

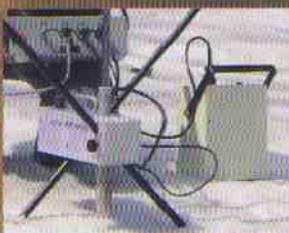
# Annual

# 50 Years

# Report

## 2008-2009

# CSIR



**Central Scientific Instruments Organisation**

Chandigarh, INDIA

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**From the Director's Desk**



It gives me immense satisfaction and pleasure to present before you the Annual Report of the Central Scientific Instruments Organisation for the year 2008-2009. The past year at the laboratory has been hectic and fulfilling and we had the privilege to receive a number of high profile visitors who renewed our enthusiasm with their encouragement. In October Shri Kapil Sibal, the then Hon'ble Minister for Science and Technology and Earth Sciences, Government of India and Vice President, CSIR visited the lab and presided over our Foundation Day events besides inaugurating the ADOM-2008 workshop and inaugurating the Advanced Optical Metrology Laboratory. Then in June 2008 the Director General of CSIR, Prof Samir Brahmachari visited the lab. He inaugurated the photonics facility and the Virtual Instrumentation Lab in the Institute. He felt that the Head Up Display was a proud achievement of CSIO, ISTC a unique and replication-worthy HR model and expressed hope that the new strategized resource planning of CSIO was sure to achieve its targeted goals. The Standing Parliamentary Committee (SPC) on S&T, Environment and Forest visited the lab on June 21, 2008. While appreciating the R&D carried out, committee members opined that CSIO is a unique institution which has carried out pioneering work on the Head Up Display, medical instrumentation and skill based training.

Going by the mandate of CSIR of taking technology to the masses, the laboratory transferred a number of technologies for commercialisation. The

technology of the Head Up Display (HUD) for the proposed indigenous Light Combat Aircraft (LCA) after successfully meeting the target of flying at the world's highest altitude airfield at Leh was transferred to Bharat Electronics in a ceremony graced by the then Minister for Science and Technology, Honourable Shri Kapil Sibal and in the presence of representatives of ADA, RCMA and RCMIL. With this achievement, India becomes one of the five nations with the capability to produce Head Up Displays. We also transferred the technology on Low Cost Oxygen Monitor (LCOM), a microcontroller based Oxygen monitoring system in oil fired boilers, developed by our Chennai Centre in April 2008. In the area of Medical Instrumentation, the know how on Artificial Hydraulic Knee Joint was transferred. The R&D work on surgical microscope for cataract surgery, anesthesia ventilator and the sodium potassium analyser reached the level of commercialisation and the technology transfer process was initiated. In an attempt to strengthen linkages with industry and academia, the laboratory entered into Memoranda of Understanding with Rajasthan Electronics and Instruments Ltd (REIL) and with Instruments Research and Development Establishment (IRDE), Dehradun on March 27 2009 for conducting joint research in niche R&D areas. Linkages were established with academic institutions like NIT, Srinagar, Anna University, Chennai, Punjab Engineering College, Chandigarh and Panjab University Chandigarh for towards joint research and technical cooperation.

With the help of recently established R&D infrastructure on photonics based sensors, various design approaches are being realised in the fabrication of Fiber Bragg Grating (FBG) and Long Period Grating (LPG) based sensors along with the measuring setup to cover a wide range of applications. Some of the studies conducted during the year include structural health monitoring of civil structures by monitoring tensile and thermal strain in mild steel, strains developed by applied compressive load on concrete and hot spot detection in heavy duty electrical equipment.

Our activities on smoked drum type seismographs have brought the laboratory to a level of technical acceptance with the Indian Meteorological Department (IMD). These are proving useful both for setting up more observatories in the Himalayan region for national level information recording and retrieval and replacing the existing imported seismographs. Our work on indigenous development of snow sensors has similarly been well received by the Snow and Avalanche Study Establishment (SASE) towards studying cold region environments in the observatories established at Manali.

In the research area of medical instrumentation, our second 6 MV LINAC (Linear Accelerator) was commissioned at the Cancer Institute, Chennai and inaugurated in April 8 2008 by the Chief Minister of Tamil Nadu. The two units, which are in regular use, have so far treated over 1000 patients. During this year the second phase of the project commenced four more such machines will in other cancer hospitals in the country. The lower cost and indigenous availability of this high demand medical equipment will help in meeting the country's requirement in setting up new infrastructure for cancer treatment.

## **Central Scientific Instruments Organisation, Chandigarh**

R&D activities in the strategic sector focussed on retrofitable lens assembly for Head up Display for Weapon Aiming Computer (HUDWAC) system, hot air leak detection sensor along with the electronic control module as per safety standards, fire safety sensors, etc.

