

## ONGOING PROJECTS WITH INDUSTRY FUNDING

| Project Title   | Source                 |
|---|------------------------|
| DESIGN, DEVELOPMENT & TESTING OF AEROFOIL HOUSING   | HAL <sup>(1)</sup>     |
| DEVELOPMENT OF COMPUTATIONAL AEROELASTICITY CODE FOR HELICOPTER ROTOR LOADS AND DYNAMIC RESPONSE ANALYSIS | "--                    |
| AERODYNAMIC STUDY OF EAGLE ESM MK II  | "--                    |
| ATLAB BASED MODELING, SIMULATION AND VALIDATION OF LCH MAIN AND TAIL ROTOR ACTUATORS                      | "--                    |
| FEASIBILITY STUDY AND SIMULATION OF ELECTRIC BREAK FOR TEJAS AIRCRAFT                                     | "--                    |
| STATIC TEST ON PMM PROTOTYPE  | "--                    |
| HAL IITK AIRCRAFT SYSTEM TECHNOLOGY CELL  | "--                    |
| DESIGN AND SIMULATION OF A 250VA.400HZ, SINGLE PHASE SOFT SWITCHING INVERTER FOR AIRBORNE APPLICATION     | "--                    |
| THERMAL & TURN AROUND ANALYSIS OF MAIN WHEEL & CARBON BRAK/ RELEASE OF ADVANCED PAYMENT                   | "--                    |
| TOPOGRAPHIC SURVEY WORK AT NTPC UNCHAHAR  | NTPC <sup>(2)</sup>    |
| CFD EVALUATION OF AERODYNAMICS AND INTERNAL COOLING PERFORMANCE OF A GAS TURBINE BLADE                    | "--                    |
| DESIGN CONSULTANCY FOR ASHDYKE AT BONGAIGAON TPP, ASSAM   | "--                    |
| WIND TUNNEL STUDY OF 70M HIGH CHIMNEY   | Thermax <sup>(3)</sup> |
| EXAMINATION OF PROPOSED FACILITIES  | BHEL <sup>(4)</sup>    |
| WIND TUNNEL STUDY OF CHIMNEY OF NORTH CHENNAI PROJECT   | "--                    |
| COMPUTATION OF HARMONICS IN THE TRANSFORMER CURRENT UNDER NO-LOAD CONDITION                               | "--                    |
| WIND SOLAR HYBRID POWER PLANT   | GE <sup>(5)</sup>      |
| SEISMIC ANALYSIS OF CAIRN BSPL PIPELINE PROJECT   | L&T <sup>(6)</sup>     |
| CREATING OF MICRO NANO PARTICLES  | HUL <sup>(7)</sup>     |
| PROTYPE DEVELOPMENT UNIT AT SAMTEL CENTRE FOR DISPLAY TECHNOLOGY KANPUR                                   | Samtel <sup>(8)</sup>  |

|  |                               |
|--|-------------------------------|
| TO DEVELOP A STRAIN PATH INDEPENDENT FORMING LIMIT DIAGRAM   | Tata Steel <sup>(9)</sup>     |
| BOF PROCESS AUTOMATION AT VSP  | VSP <sup>(10)</sup>           |
| LANCE DESIGN FOR OPTIMAL PERFORMANCE OF BOF-VSP IN TERMS OF SLAG-METAL REACTION, HEAT TRANSFER TO LANCE & LANCE SKULLING | "--                           |
| YIELD IMPROVEMENT FROM 4 STRANDBLOOM CASTER TUNDISH  | "--                           |
| COMBICASTER YEILD IMPROVEMENT  | JSPL <sup>(11)</sup>          |
| DEVELOPMENT OF WEB BASED MICROBIAL DATABASE (BACTERIA, ACTINOMYCETES AND FUNGI) OF NORTH-EAST INDIA                      | NEHU <sup>(12)</sup>          |
| DEVELOPMENT OF AN ECM MACHINE  | EMTL <sup>(13)</sup>          |
| REDUCTION IN TAP TO TAP TIME   | Mukund <sup>(14)</sup>        |
| ENGINE TESTS ON BIODIESEL  | Shell <sup>(15)</sup>         |
| CHARGE CALCULATION MODEL FOR LARGER THROUGH PUT EOF OPERATION AT HOSPET STEEL WORKS                                      | Hospet steels <sup>(16)</sup> |
| VALIDATION OF POWER EXCHANGE ALGORITHM   | PXIL <sup>(17)</sup>          |
| FIELD TRAL OF BIODIESEL FUELLED SCORPIO CRDE VEHICLE   | Mahindra <sup>(18)</sup>      |
| SUZLON AIRFOIL TEST  | Suzlon <sup>(19)</sup>        |
| MODELLING INTER SPEAKER VARIABILITY IN AUTOMATIC SPEECH RECOGNITION  | BSNL <sup>(20)</sup>          |
| SPEECH ENABLED VALUE ADDED SERVICES  | "--                           |
| PROTECTION DEVICES FOR RURAL AND URBAN EXCHANGES   | "--                           |
| IMPLEMENTATION OF IPVG AND MULTICAST IN BSNL NIB NETWORK   | "--                           |
| SPEECH- ENABLED TRAIN-NAME RECOGNITION SYSTEM  | "--                           |
| SERVICE BASED MULTIMEDIA CONTENT SUMMARIZATION AND DELIVERY IN INDIA CONTEXT   | "--                           |
| CELLULAR NETWORK OPTIMIZATION : PHASE-I  | "--                           |
| FEASIBILITY STUDY OF AUTOMATIC SELECTION OF IMSI IN INTER NATIONAL ROAMING   | "--                           |
| MODELLING INTER SPEAKER VARIABILITY IN AUTOMATIC SP. RECOGNITION   | "--                           |
| IMPLEMENTATION OF IPVG AND MULTICAST IN BSNL NIB NETWORK   | "--                           |

