings, bridges, industrial structures and other subsystems.

Constant, long-period, vibration-protective pendulum isolator:

- for structures having constant fundamental periods of 0.3 -10 s
- dissipates energy through friction and transmits a reduced energy level into the structure
- can also be used as a constant, long-period, tuned mass damper

Variable period, vibration-protective pendulum isolator:

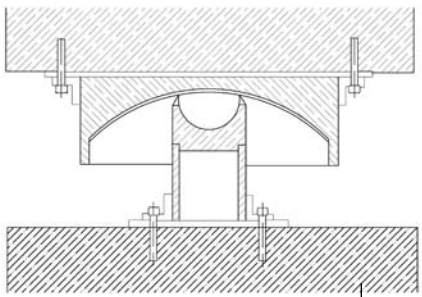
- for structures having fundamental time periods from 0.2 - 6.0 s
- dissipates energy through friction at the sliding surface and transmits reduced energy into the structure
- provides periods that vary in a pre-determined way as the sliding takes place
- limits the restoring force so that the force transmitted to the structure is restricted, irrespective of the magnitude of the isolator's sliding displacement or the magnitude of the earthquake

Applications:

- reduction of vibrations in life-safety structures such as hospitals and communication facilities and in bridges, pipelines and museums

Inventors: R. Sinha and M. Pranesh, Department of Civil Engineering

Patents granted (Application number: 15/MUM/2001, grant number: 197756; Application number: 867/MUM/2001, grant number: 197850)



Schematic of pendulum isolator

Uncooled Coloured Imaging System

Inventors: P. Apte, B. Seth, O. Karhade and S. Chiluveru, Departments of Electrical Engineering and Mechanical Engineering

Patent granted (Application number: 541/MUM/2005, grant number: 236126)

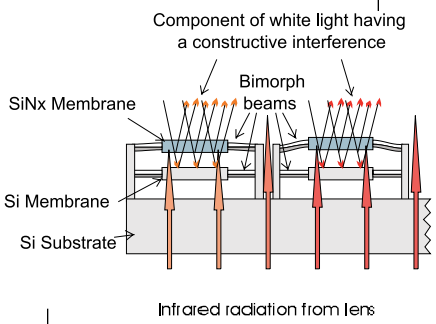
An opto-thermo-mechanical integrated, uncooled imaging system that captures thermal images and allows for their direct coloured display.

Features:

- IR sensing and coloured image display capabilities
- room temperature operation sensing
- has inherent room temperature compensation

Benefits:

- simple and robust
- has a minimal number of parts
- no processing devices, intervening electronics or electrical connections required
- no thermal cross-talk between neighbouring pixels
- no internal heat is generated due to the absence of electrical currents
- no cryogenic cooling equipment is required
- no further image processing of the captured IR image needed



Working of coloured infrared imaging system

Applications:

- night vision
- environmental monitoring
- astronomy
- biomedical diagnostics
- thermal probing of microelectronic devices

3D Microprinter

Microsteriolithography (MSL) - a technology to achieve 3D microdevices by using layer-by-layer photopolymerisation of liquid resin.

Method:

- 3D CAD model of the microcomponent is sliced into a number of 2D layers
- each of the 2D layers is cured by scanning focused laser light on the free surface of the resin
- the cured layer is dipped into the tank to allow the resin to flow over to enable curing and stacking of the next layer

Performance features:

- uniform spot characteristics (spot size and intensity profile) over entire range of scan (spot size 6 µm)
- resolution of spot positioning (50 nm)
- speed of scanning (maximum speed 10 mm/s)
- range of scanning (8 x 8mm)

Components:

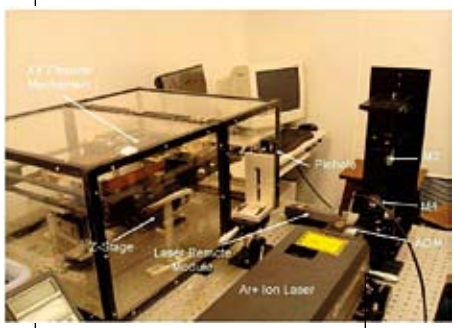
- laser scanning system
- resin system
- optical shutter (Acousto-Optical Modulator)
- optical system
- mechanical XY scanning stage
- layer preparation system i.e., Z-stage
- computer and interfacing electronics

Applications:

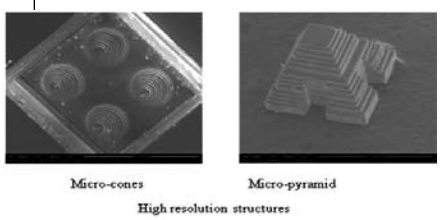
- accelerometers
- pressure sensors
- micromirrors
- microcantilevers
- microfluidic devices
- biosensors
- biomimetic microstructures