In Agrionics, R&D efforts were focussed on photosynthesis measurements, soil health by monitoring soil salinity, quantification of quality of tea and honey using e-vision, e-nose and e-tongue measurement techniques. A prototype automation system for post harvest storage under controlled environment was developed and experimental trials on potato storage are in progress. The expertise developed in the laboratory for potato storage under controlled atmospheres can be equally applied to other, similar applications such as mushroom cultivation.

CSIO has been steadily contributing in generation of HR through its Indo Swiss Training Centre. We have taken a big leap in the area this year by starting a new post graduate course in Advanced Instrumentation Engineering under the new CSIR-Post-Graduate Research Training Programme (PGRTP), beginning next year. In collaboration with CMERI, Durgapur; CEERI, Pilani and BESU, Shibpur, the first batch of 17 M. Tech (Mechatronics) students completed their course work at CSIO. As part of new modernization plans, the planning for the infrastructure and curriculum activities of Indo Swiss Training Centre was carried out. A number of capsule programmes were also conducted on analytical instrumentation and bio-medical instrumentation for defence and overseas candidates.

I would like to thank the Department of Science and Technology, Department of Information Technology, Aeronautical Development Agency, Bharat Heavy Electricals Limited, Hindustan Aeronautics Limited, Indian Meteorological Department and Defence Research & Development Organisation for their continuing support and faith in our research and development activities.

We have been ably guided by our Research Council under the chairmanship of Prof Surendra Prasad, receiving valuable feedback, suggestions and help from the Council.

Our parent organisation, CSIR has continued its unstinting support to our activities through the year, and the visit of Prof Samir Brahmachari, Director General, CSIR in June 2008 has indeed motivated our scientists greatly.

October 30, 2009

(Pawan Kapur)

CSIO Foundation Day

Director



## **Instrumentation for the Strategic Sector**

The work carried out on the Head Up Display (HUD) was brought to the level of acceptance by the test pilots after the testing of the HUD at the world's highest airfield at Leh under intense cold conditions, thereby testing the full capabilities of the unit as per international standards. This made India the fifth nation in the world with the capacity to produce the Head Up Display. The HUD technology was transferred to Bharat Electronics Limited (BEL), Panchkula with the signing of an agreement on October 30 2008 in the presence of the then Honourable Minister of Science and Technology, Shri Kapil Sibal. During the year the HUD cleared further rigorous, gruelling testing in the form of low temperature storage-cum-operational tests and high altitude flight trials in Leh, some of which were not cleared by other Head Up Displays. About 1100 successful test flights of the LCA have proven the ruggedness of the CSIO Head Up Display.

The first of the HUDs with Raster (night mode capability) was delivered and has been cleared for flight. A Head Up Display for the HJT-36 Intermediate Trainer Aircraft also cleared Limited Qualification Tests (LQT) and the first unit is scheduled for delivery in July 2009. Ongoing work in this field includes a night mode capability Head Up Display with additional raster features and a Head up Display for Weapon Aiming Computer.

In Photonics, this year the laboratory fabricated Fiber Bragg Grating (FBG) Sensors for strain and temperature measurement in metal and concrete structures in collaboration with SERC, Chennai. Under another program FBG sensors were tested for detecting hotspots in electrical equipment such as transformers. Other research areas include design and fabrication of overlapped FBGs and chirped LPG, fabrication of LPG on erbium doped fiber, fabrication of Gain Flattening Filter (GFF) for EDFAs, Micro-fiber loop with sub-micron fiber and FBG sensor studies for petrol, CNG and hydrogen gas tested at IIP Dehradun.

The laboratory has been providing sensor support to various agencies and delivered sensors for measuring snow moisture, temperature and hardness of snowpack. New sensors for soil properties and photosynthesis measurement are being developed under the Supra Institutional programmes. Five improved Analog Seismic Recorders were delivered to the Indian Meteorological Department (IMD) New Delhi in January 2009.

## **R&D Achievements**

### **Head Up Display (HUD) for Light Combat Aircraft**

*"LCA Tejas will be part of IAF and delivery of 20 LCAs will be done to IAF by 2011"  
- Hon'ble AK Antony, Minister of State for Defence, October 25 2008 at ADA, Bangalore*

The above remarks put the laboratory on a strong footing to take up further tasks in the field of cock-pit instrumentation. The Head Up Display forms an essential component of the cockpit display by providing the pilot with essential flight information, navigational and target/ weapon release cues superimposed on the window to the outside world. Thus a HUD is a transparent display that presents data without requiring the user to look away from his viewpoint. The user is constantly able to view information with his head "up" while simultaneously looking at the outside world through the aircraft windscreen rather than periodically glancing down to look at the instrument panel.