|   |                             |
|---|-----------------------------|
| SOME RESEARCH ISSUES IN COGNITIVE RADIO   | --                          |
| RLO PLATFORM  | ICRISAT <sup>(21)</sup>     |
| STUDIES ON CATALYST COMPOSITION   | Chevron <sup>(22)</sup>     |
| IN SITU SULFIDING OF NIMO/A12O3 HYDROTREATING CATALYSTS   | --                          |
| SUPPORTED IONIC LIQUID CATALYSIS AND HYDRODYNAMICS IN PACKED BED                                  | --                          |
| HIGEE   | --                          |
| GENERATION AND IMPROVEMENT OF FUNCTIONAL TESTS FOR SEQUENTIAL CIRCUITS                            | Intel <sup>(23)</sup>       |
| TO DEVELOP ORGANIC AND POLYMER SOLAR CELLS AND LIGHT EMITTING DIODES ON CORUS STEEL SUBSTRATE     | Corus Steel <sup>(24)</sup> |
| LARGE FORMAT PARTICLE IMAGING VELOCIMETRY SYSTEM  | Boeing <sup>(25)</sup>      |
| HIGH LIFT AERODYNAMICS PROJECT  | --                          |
| DESIGN AND DEVELOPMENT OF AN AUTONOMOUS VEHICLE   | --                          |
| PASSIVE AND ACTIVE RFID AND LOCATION TECHNOLOGY RESEARCH  | --                          |
| TELEOPHALMOLOGY: MOBILE EYE CARE DELIVERY   | Microsoft <sup>(26)</sup>   |
| UNDERSTANDING ADHENSION & CONTACT MECHANICS OF MICRO PARTICLES WITH SUBSTRATES                    | P&G <sup>(27)</sup>         |
| VETTING OF STRUCTURAL AND HYDRAULIC DESIGN OF PROPOSED 200 MLD WATER TREATMENT PLANT BARRAGE SITE | --                          |
| QUALCOMM-IITK RESEARCH PROJECT  | Qualcomm <sup>(28)</sup>    |
| UNSUPERVISED ACTIVITY CLASSIFICATION IN SURVEILLANCE SCENARIOS                                    | EADS <sup>(29)</sup>        |
| CONSULTATNCY FOR THE NON DESTRUCTIVE CORE CUTTING AND REBOUND HAMMER TEST                         | SIEMENS <sup>(30)</sup>     |
| DEVELOPMENT OF OUTER-ROTER SURFACE PERMANENT MAGNET MOTOR   | IHI Japan <sup>(31)</sup>   |
| HIGEE FOR GAS DEHYDRATION   | Aramco <sup>(32)</sup>      |

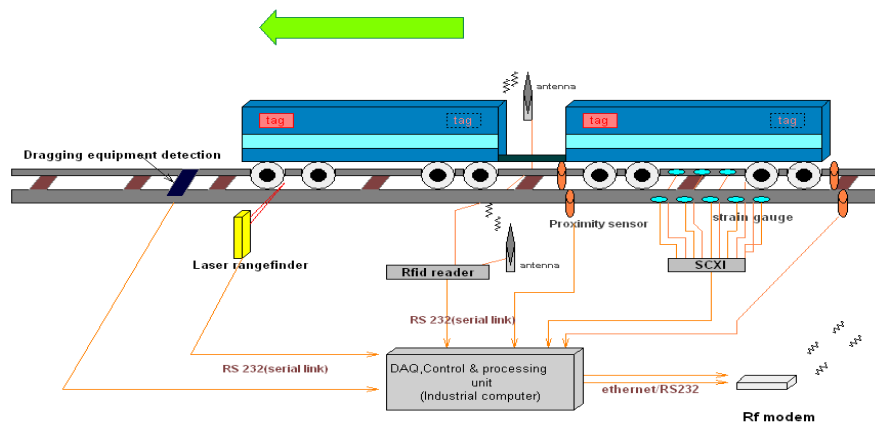
## *Notes on funding agencies*

1. *HAL*: Hindustan Aeronautics Limited (HAL) has played a significant role for India's space programs by participating in the manufacture of structures for Satellite Launch Vehicles.
2. *NTPC*: National Thermal Power Corporation Limited is the largest state-owned power generating company in India. NTPC's core business is engineering, construction and operation of power generating plants and providing consultancy to power utilities in India and abroad.
3. *Thermax*: Thermax Ltd. is an INR 3,246 crore (USD 800 million) company, providing a range of engineering solutions to the energy and environment sectors.
4. *BHEL*: Bharat Heavy Electricals Limited is the largest engineering and manufacturing enterprise in India in the energy-related/infrastructure sector. BHEL manufactures over 180 products under 30 major product groups and caters to core sectors of the Indian Economy viz., Power Generation & Transmission, Industry, Transportation, Renewable Energy.
5. *GE*: The General Electric Company is an American multinational conglomerate corporation. It is the world's second largest company, based on a formula that compared the total sales, profits, assets, and market value of several multinational companies.
6. *L&T*: Larson & Toubro's engineering and construction track record consists of implementation of turnkey projects in major core and infrastructure sectors of the Indian industry. It also works in the areas of Power generation, Refineries, Cement plants, Ships, Switchgears.
7. *HUL*: Hindustan Unilever Limited is India's largest fast moving consumer goods company, touching the lives of two out of three Indians with over 20 distinct categories in home & personal care products and food & beverages.
8. *SAMTEL*: Samtel Group is India's largest integrated manufacturer of a wide range of displays for television, avionics, industrial, medical and professional applications, TV glass, components for displays, machinery and engineering services.
9. *Tata Steel*: One of the world's pioneering steel companies, Tata Steel manufactures a wide range of steel products.
10. *VSP*: Visakhapatnam Steel Plant is a steel producing company and is India's Premier Steel Mills.
11. *JSPL*: Jindal Steel & Power Limited is a leading player in Steel, Power, Mining, Oil & Gas and Infrastructure. The company operates in sectors straddling across Asia, Africa, South America and Georgia.
12. *NEHU*: North-Eastern Hill University was set up to disseminate and advance knowledge by providing instructional and research facilities to the improvement of the social and economic conditions and welfare of the people of the hill areas of the North-eastern region.
13. *EMTL*: Electronica Machine Tools Ltd. Pune is an Indian Limited company, engaged in design & development and manufacture of CNC Wirecut EDM and Sinking EDM machines.
14. *Mukund*: Mukund Steels Mumbai is one of the leading steel companies in India.
15. *Shell*: Shell is a global group of energy and petrochemicals companies.
16. *Hospet Steels*: Hospet Steels is a World Class Steel plant set up by way of strategic alliance between M/s Mukand limited of Mumbai and M/s Kalyani Steels Limited of Pune.
17. *PXIL*: Power Exchange India Limited (PXIL) is India's first institutionally promoted Power exchange that provides innovative and credible solutions to transform the Indian Power Markets.