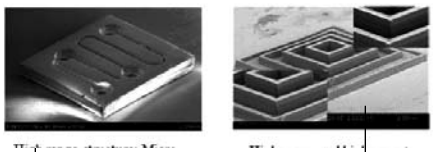
Inventors: P. S. Gandhi and T. Kundu, Departments of Mechanical Engineering and Physics

Patent filed (Application number: 1847/MUM/2007)



Photographic view of scanning MSL system





SEM images of the high resolution, high range and aspect ratio microstructures developed using scanning MSL system

Track It

Inventors: B. Seth, A. C.Acharya, R. Raj and K. Moharir, Department of Mechanical Engineering

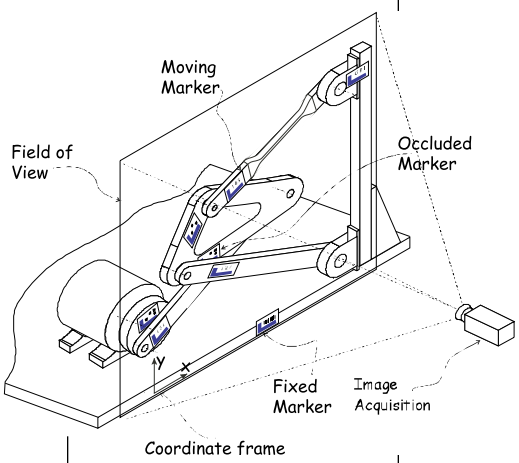
Patent granted (Application number: 1278/MUM/2003, grant number: 206126)

A method that uses markers to track planar movement of multiple objects from a sequence of digital images.

Tracking of objects from a sequence of images requires automatic identification of the objects of interest as well as accurate location and orientation information on the tracked objects in each image frame. The approach used to meet these requirements includes item recognition based on the radiation characteristics and reflective properties of the object or of a tag or marker that is attached to the object. Use of such markers, when permissible, assists in tracking by facilitating the automatic recognition of the objects.

Features:

- markers are fixed to the parts of interest and the method accurately tracks the motion of the selected parts
- during motion, even though the markers may get occluded, tracking of their position and orientation information can resume when the marker returns to the camera's view



Schematic from patent document

Advantages:

- robust marker detection
- no increase in analysis complexity when more markers are used
- a single marker yields both position and orientation information
- identification problem of a marker is eliminated by the use of a unique tag
- re-tracking of an occluded marker starts immediately after the marker returns to the camera's view again

Application:

- videographic study of motion in machines

New Composite Layer to Help Make ICs Faster

A novel method of depositing an amorphous SiC:H barrier layer on a low dielectric material layer which speeds up the process of manufacturing Integrated Circuits (IC).

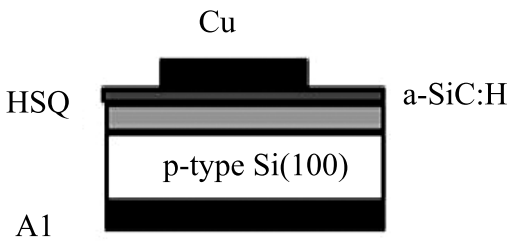
The barrier layer is deposited by exposing the low dielectric material layer to hot wire chemical vapour deposition (HWCVD) using a mixture of silane and acetylene gases at temperatures of 200 to 300°C and at pressures of 100–200 mTorr.

Features:

- simple, easy to carry out
- cost effective
- layer has a reduced thickness compared to those created by traditional methods, contributing to lower manufacturing costs
- eliminates the use of radio frequency generators and impedance matching circuits
- process does not damage the dielectric layer
- composite barrier material and low dielectric constant material layer is able to reduce current leakage
- lesser time required to charge capacitor and an improved frequency/speed of operation

Inventors: R. O. Dusane, A.A. Kumbhar and S.K. Singh, Department of Metallurgical Engineering and Materials Science

Patent granted (Application number: 4/MUM/2006, grant number: 223221)



HWCVD barrier layer deposited over low k film to avoid Cu diffusion

Low Cost Deposition Method for Faster ICs

Inventors: R. O. Dusane, A. A. Kumbhar and S. K. Singh, Department of Metallurgical Engineering and Materials Science

Patent granted (Application number: 5/MUM/2006, grant number: 232216)

Hot wire processing chamber for treating low k films

A simple, cost effective and easy to perform method to make the low-K dielectric material layer coated on a silicon substrate robust against the degradation during ashing process and moisture uptake.

The speed with which integrated circuits (ICs) work depend on the RC time constant (i.e., the time taken to process information). It is essential to use a material that has a low dielectric constant so that the RC time constant is also low. Hydrogen silsesquioxane (HSQ), with a dielectric constant of approximately 2.95, has been developed as a material to be deposited during the IC fabrication. However, HSQ is a porous material and is thus susceptible to the presence of moisture.