Through a series of tests conducted to full specifications, the research design was frozen and documented into several volumes of know-how and delivered to BEL for commercialisation. Broad features of the CSIO HUD are:

## Research and Development Achievements

- A Total Field of View (TFOV) exceeding 25°
  - Symbol brightness exceeding 2700 fL, maintaining contrast of over 1.2 throughout the brightness level of the outside world
  - Free from sun glare at strong noon conditions
  - Optimum viewing in all weather conditions
  - Optimum parallax positional accuracies
  - User friendly Multi Function Up Front Control Panel (MF-UFCP)
  - Open architecture computer interface compatible with RS 422 protocol
  - Optimal thermal management avoiding forced air-cooling
  - Ease in maintenance due to modular design approach
  - Conforming to standards MIL STD 810D, MIL STD 704D and MIL STD 461C
  - Raster version for night flying conforming to cockpit geometry and power constraints
- The accompanying photograph depicts a typical Symbology and explains some symbols;



*Symbology of CSIO HUD (photo courtesy of ADA)*

About 1100 successful test flights of the LCA carried the CSIO HUD on TD2, PV1 - PV3 and Limited Series Production series like LSP1-LSP2 aircraft, have proven the quality and ruggedization of technology of the CSIO HUD. Based on these test flights, various Request for Actions (RFAs) reported by National Flight Test Centre (NFTC) pilots during test flights of LCA with CSIO HUDs were also attended to and resolved successfully.

Based on the design perfection, testing under all weather conditions and fulfilling requirements as per military standards, the HUD technology was transferred on October 30, 2009 to Bharat Electronics (BEL) Panchkula in presence of Honourable Minister of Science and Technology Shri Kapil Sibal. The Hon'ble AK Antony, then Minister of State for Defence had earlier announced on October 25 2008 at ADA, Bangalore that "LCA Tejas will be part of IAF and delivery of 20 LCAs will be done to IAF by 2011". India has now become one of only five nations in the world that possess Head Up Display technology, priced less than comparable HUDs.

In a letter of appreciation dated March 27, 2009, the Programme Director (CA) and Director, ADA stated that "I would like to pass on my sincere appreciation to your team for having succeeded in the development, flight testing and technology transfer of the Head Up Display for the indigenous Tejas aircraft program... We are privileged to have your premier organization as a partner in the national team that achieved many milestones in the Tejas aircraft program."

On 16 and 17 December 2008 the CSIO HUD completed successful test flights, during 20 sorties, on two Light Combat Aircraft (LCA) Tejas. This was a low temperature storage-cum-operational test, the aircraft having been soaked under snow at temperatures ranging from -5°C to -20°C for 24 hours. The unit was also part of weapon trials – weapon aiming, bomb drop conducted at Pokhran.

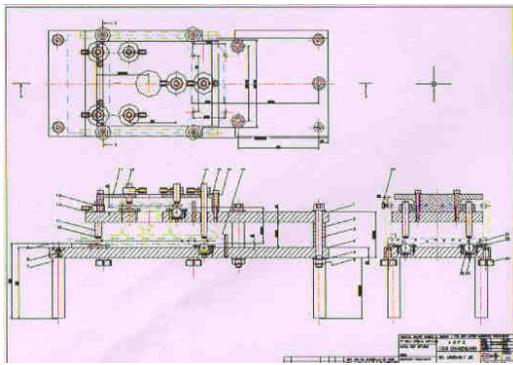
In order to meet the urgent requirement of more HUDs for flight trials, ADA last year sponsored a project for design, development and supply of seven more cursive HUD units, modified as detailed in the RFAs (Request For Action). Four of these units have been delivered. The units are undergoing test flights with LCA PV series aircraft. The assembly, testing, calibration of the next two units is complete and evaluation is under progress.

## Head Up Display (HUD) for HJT-36 aircraft

The Hindustan Jet Trainer-36 (HJT-36) is an Intermediate Jet Trainer aircraft (IJT) under development by Hindustan Aeronautics Limited (HAL). The HUD for HJT-36 is an enhanced version of the LCA HUD incorporating a number of modified, and some new features like: opto-mechanical lay out with tilted CRT plane from vertical in order to reduce the overall weight, volume and size as per the new requirement of fitment in HJT-36 aircraft, stringent requirements of NCL and ECL adding critical tolerances, new features of Electronic Stand by Sight (SBS) and provision of Raster feature.

The HUD for the HJT36 is aimed to be compact, free from sun glare and lightweight as compared to the LCA HUD and will use a dual beam combiner with multilayer linear coating (the LCA HUD has graded coating). A drawing for the jig designed for mounting the Beam combiners is depicted in the figure.