18. *Mahindra:* Mahindra & Mahindra Limited is part of the Indian Industrial Conglomerate Mahindra Group based in Mumbai. It is the leader in the utility vehicle segment in India with its flagship UV Scorpio.
19. *Suzlon:* Suzlon is now a leading wind power company based in India having operations across the Americas, Asia, Australia and Europe.
20. *BSNL:* Bharat Sanchar Nigam Limited is a state-owned telecommunication enterprise in India. BSNL is the third largest cellular service provider and the largest land line telephone provider in India.
21. *ICRISAT:* International Crops Research Institute for the Semi-Arid Tropics is a non profit and non political research organisation that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world.
22. *Chevron:* Chevron is an American multinational energy corporation. It is engaged in every aspect of the oil, gas, and geothermal energy industries, including exploration and production; refining, marketing and transport; chemicals manufacturing and sales; and power generation. Chevron is one of the world's six "supermajor" oil companies.
23. *Intel:* Intel Corporation is a technology company, and the world's largest semiconductor chip maker, based on revenue. It is the inventor of the x86 series of microprocessors, the processors found in most of the personal computers.
24. *Corus Steel:* Corus is a subsidiary of Tata Steel and is Europe's second largest steel producer.
25. *Boeing:* The Boeing Company, St. Louis is the world's leading aerospace company and the largest manufacturer of commercial jetliners and military aircraft combined. Additionally, Boeing designs and manufactures rotorcraft, electronic and defense systems, missiles, satellites, launch vehicles and advanced information and communication systems.
26. *Microsoft:* Microsoft Corporation develops, manufactures, licenses, and supports a wide range of products and services predominantly related to computing through its various product divisions.
27. *P&G:* Procter & Gamble is a global company that provides consumer products in the areas of pharmaceuticals, cleaning supplies, personal care, and pet supplies.
28. *Qualcomm:* Qualcomm Incorporated ideas and inventions are driving wireless growth and helping to connect people to information, entertainment and one another.
29. *EADS:* The European Aeronautic Defence and Space Company N.V. (EADS), a large European aerospace corporation, develops and markets civil and military aircraft, as well as communications systems, missiles, space rockets, satellites, and related systems.
30. *SIEMENS:* It is a German engineering conglomerate that is the largest in Europe. The company has three main business sectors: Industry, Energy and Healthcare; with a total of 15 divisions.
31. *IHI Japan:* IHI manufactures an enormous range of products. From a wide variety of plants, machinery and facilities that support industry and society, to simpler facilities closer to our daily lives.
32. *Aramco:* Saudi Aramco is the state-owned national oil company of Saudi Arabia. It is the largest oil corporation in the world with the largest proven crude oil reserves and production.

## ONGOING INDUSTRIAL RESEARCH AT IIT KANPUR

The Institute executed a major project for **Indian Railways**. As a result of a research project, several technology developments have taken place. These include (i) development of an automated system which can be installed along the track for detecting faults in bogies of rolling stock, (ii) measurement of lateral and vertical rail forces in components of the rolling stock which may cause derailment, (iii) development of an indigenous electronic derailment detection device for the coach and a mechanical device for the freight, (iv) development of an on-board diagnostics panel for diesel and electric locomotives through microprocessor based controls, (v) a new chemical composition of wheels, axles both for forging and casting without altering the design parameters, (vi) development of corrosion prevention methods of the existing rails and the liner location, (vi) design and development of an instrumented wheel set for wagon, carriage and locomotive, (vii) indigenous flaw detection and testing equipment for rails and rail weld joints at a speeds of about 40-50 kmph, (viii) design and development of an environmental friendly railway coach toilet system for Indian Railways, (ix) holding the rails with sleepers elastically with elastic rail clips (ERCs), liners and rubber pads, (x) SIMRAN, a real time train tracking system, and (xi) improvement in the visibility under foggy conditions by developing a proper fog vision system.



Indian Railways placed a commercial order for buying 10,000 tons of the rail steel from SAIL. This rail steel composition considered unique was developed at the Institute as one of the projects under the technology mission on rail safety. The total cost of this order was just over Rs. 50 crores. The rail corrosion prevention project not only has an industrial partner, but tangible deliverables have resulted from it.



Classic and revised geometries



Proximity under test



MCT under bench test



Field testing in progress

**Agropedia** is a comprehensive, seamlessly integrated model of digital content organization in the agricultural domain. It aims to bring together a community of practice through an ICT-mediated knowledge creating and organising platform with an effort to leverage the existing agricultural extension system. It is envisioned to be a one stop shop for all types of information related to the Indian agriculture. The practice of crop knowledge models has been defined and developed for the first time worldwide to create the architecture that accumulates known codified and approved information about crops. This work has been carried out with the support of the Food and Agriculture Organisation (FAO), Rome. ICRISAT is the consortium leader. For agropedia, IITK finalises the software architecture and deploys it complete with user interface, which hosts the portals of IITB and IIITM Kerala, who benefit from the semantic search facilities of agropedia for their servers as well.

Bharat Sanchar Nigam Limited (BSNL) has set up a ***BSNL-IITK Telecom Centre of Excellence*** at the Institute. The focus areas of BITCOE are multimedia and telecommunication technologies, innovation, integration and dissemination and cognitive radio and computational mathematics.

**Moser Baer** India Limited, New Delhi (MBIL) has funded several projects in organic photovoltaics for developing a strategic partnership for futuristic research, conducting basic studies and scientific investigations, and establishing partnership with the governmental agencies. MBIL projects will nurture and support the growth of infrastructure, organise continuing educational programs, undertake development of human resources, organize professional activities, workshops, conferences and short-courses in technology areas.

There are projects funded by **Manipal Press** Limited, Manipal (MPL) for manufacturing printable RFID tags.

***Chevron Corporation, USA and Hindustan Petroleum Corporation Limited*** joined hands with the Institute to form a research consortium. Very significant methodologies have been developed in the domain of petroleum processing. The common goal of the consortium is to develop futuristic technologies related to petroleum refining as well as gas separation processes.

Two technologies developed at the Institute that have been highly appreciated are related to monolith catalyst blocks and separation process using the idea of HIGEE (separating gases such as SO<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>S from petroleum). Both Chevron and HPCL are pursuing future commercial applications in their respective organizations. With these innovations, the consortium is expected to continue collaboration well into the next decade.