Features:

- does not damage the dielectric layer
- renders the dielectric layer very effective against the adverse effects of oxygen plasma treatment
- improves the hydrophobicity by reducing moisture adsorption
- current leakage is lowered, improving performance of the treated IC
- enhances the deposition of the low dielectric material layer on the silicon substrate
- helps retain the low dielectric properties of the deposited layer

Improved Process to Make Fluoride Glass

Fluoride glasses are known for Infra Red (IR) transmitting applications and have improved chemical durability as against oxide glasses, also used for transmitting applications.

Features:

- modified composition consisting of Yttrium fluoride, Cadmium fluoride, Aluminium fluoride and Lead fluoride used
- Teflon powder added to remove moisture content there by preventing loss of metal fluorides
- produced glass shows improved stability against crystallisation
- process confers enhanced chemical durability upon produced glass, corrodes only at the surface which is removable by polishing
- higher percent IR transmission observed in the glass
- tackles the problem of formation of crystallites
- higher mechanical strength
- lower thermal expansion coefficient, thus making it suitable for application in extreme thermal conditions
- nearly 80 % transmission with extended IR cutoff upto 9.5µm
- process is energy efficient, requires heating at temperatures of 1150 to 1170 °C for 2-5 minutes and 1200°C for 1-2 minutes as compared to the existing process of 1200°C for 2 hours
- better quality of fluoride glasses

Inventors: Ajit R. Kulkarni and team, Department of Metallurgical Engineering and Materials Science

Patent granted (Application number: 1035/DEL/96, grant number: 193981)

Operating system including mould bars, furnace and hot press

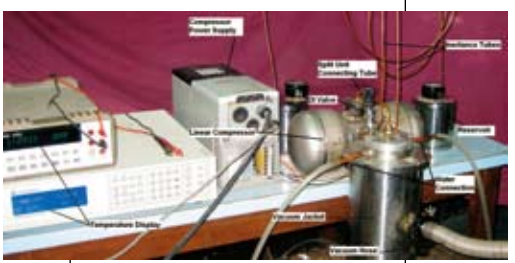
Specimens of fluoride glasses'

Pulse Tube Cryocoolers

Inventors: M.D. Atrey and team, Department of Mechanical Engineering

In-line, U-type and Co-axial configurations

Experimental set up for single stage cryocoolers



Experimental set up for two stage cryocoolers

A vibration and maintenance free Pulse Tube Cryocooler (PTC) has been developed, which can attain and maintain temperatures below 80 Kelvin. It is available in various configurations such as In-line, U-type and Co-axial.

Features:

- minimum temperature of 55 K can be attained in 30 - 40 minutes using helium as working fluid at 16 bar charge pressure
- cooling effect of 5 - 8 W can be obtained at 80 K with a power input of 350 W
- chilled water is not required
- can be customised for the end user

Applications:

- basic research in low temperature Physics, superconductivity, High TC experiments
- military - infrared thermal imaging equipment for night vision and heat seeking missile guidance
- space vehicles - to cool sensors

In addition to single stage cryocoolers, two stage cryocoolers of different configurations have also been developed to achieve minimum temperature 20 K. They have applications in the cooling of electronic devices, infrared sensors and superconductivity.

Mixed Refrigerant Cryocoolers

Mixed Refrigerant Joule–Thomson (J-T) cryocoolers use mixed refrigerants (5-8 components) instead of pure substances such as nitrogen and argon as working fluids in order to improve performance.

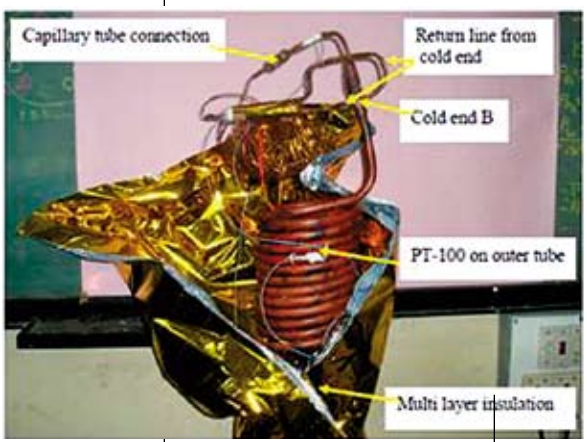
Inventors: M.D. Atrey and team, Department of Mechanical Engineering

Features:

- driven by an oil-lubricated commercial compressor with moderate delivery pressure (20-25 bar)
- low-cost, efficient and highly reliable for a wide range of flammable and non flammable mixed refrigerants to produce cryogenic temperatures in the range of 70 - 200 K
- required cool down time to achieve 100 K is about 60 minutes
- a temperature of 65 K can be achieved using specific Ne-Nitrogen-hydrocarbon mixture
- cooling capacity of 5 W at 80 K with a compressor power input of 868 W can be obtained for the specific mixture
- vibrations at the cold end can be minimised significantly because the cold end does not contain any moving parts
- can be customised based on the required temperature to be obtained by selecting the optimised mixture

Applications

- preservation of stem cells, in cryo banks
- gas chiller or liquefaction
- water vapour cryo-trapping



Heat exchanger

Experimental Setup

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