After successful integration of Engineering Unit with Mission Computer at ARDC, HAL



*A jig was designed for mounting Beam Combiners*

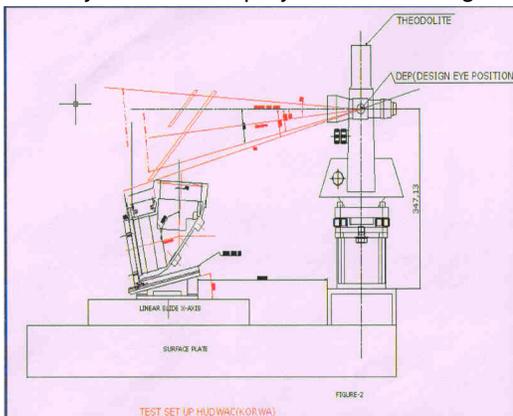
Bangalore, the Electronics and Optical block of Safety of Flight (SOF)/LQT Unit H-002 were successfully assembled and finally the Unit has been integrated and tested with Mission Computer at ARDC, HAL Bangalore. The LQT unit has cleared the stringent electrical & environmental tests as per MIL STDs 704D, 461C and 810D. The tests cleared by the HUD are: Power Supply tests; a series of EMI/EMC test CE01, CE03, CE07, RE01, RE02, CS01, CS02, CS06, RS01, RS02 and RS03. After passing these tests the unit was subjected to a series of Environment tests like Sinusoidal Vibration, Random Vibration, Mechanical Shock, High

Temperature Storage cum Operational Test, Low Temperature Storage Test, Humidity Test, Acceleration Functional & Structural Test, Rapid De-compression Test etc. at various locations like, BEL, Panchkula & BEL, Bangalore, RCI, Hyderabad, Institute of Aerospace Medicine (IAM), Bangalore etc. Software versions definition and Standard of Preparation etc have been prepared for qualification of airworthy units.

With the design being frozen after successful testing, the first airworthy unit will be offered for ESS by August 2009.

## Lens Assembly for HUDWAC System

The objective of this project was to design and develop a lens assembly for the Head up



Display for Weapon Aiming Computer (HUDWAC) as a retrofitable system which can be used with the existing electronic block of Jaguar aircraft currently in use by the Indian Air Force.

The optical system offers the additional feature of optical Stand by Sight (SBS) for safe landing in the event of failure of the mission computer. The system is optically corrected for narrow wavelength of CRT (546 nm) and also for avionics red colour

*Optical Performance Evaluation Test facility was designed (at left)*

## **Research and Development Achievements**

for SBS (625 nm). The optical system for HUDWAC was assembled along with Beam Splitter and the target illumination lens in a single barrel. The effective focal length and back focal length of the optical system have been checked and found within the required tolerance limits of theoretical values. The fiber illuminated graticule was assembled along with fiber bundle. The beam combiner assembly of Jaguar HUD has been carried out on the optical module. A schematic showing the optical performance is depicted in the figure.

The optical system of the HUDWAC was tested at HAL Korwa. The image through the optical system was found to be better than the existing optical block available with HAL.

### **Hot Air Leak Detection System for ECS of LCA**

A Hot Air Leak Detection Sensor Along with the electronic control module for an Environment Control System (ECS) in the Light Combat Aircraft was developed and tested. The module is used as an early warning system.

Eutectic salt, sensors with end connector and electronic control box were developed as per MIL Grade specifications. These were subsequently tested and ADA/RCMA clearance has been obtained. Future work plan is for qualification of these sensors for airworthiness.

### **Fire Safety Sensor for LCA**

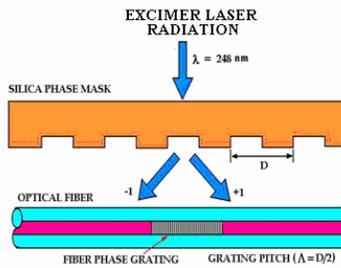
Qualification testing of two sets of Fire Safety Sensors for environment and endurance were also successfully completed. This included low temperature test at -40°C for 24 hours, high temperature test at 85°C for 7 days, 90% Humidity testing for 7 days, 18 km altitude, altitude test, salt fog test, 300 cycles upto 350°C testing and Flame test at 1100°C for 50 cycles.

The sensors will be put through vibration tests during the coming year, after which it will be ready for use in the LCA trials. TBRL and IRDE scientists provided necessary testing and other related coordination activities.