The ***Boeing*** funded project on High Lift Aerodynamics seeks to enhance understanding of high lift flow physics and to obtain highly accurate and detailed measurements for two-dimensional high-lift geometry. Design of high lift systems is a challenging task both from the vantage point of performance and noise generation. Fundamental understanding of the associated complex flow physics is essential for effective designing of high lift Systems.

Development of a large format PIV system capable of interrogating an area of 1m × 1m is a challenging task for wind tunnel applications. Fundamental understanding of the properties of the light sheet, imaging cameras, and their orientation relative to the light sheet is essential for the effective designing of a large format PIV system.



**MULTI element Airfoil**



**2D Airfoil**

This project aims to develop a large format PIV system with advanced flow diagnostic capability. The system is to be used for flow past multi-element airfoil to understand high lift flow physics.

The Boeing Company has also funded a project titled *Passive and active RFID and location technology research*. Radio Frequency Identification (RFID) and sensor systems integrated into a computer network are used to achieve awareness in the manufacturing environment. RFID is used to achieve awareness about objects, such as tools and consumable supplies as well as a trolley that holds several such objects. Various types of sensor systems are used to achieve health awareness, which includes both condition monitoring (process of detecting deterioration in the

performance) and diagnosis (identifying the cause and suggesting remedial measure) of rotating machines.

### ***IIT Kanpur-Boeing Collaborative Undergraduate Research Project***

*Abhyast* is a mobile robot device designed to be reliable and rugged for map interpretation, robotic navigation, and imaging. It navigates with the help of GPS (Global Positioning System), IMU and Digital Compass (direction). The robot communicates with the user through GSM network which brings in the added benefit of large areas of network coverage. The autonomous navigation system is enabled through self- localization and path planning capabilities. As such, the commanded paths are susceptible to obstacles-both static and dynamic. The navigation system in *Abhyast* is able to detect obstacles along the commanded path and steer the vehicle to avoid these. Since this vehicle takes images of the target location, it makes possible vast application areas in monitoring of remote areas.

The following capabilities are inbuilt into the vehicle.

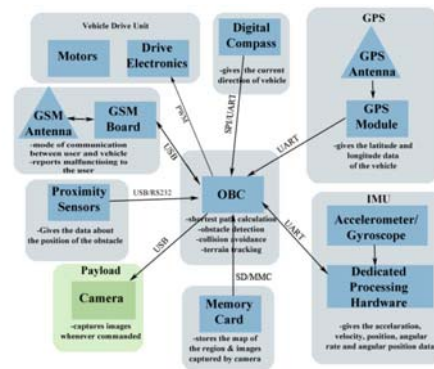
- 1) Accepts the co-ordinates (latitude, longitude or name) of its destination from GSM network (e.g. BSNL and Idea).
- 2) Finds the shortest path to its destination by processing a pre-stored open street map of the region.
- 3) Navigates autonomously using obstacle detection and collision-avoidance techniques to the destination using IMU assisted GPS, Digital compass and Laser Scanner.
- 4) Takes images in the vicinity of the destination point.

The following diagram summarizes the intended capability of the vehicle.

Phase II of this project is currently underway in which three fold tasks are planned. A new team of 16 undergraduate students are currently working to accomplish these activities.

The tasks for phase II are the following:

- (a) Optimization algorithms or the on board computer with respect to path and time planning and power management.
- (b) Inclusion of On board health management and increasing the level of communication of the existing on board computer for multi agent problems.
- (c) Design and development of a gas sensor for environment reading and monitoring in chemically hostile environments. (i.e., inter vehicle communication in a swarm of such vehicles).



In the research agreement with **Qualcomm Incorporated**, a Delaware corporation, areas of interest are fundamental and applied research in computing, communications, wireless and mobility, including but not limited to: (i) joint research programs with relevance to India, (ii) applications with relevance to social behaviour, usage patterns and business needs, (iii) new deployment models as applicable to emerging markets and populations, and (iv) speech, video and user interface research relevant to local languages and behaviours.

The **Intel Higher Education Program** is a worldwide collaboration between Intel and more than 150 universities in 34 countries. This program, in India, will collaborate with IIT Kanpur to form the first Focus School for Intel in India. The objectives of this programme are to encourage academia-industry collaboration and to support the development of a higher education ecosystem.

**IHI** Japan has funded project titled *Optimization of efficiency of outer-rotor Surface Permanent Magnet Synchronous Motor (SPMSM) over a given speed range*. Permanent Magnet (PM) motors have come into vogue, in recent times, principally from the point of view of saving in energy. Additionally, outer-rotor motors have been seen to offer several advantages e.g. resistance to centrifugal force, increased motor inertia, and reduced thickness of the motor in the axial direction. Therefore, outer-rotor motors find application in electrical vehicles, new generation washing machines and hard disks. In this project, optimization of the proposed machine will be undertaken with the objective of minimizing magnet losses in the machine.

## Inventions found suitable for commercialization in 2010

1. Image-based structural characterization of fibrous materials.
2. Energy saving electric lamps using straight MWCNT coated Tungsten Filament.
3. Alignment of Carbon Nanofibers on Glass fiber through Chemical Vapour deposition and its nanocomposites.
4. *In-situ* and controlled growth of hydroxyapatite polyetheretherketone nanocomposites (nanoparticles) from calcium oxide, phosphoric acid and polyetheretherketone and method of manufacturing the same.
5. Flexible temperature sensor and sensor array.
6. A three dimensional reconstruction and characterization system for biomedical images.
7. An instrument for imaging spatial distribution of magnetic fields generated from small direct and alternating electric currents enabling in the non- destructive mapping of regions with structural damage.
8. A scheme for maximal power extraction from Photovoltaic cells/strings/panels connected in series.
9. A scheme for maximal power extraction from dissimilar batteries connected in series.
10. Functionalization of poly (etheretherketone) Biopolymer: method of manufacturing the same.
11. A hard-soft expectation - maximization (HSME) based channel estimation for JPEG image transmission over MIMO.
12. Conducting polymer based temperature sensor array in a breast cap for early detection of breast cancer.
13. Improving organic solar cell efficiency by incorporating CuPc thin film that was annealed under an electric field.
14. Tuning magnesium inserted porphyrin for improved solar spectrum absorption and fabrication solar cells with these molecules.
15. Fabrication of Adhesives with subsurface hierarchical structures.
16. A neo-cartilage for osteoarthritis.
17. Stem cell separation technology using supermacroporous cryogels
18. Bio-artificial lever support using Cryogel bioreactor
19. Cigarette filter accessory using supermacroporous cryogel
20. Metal chelate affinity precipitation for protein separation.
21. Disposable cryogel bioreactor for the production of therapeutics.
22. Cryogel filter for the depletion of leukocytes from blood.
23. Antiseptic wound dressing bandage using PVP-I macroporous sheet.
24. Polymeric macroporous scaffolds for skin tissue engineering.