## Fiber Bragg Gratings (FBGs) for Sensing Applications

The laboratory established a complete R&D infrastructure on photonics based sensors which was formally inaugurated on June 15 2008 by Prof SK Brahmachari, Director General, CSIR. Various design approaches were realised in fabrication of of FBG and Long Period Grating (LPG) based sensors along with the measuring setup to cover a wide range of applications.

Several applications were attempted for monitoring the health of civil structures like bridges and buildings, moisture content and temperature measurement in agro soil and prediction and prevention of hot spots in power transformers.

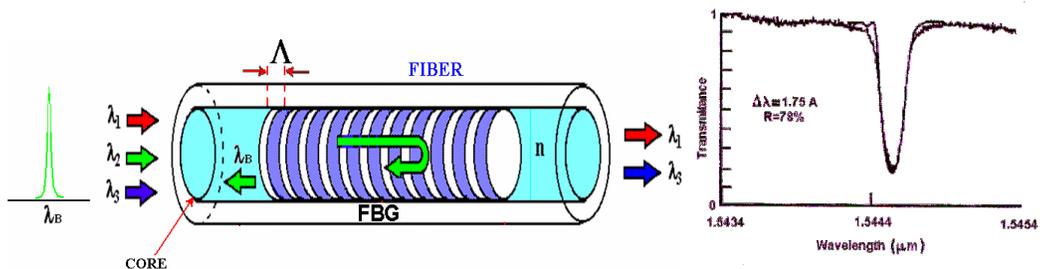


*Phase mask technique*

FBGs are fabricated using special light sensitive single mode optical fiber which is doped with the element Germanium to enhance its photonic or light sensitivity. A portion of the fiber segment is stripped of its protective acrylic covering jacket before to writing the FBG pattern. The Ultra Violet (UV) light source is typically a Krypton Fluoride (KrF) gas based laser source of wavelength 248nm which is used with either a phase mask or holographic techniques. The accompanying figure illustrates the phase mask technique. The pitch and periodicity are varied to achieve distinct FBG's. Typical period followed was 1060 nm designed at 1550 nm peak wavelength.

The process of fabrication involved stretching the uncoated fiber segment under tension. A phase mask was appropriately placed to obtain vertical and horizontal alignment. UV light was directed on the exposed fiber portion for a fixed duration of time to inscribe the desired pattern of varying refractive index ( $10^{-5}$  to  $10^{-3}$ ). Multiple scans are applied to achieve 90% reflectivity. For device protection, acrylate coating is done followed by thermal annealing at elevated temperatures beyond  $150^{\circ}\text{C}$ .

Depending on the pitch, refractive index difference between the core and the cladding and particular wavelength of excited light, a resonance condition is created which reflects back this wavelength, hence producing a dip in the output spectral response. The adjoining figure highlights the Bragg condition. The shift in the wavelength before and after the applied perturbation gives a measure of unknown parameter.



*Reflected light spectrum and FBG schematic diagram*

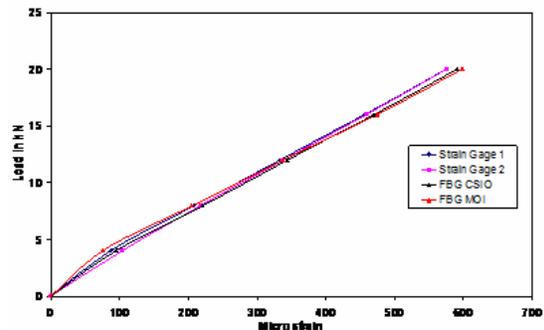
*Transmitted light spectrum*

### FBG Sensors for Structural Health Monitoring

In recent years, FBG sensors due to their various attractive features have become attractive for use in Structural Health Monitoring. Under a joint R&D activity involving CSIO and SERC, Chennai, studies were carried out on strain and temperature measurement in metal and concrete structures using FBG sensors developed in-house. The results were compared with similar commercially available sensors and are depicted in the adjoining figure. The concept of dual grating configuration was followed for strain-temperature discrimination for different civil structures.

#### Measurement of Tensile Strain in Mild Steel (MS) specimens:

A strip of mild steel having central length 250 mm and central width 25 mm with holding ends of sizes 65x50 mm on both ends and overall thickness 6 mm was taken as a test specimen. The surface of the mild steel specimen was first cleaned with fine emery paper and then well finished by Isopropyl alcohol. Afterwards a single indigenous FBG of 15 mm length having Bragg wavelength of 1545.618 nm and  $\Delta\lambda$  0.122 nm was bonded on to the surface of specimen along with a conventional electrical strain gauge (ESG) with



*Tensile Strain Measurement on MS Specimen using both the CSIO-Developed FBG Sensor and Micron Optics FBG sensor with Electrical Strain gauge*

*Performance comparison for tensile strain between FBG sensors and electrical gauge*

the adhesive, An FBG Sensor of Micron Optics, USA was also spot welded on the other side of the specimen for comparative evaluation. Desired bonding strength was achieved after three hours stabilisation on period and was finally mounted on the Universal Testing Machine (UTM). FBG Sensor and ESG were interfaced with the Optical Interrogator and Strain gauge Indicator respectively and initial stabilization was carried out at 40 Kg. After this tensile load was applied up to 2000 Kg with an interval of 400 Kg and data was recorded for wavelength shifts in the FBG Sensor along with the corresponding change in the value of microstrain obtained from ESG. Data was also recorded during the unloading cycle. The same procedure was repeated several times to establish the reliability and repeatability of the measurement. Results are presented in the figure which show satisfactory performance of FBG's.

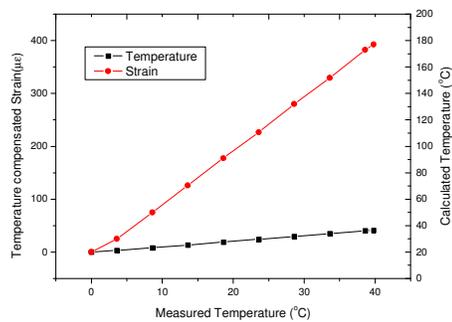
#### Measurement of Thermal Strain using Dual FBG Sensor:

Another study was made on the measurement of thermal strain in mild steel specimen using a dual FBG Sensor configuration, each with grating length of 15 mm and Bragg wavelengths at 1551.495 nm and 1556.454 nm producing  $\Delta\lambda=0.150$  nm and 0.153 nm respectively. One FBG sensor with a central wavelength of 1551.495nm was bonded with the adhesive on the surface of second mild steel specimen of the same dimensions as stated in the first experiment to measure the thermal strain and the second FBG sensor with central wavelength of 1556.454 nm was kept on the surface of specimen without

adhesive bonding for sensing temperature. Conventional strain and temperature gauges were also fixed side by side at equal distance with the FBG sensor.



*Set-up and response for Thermal Strain Measurement in Mild Steel using Dual FBG sensors*



*Average strain responses from FBG sensors and Electrical resistance strain gauges*

The above experiments were repeated several times in both the specimens to establish the reliability in measurement. The proposed technique can be used for temperature-strain discrimination studies for civil structures.

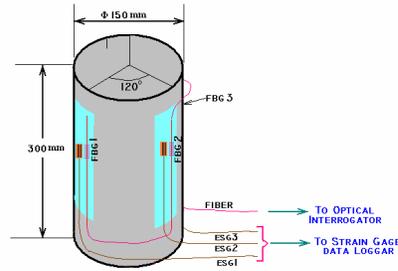
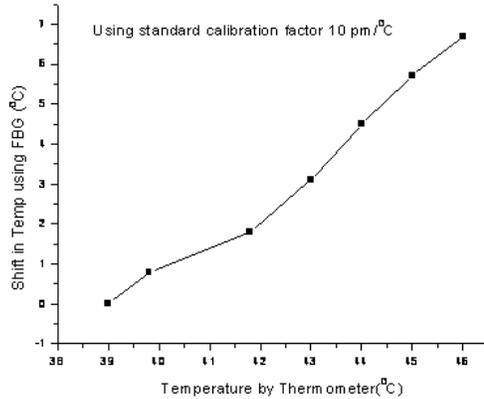
### Measurement of strains developed by the applied compressive load on the Concrete Test Specimen using FBGs and ESG

A solid concrete cylinder with diameter of 150mm and length 300mm was selected for bonding multiple FBGs along with strain gauges. In the first instant, surface of the concrete specimen was well finished with emery paper before applying adhesive to eliminate the loose dust particles and free multiple air bubbles from micro cracks. On the lateral (longitudinal) surface of the specimen, three points were located at an angle 120° each for bonding FBGs and strain gauges. The three FBG sensors each having length of 30mm, interspacing of 300mm, nominal wavelengths of 1545.49 nm, 1550.410nm and 1555.348 nm and  $\Delta\lambda$  of 0.083nm, 0.088nm and 0.085nm respectively were bonded on the indicated points. Three conventional electrical strain gauges of 30mm gauge length each were also bonded along with the FBGs for comparison. A Cyno-acrylic (CN) adhesive was used to complete the bonding process and the specimen was allowed to stabilise for 24 hours to achieve the desired bonding strength.