# BSNL-IITK Telecom Center of Excellence

## Executive Summary of BITCOE Research and Projects

The BSNL-IITK Telecom Centre of Excellence (BITCOE) has been established with the central goal of addressing the technical and regulatory challenges arising out of the remarkable growth rate leading to fast paced innovations in the Indian telecom sector. It has come into existence with the support of the Department of Telecommunications, Government of India, Bharat Sanchar Nigam Limited (BSNL) and Indian Institute of Technology Kanpur. The focus areas of BITCOE are 'Multimedia and Telecommunication Technologies: Innovation, Integration and Dissemination' and 'Cognitive Radio and Computational Mathematics'. A list of projects which have either been completed or are currently in progress is given in the accompanying Table.

| S.No. | Project   |
|-------|---|
| 1.    | Cellular Networks Optimization – Phase I  |
| 2.    | Speech Enabled Train Name Recognition System                                      |
| 3.    | Modeling Inter-Speaker Variability in Automatic Speech Recognition                |
| 4.    | Platform for Development of Interactive Speech Based Applications                 |
| 5.    | Commercially Viable Professional Courses  |
| 6.    | Multistage Integrated Protection Modules in Telephone Exchanges                   |
| 7.    | Spectrum Sensing and Co-operation for Cognitive Radio Applications                |
| 8.    | Automatic Selection of IMSI in International Roaming                              |
| 9.    | Implementation of IPv6 and Multicast in BSNL NIB network                          |
| 10.   | Service Based Multimedia Content Summarization and Delivery in the Indian Context |
| 11.   | Asset-Map: A Geo-Location Based Telecom Asset Management Software for BSNL        |
| 12.   | IPv6 based intelligent Transport Management System using BSNL Network             |
| 13.   | Content Management and Delivery over Cell phone Like Devices                      |
| 14.   | Scalable Video Coding based Wireless Transmission for Live Video Streaming        |
| 15.   | Networks Lab for Research and Education   |
| 16.   | Variable Phase Input Power Plant Design for Telecom Application                   |
| 17.   | Data Storage & Backup Solutions   |

## Scalable Video Coding (SVC) based Wireless Transmission for Live Video Streaming

Video transmission over wireless communication links provides the key to critical applications such as real time surveillance, health monitoring, defense and home land security. However, the wireless signal propagation environment is significantly challenging for video transmission compared to a conventional wireline channel due to the effect of *multipath interference* (shown in Figure 1-left), which results in disruption of the communication link. This in turn leads to poor quality of the received video stream and erratic delivery of video data.

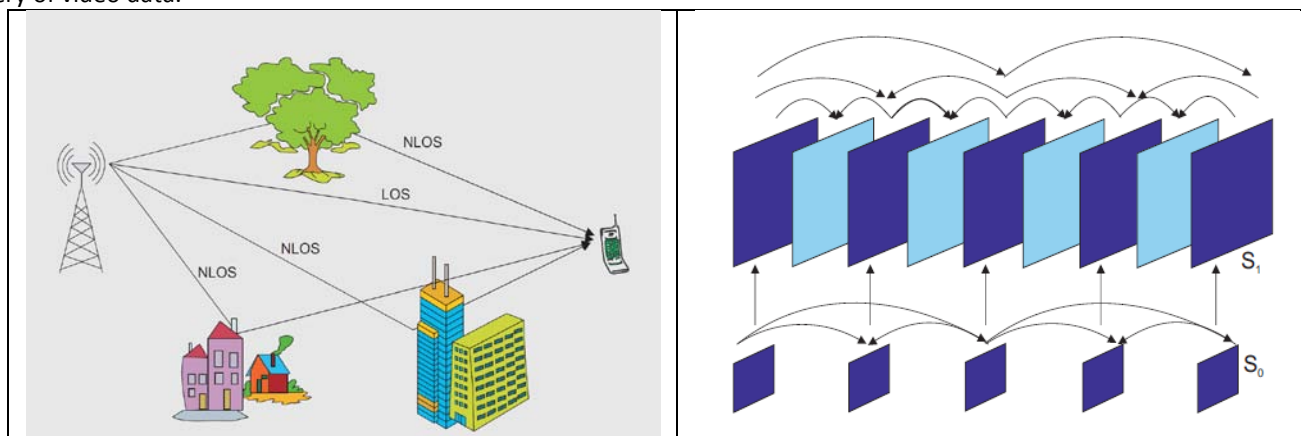


Figure 1: Multipath Wireless Interference and Scalable Video Frame Sequence

The H.264 based scalable video codec is ideally suited to combat this adverse effect of multipath fading for video transmission. It enables the transmission and extraction of a video stream of whose quality can be scaled (shown in Figure 1-right) depending on the wireless link quality. This is possible through the embedding of multiple lower resolution video sub-streams in a master high resolution stream through a base-enhancement layer based progressive video encoding strategy. In this context, the "Scalable

Video Coding based Wireless Video Transmission for Live Video Streaming” project funded by BITCOE at IIT Kanpur is aimed at building an H.264 based SV codec to enable live video streaming over wireless networks.

## Spectrum Sensing and Co-operation for Cognitive Radio Applications

Cognitive radio (CR) is a new wireless paradigm that can reconfigure the analog RF output of a conventional radio and incorporate self-awareness and knowledge of transmission protocols for *Dynamic Spectrum Access*. A cognitive radio is able to sense its RF environment (as shown in Figure 2-left), location and then alter its power, frequency, modulation and other operating parameters so as to dynamically reuse the unutilized spectrum or *spectral holes*. Thus, it substantially enhances the efficiency of the wireless spectrum utilization, which is currently very low due to fixed spectrum allocation technologies. This project on the development of cognitive radio technology deals with the technical and practical considerations as well as regulatory requirements. The key enabling techniques for cognitive radio networks are wideband signal processing techniques for digital radio, advanced wireless communication methods, artificial intelligence and machine learning techniques (Figure 2-right).

Orthogonal Frequency Division Multiplexing (OFDM) has been widely recognized as potential transmission technology for cognitive radio systems as it provides great flexibility in dynamically allocating the unused spectrum to the secondary cognitive users as well as an easy analysis of the spectral activity of the primary user. This project investigated the design of optimal power allocation strategies for OFDM based cognitive radio. Further, innovative spectrum sensing algorithms have been formulated for a cooperative secondary user cognitive radio environment, which have been demonstrated to yield significant performance benefits.

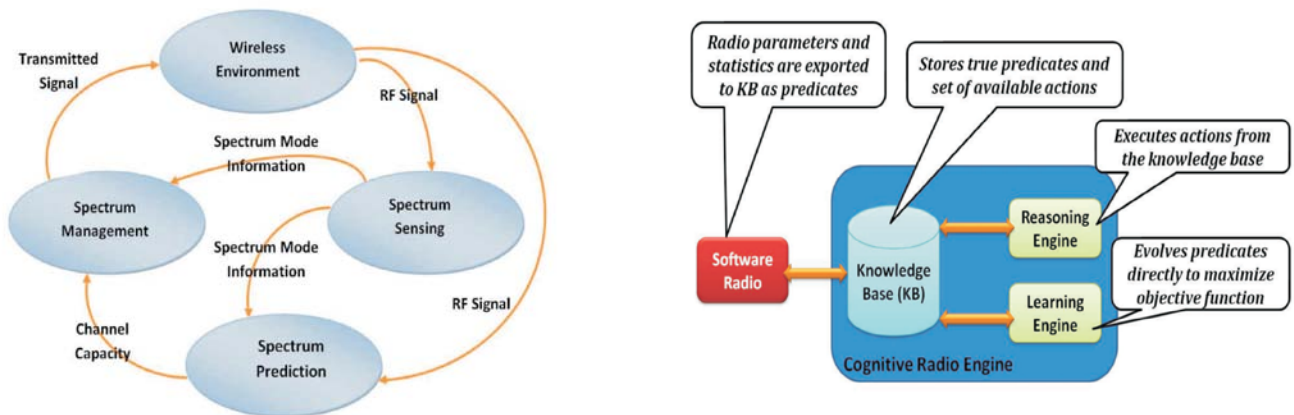


Figure 2: Cognitive Radio and Machine Learning

## Variable Phase Input Power Plant Design for Telecom Applications

This project is aimed at designing a power plant solution that simultaneously tackles two primary issues, namely, 1-2-or 3 phase operation and reduction of neutral current. A three phase prototype is desired with a manual output variation capability of 48 V to 56 V. Further, it should be able to sustain a maximum 3 phase input voltage of up to 490 V (L-L) under extreme situations. As per the deliverables, a new power plant has been designed for the above implementation. The first stage of the power plant comprises a three phase AC to DC rectifier consisting of a four leg-diode bridge and a boost DC to DC converter. This stage is followed by a DC to DC forward converter with isolation. A fully controlled prototype is now being designed and tested. All the deliverables pertaining to this phase of the proposal have been completed and an operating power plant prototype, which provides steady output with variable phase input, is illustrated in Figure 3.



Figure 3: Lab Prototype of Designed Power Plant

# Collaboration of IITK with Chevron Corporation

## Executive Summary of Chevron Research and Projects

Chevron Corporation is an American multinational energy corporation. It is engaged in every aspect of the oil, gas, and geothermal energy industries, including exploration and production; refining, marketing and transport; chemicals manufacturing and sales; and power generation. It is one of the world's six "supermajor" oil companies. A joint research agreement between IIT Kanpur, Chevron Corporation, USA, Advanced Refining Technologies, USA and Hindustan Petroleum Corporation Ltd., India was signed in 2005 with the objective of undertaking research projects that will lead to improved characterization of petroleum processes and reactor hydrodynamics and evaluation of new catalytic materials for various refinery processes. The initial period of the project was for 5 years with a funding of \$100,000 per year. Two technologies developed at the Institute that have been highly appreciated are related to *monolith catalyst blocks* and separation process using the idea of *HIGEE* (separating gases such as SO<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>S from petroleum). Both Chevron and HPCL are pursuing future commercial applications in their respective organizations. A list of projects which have either been completed or are currently in progress is given in the accompanying Table.

| S.No. | Project  |
|-------|--|
| 1.    | Monolith reactors for multiphase reactions-to evaluate the feasibility and potential of using monolithic catalysts for new process applications as well as to replace catalysts currently used as packed beds.                             |
| 2.    | Hydrodynamics of slurry bubble columns-to determine the effect of gas density and liquid velocity on the fluid flow characteristics of slurry bubble column reactors for better scale-up.  |
| 3.    | Modeling of mass transfer effects in resid FCC- to model the effect of diffusional limitations on the activity, selectivity and deactivation of catalysts for FCC of heavy feeds with the aim of designing better catalysts for resid FCC. |
| 4.    | In situ sulfiding of NiMo/Al <sub>2</sub> O <sub>3</sub> hydrotreating catalysts- to enhance the hydrodesulfurization activity of hydrotreating catalyst and to better understand the sulfiding procedure.                                 |
| 5.    | Supported ionic liquid catalysts- to evaluate the feasibility and potential of using supported ionic liquid catalysts for alkylation.  |



Monolith reactor for multiphase reactions



Set-up for in situ sulfiding of hydrotreating catalysts

## Accomplishments

- Two technologies were identified for potential commercial demonstration:
  - *Higee* for removal of sour gases from gas streams.
  - *Monoliths* as replacement for fixed-bed reactors for improved performance.
- Discovered a technique to immobilize an ionic liquid catalyst on a solid substrate for easier scale-up.
- Discovered a new ionic liquid based catalyst complexed with silica gel for production of linear alkylbenzenes that works at lower temperature, takes less reaction time and has better product selectivity.
- Expanded knowledge base in the design and operation of slurry bubble column reactors.
- Developed catalyst coating know-how for washcoating of monoliths with different washcoating substrates( alumina, zirconia and titania) and different catalytic materials( Ni, Mo & Pd).A pre-wetting technique developed for achieving washcoat loadings of upto 80%.
- Developed a comprehensive FCC reactor model that accounts for partial vaporization of feed in the riser.

Based on the encouraging results in the first phase, Chevron is also directly funding research in evaluating monolithic reactors as replacement of fixed bed reactors. As part of this project, Chevron has funded a bench-scale continuous reactor that can operate at high temperature and high pressure.