This specimen with instrumented FBG sensors and electrical strain gauge were placed inside the oven and temperature initialization was done at 26.4°C. Recording of the initial values of FBG sensor, electrical gauge and temperature gauge were made as shown in the figure. The temperature was steadily increased up to 65°C at 5°C intervals and corresponding wavelength shifts in both FBG sensors and strain values of the electrical gauge were recorded and are shown in the figure.

The temperature values were estimated from the wavelength shifts using calibration factor for silica fibers (11pm/°C). The results agreed well with other standard approaches. The Bragg wavelength shifts in both the FBGs were observed to be the same under change in temperature. However, additional effect of strain results in larger wavelength shifts for the FBG which is bonded to the specimen. Wavelength shift due to temperature is subtracted from total shift of the first FBG and divided by 1.2 (standard calibration factor for bare silica gratings) to get the absolute thermal strain due to thermal expansion of mild steel.

## Research and Development Achievements

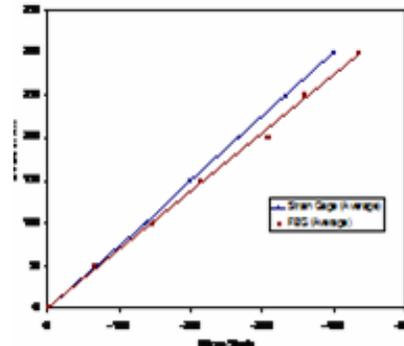


*Concrete specimen with surface bonded FBG and ESG sensors*

The specimen was loaded on the Universal Testing Machine (UTM) for compression. The FBG sensors and electrical strain gauge sensors were connected to FBG optical interrogator and strain gauge indicator respectively. Initial stabilization was done at 1 Ton. Further compressive load was applied up to 30 Tons at intervals of 5 Tons. Wavelength shifts in all the three FBG sensors and microstrain in electrical gauges were recorded for different compressive loads and a few trials were carried out. A data logger was employed to read electrical strain gauge output for comparison. The study was repeated for reverse process to study any hysteresis effects. The results obtained are depicted in the adjoining figures.



*Setup for measuring compressive load using FBG sensors on a concrete specimen*



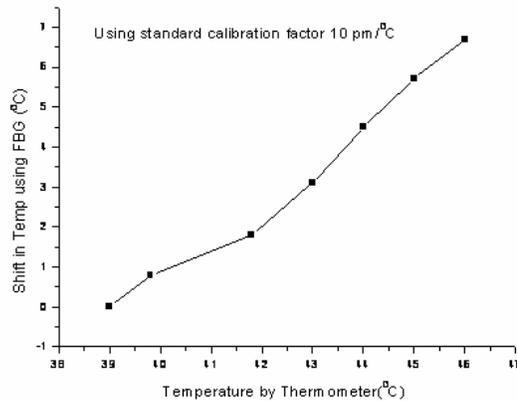
*Performance comparison for compressive strain between FBG sensors and electrical gauges*

### Hot Spot Detection and Location in Electrical Equipment:



*Inside view of transformer with CSIO fabricated FBG mounted*

In yet another innovative study three Fiber Bragg Grating (FBG) sensors were designed and inscribed in a single fiber and supplied to Electrical Research and Development Association (ERDA) Vadodara for studying hot spot detection in power transformers. The FBG sensors were calibrated for 10 - 100 °C range and used in HV winding of 25 KVA transformer energized to 11 KV (HT side) at ERDA



*Temperature response of a transformer core using FBG*



*Online monitoring of hot spot in power Transformer at ERDA Vadodara using CSIO fabricated FBG*

Temperature measurements in the transformer using CSIO fabricated FBG's were undertaken at Ardison Associates, Mohali. The results obtained are depicted in the adjoining figure.

A sensitivity of 10.1 pm/°C was achieved, which is well acceptable to the transformer industry.

## **Seismic Recorders for Meteorological Studies**



*Analog Seismic Recorders under long term testing*

Seismographs are widely used to monitor and record feeble seismic signals with low frequency components at relatively low amplitudes levels under noisy environments. Analog seismographs with enhanced capabilities were developed having features of: internal clock synchronised with ATA timing signal transmitted by National Physical Laboratory (NPL) Delhi; low power consumption with MOS technology; solar panel based power packs and calibration

facilities. The indigenous technology was perfected and several systems were supplied to Indian Meteorological Department for use in their Seismic Observatories. According to Director, Seismology Division, IMD, in a letter dated July 7, 2009 "more than twenty five such CSIO developed and supplied analog smoked type seismic recorders are working consistently and continuously and providing the data for earthquake monitoring in our Seismic Monitoring National Network from which we are immensely benefited. ... More such recorders are required to meet the growing demand for replacing the existing photographic recorders. IMD is dependent on CSIO for supply of such recorders. We would also request CSIO to supply the analog recorders to met the requirement of IMD in future for the vital national cause of earthquake monitoring in the country"