During the next stage, the following projects will be undertaken:

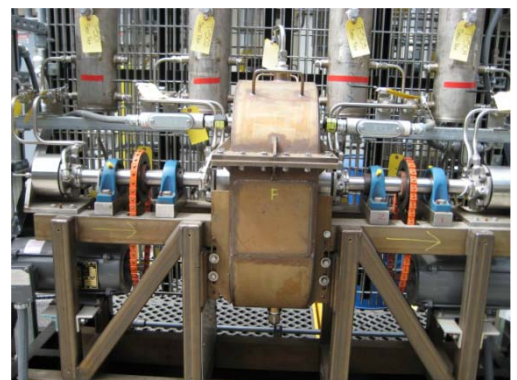
- Nanocatalysts for hydrodesulphurization- to develop bimetallic nanocatalysts of tailored size , porosity and structure for hydrodesulfurization having better activity and stability than the currently available state – of – the - art catalysts.
- Carbon dioxide capture on supported zeolites- CO2 capture on zeolites and its enhancement using amines, functionalized ionic liquids (ILs) and poly ILs.
- Performance analysis of reactor internals using CFD simulation- to study the hydrodynamics and optimize the reactor internals geometry in a down-flow multiphase fixed bed reactor for enhancing uniform flow distribution to ultimately prevent maldistribution of temperatures in catalyst bed.
- Alkylation of isobutane with butene for the production of gasoline - to design supported ionic liquid complex catalyst for alkylation of isobutane with butane and develop methods for regeneration of the deactivated acid catalyst.



High temperature, high pressure bench-scale reactor for studies on monoliths and packed beds



HIGEE at IIT Kanpur



HIGEE at Chevron

# Samtel Centre for Display Technologies (SCDT)

---

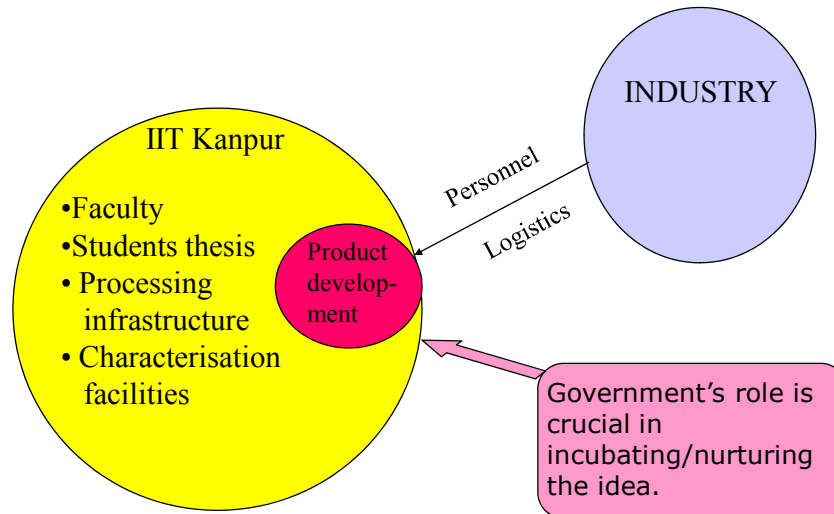
Samtel Group is India's largest integrated manufacturer of a wide range of displays for television, avionics, industrial, medical and professional applications, TV glass, components for displays, machinery and engineering services. Samtel Center for Display Technologies was established in the year 2000 under a MOU between Samtel Group of Industries and IIT Kanpur with active participation from DST with the objectives to conduct basic research in science and technology relevant to the field of electronic displays; to establish a tripartite relationship between industry, academia and various governmental agencies to nurture and support the growth of science and technology in the field of electronic displays with the aim of making India a global leader in display technology; to undertake human resource development; to organize continuing education programmes in areas related to display technology; and to organize other professional activities such as conferences, workshops, and short courses in relevant areas.

A list of projects which have either been completed or are currently in progress is given in the accompanying table.

| S.No. | Project   |
|-------|---|
| 1.    | Development of next generation plasma display technology and 50 NCH HD-PDP Prototype.                 |
| 2.    | Fabrication of efficient thin-film organic solar cells based on organic/inorganic heterojunction.     |
| 3.    | Development of prototype full color Organic Light Emitting Diode (OLED) display                       |
| 4.    | Organic and/or polymer solar cells and light emitting diodes on steel substrate.                      |
| 5.    | Evaluation of the feasibility and potential of using supported ionic liquid catalysts for alkylation. |
| 6.    | Development of magnesium oxide coatings by sputtering for plasma display panels.                      |

## Our Approach

1. Establish the best laboratories.
2. Share laboratories with Industry.
3. Joint R&D execution with Industry with its personnel deployed at SCDT.
4. Work with best practices of both, academia and industry, in joint deployment.



### Ongoing product development and research on:

- two OLED display with Samtel Colour Ltd.
- organic solar cells and solid state lighting with Moser Baer.
- RFID tags and printable electronics with Manipal Press Ltd.
- organic solar cells with Tata Corus.



Samtel Center for Display Technologies (SCDT)



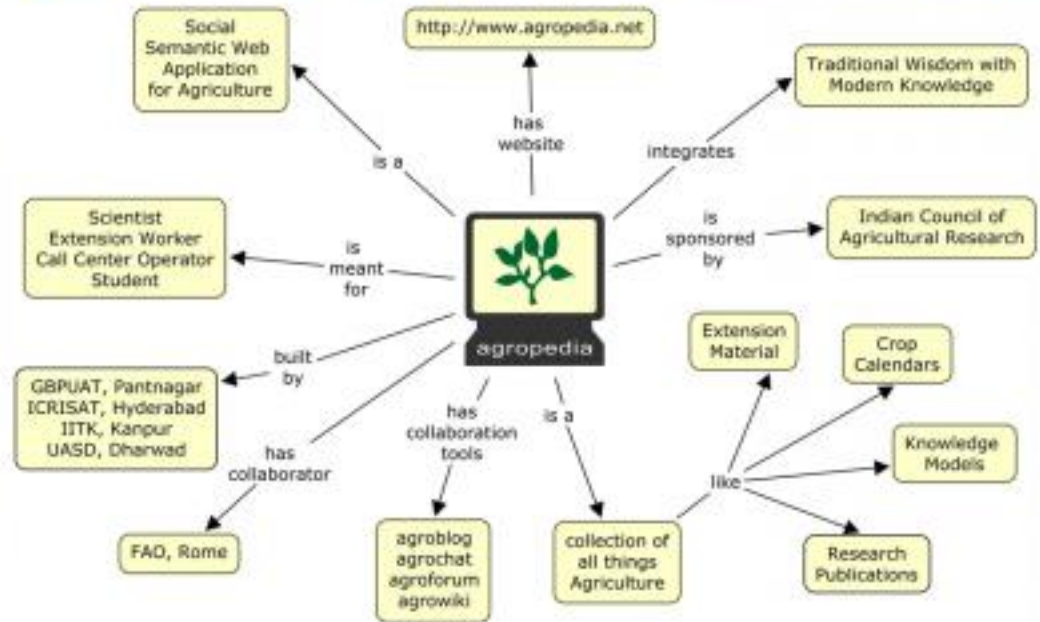
Processing facilities at SCDT





## What is agropedia?

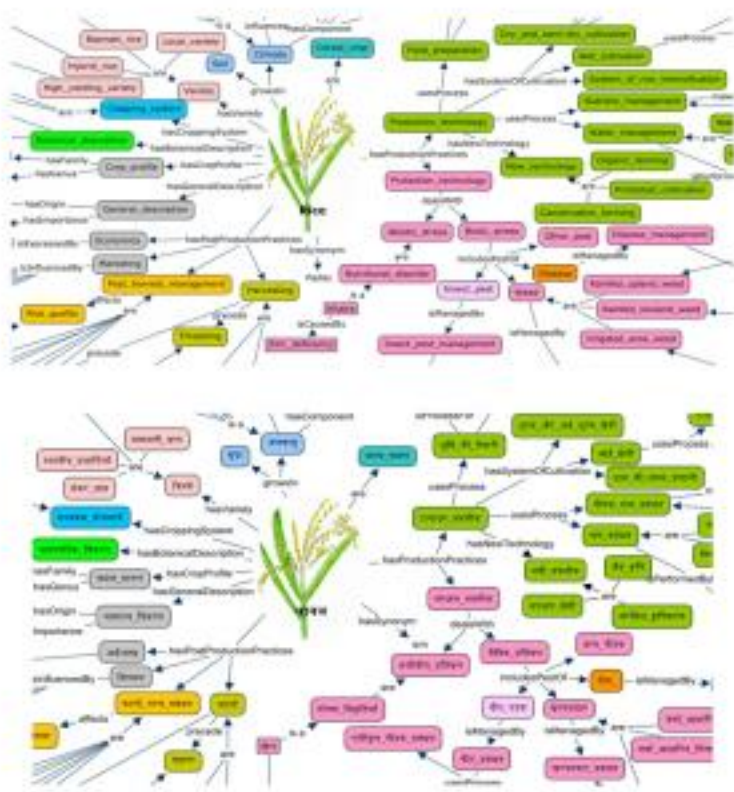
- Online repository for agricultural knowledge
- Social Networking and Semantic Technologies for agriculture
- Combines *Gyandhara* (certified content) with *Janagyan* (emergent knowledge)



## Crop Knowledge Model ?

- Visual Representation of the important concepts of agriculture with appropriate relationship between them
- An attractive, interactive and efficient way of information dissemination to the user
- Designed for indexing and browsing the content

## Knowledge Model - Basis of agropedia



- Production Technology- Green
- Protection Technology- Pink
- Post Harvest Management- Yellow
- Climate & Soil- Blue

## Content from agropedia

(<http://agropedia.iitk.ac.in/?q=content/agropedia>)

### भूरा तेल (Brown Plant Hopper)

**वैज्ञानिक नाम :** नीलपर्वीया सुलेनस (Nilaparvata lugens Stal.)  
**वर्णन :** इसके युवा कीट इनके अथवा मूढ़े मूठे रंग के 2-4 से 3 मि.मी. अन्वर्ध के होते हैं। इनके अंडे सफेद से रंग के अथवा पारदर्शी होते हैं, जो समूह में एक दूसरे से जुड़े होते हैं। पांच वा आठ दिनों में अंडों से निम्न बाहर आते हैं, जो मूठे रंग के होते हैं। इनका जीवन 12 से 15 दिन का होता है।



**क्षति की वस्तुतः** इस कीट के निम्न एवं युवा दोनों ही पांच से इसका कोशिका रस (Cell Sap) चूसते हैं। परिणामस्वरूप पत्तियां पीली होकर सूख जाती हैं तथा पौधे लीधे की ओर झुकने लगते हैं और फसल नष्ट जाती है। पौधे का सूखना घेत में ऊर्ध्व-ऊर्ध्व दिशा में आरम्भ होता है और बाद में पीरे-पीरे बने घेत में फैल जाता है। पुष्प आने से पूर्व संक्रमण होने पर घेत लगी बनते और पूरा आने की अवस्था पर संक्रमण होने से उपज में 20 से 30 प्रतिशत की गिरावट होती है। भारत में इस कीट से वाइनस संरक्षण जो नहीं होता, परन्तु धान की फसल को कुछ क्षेत्रों में अधिक क्षति पहुंचती है।



### निबंधन :

- कीटरोधी किस्मों का चुनाव करें, जैसे आर.आर.24, कुल्ला, रत्नजी, लंजा -सानी, दया, पंच.के.आर. 124, आर.आर. 44, नीला (Neela) एवं सरसा (Sarasa)।
- कर्षणिक - 4.54 कि.बा.ए.आई./हे. अथवा मेलोथोटॉक्स वा कोसावोल वा क्लोरपाइरिफॉस-0.4 कि.बा. ए.आई./हे. का छिड़काव करें।
- दामोदर कीटनाशी कार्बेन्सुलान-0.54 कि.बा.ए.आई./हे. अथवा फीरेट-0.24 कि.बा.ए.आई./हे. का प्रयोग करें।
- कोविडाव वा कार्बेरीव वा क्लोरान्थोस 24 से 30 किगो घुल घुल घुलित करें।



**agropedia as of November '09**

- Deals with 9 Crops
- Accessed by >150 Countries
- >350 Visits per day
- >1400 registered users
- >3500 Pages
- >25,000 Pageviews

Be a part of the agriculture knowledge revolution - Join agropedia today  
[www.agropedia.net](http://www.agropedia.net)