## **Low Moisture Measurement System**

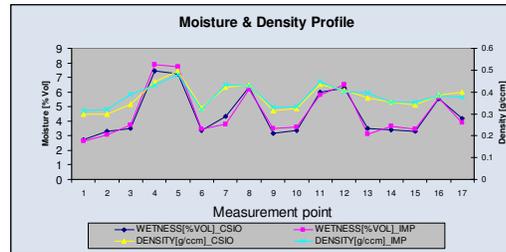
The presence of liquid water in snow plays a major role in studying snow metamorphism, mechanics and hydrology. Knowledge of snow parameters is important for understanding

## Research and Development Achievements

snow characteristics, climatology, meteorology, snow avalanche forecasting, flood prevention and hydropower energy. Measuring snow moisture is a complicated task because of the rapid snow metamorphism at and around melting point. Any perturbations in the snow may change its structure, texture and moisture rapidly.



*Field Trial of Snow Moisture Measurement System in progress*



*A comparison of Snow Moisture and Density profile measured with CSIO developed instrument and an imported instrument*

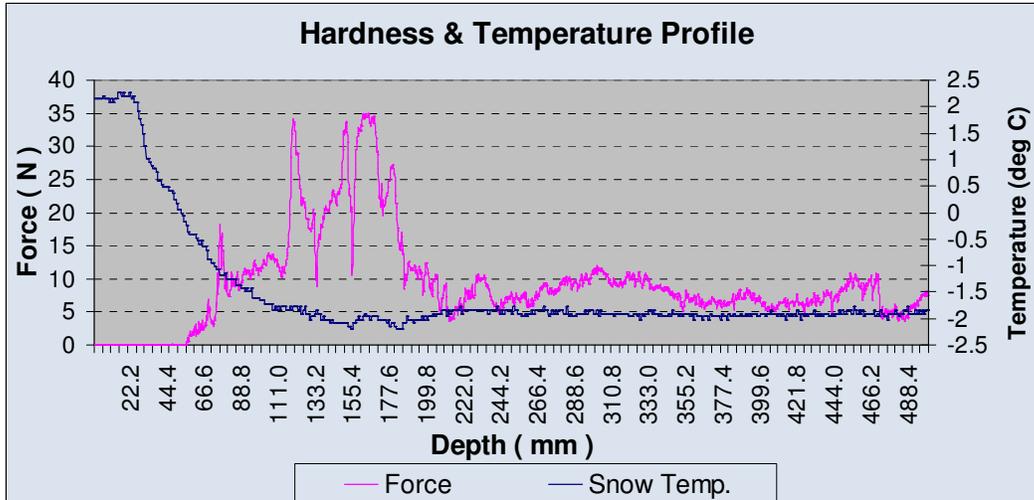
Research was carried out towards the development of a portable snow moisture measuring instrument for quick, non-destructive and in-situ determination of snow liquid water content (moisture) and compactness (density). The module was designed around a dedicated micro-controller which can withstand temperatures as low as  $-25^{\circ}\text{C}$ . The sensor comprised a fork shaped structure at quarter wavelength dimensions and operating at micro-wave resonance. The sensor assembly was shaped with sharp edges for easy insertion into snow packs. The sensor is excited with a radio-frequency sweep in the range of 450-950MHz. The moisture content lowers the real part of the permittivity while the imaginary component broadens the resonance curve with a dip at the centre frequency. A micro-computer extracts features out of the response pattern for display as compatibility towards other communication protocols. The unit offers faster response time, enhanced accuracy and is designed for sub-zero temperatures and strong wind conditions.

The modules were commissioned at Snow and Avalanche Study Establishment (SASE) observatories and long term field trials were carried out in association with SASE scientists. The design was frozen after incorporating feedback from user trials. The broad features are: auto calibration of Voltage Controlled Oscillator, enhancing resolution of power detector and RF coupling. The adjoining figure depicts the site installation and results obtained which meet the desired specifications. Several such modules were fabricated and delivered to SASE.

## Multi-Parameter Probe for measurement of temperature and hardness of snowpack

Snow is a fragile and cellular material with a distinct structural setup of ice crystals. Their mechanical properties and stability determine the stability of packs, which are related to avalanche phenomenon. Snow is a rapidly changing material with a complex structure and fast changing properties such as temperature, wetness, compactness and shape. One therefore needs a robust, reliable and eco-friendly gadget for the on-line measurement of these properties. The need for an integrated probe with multiple measurement capabilities has long been felt.

The laboratory developed a Multi-Parameter Probe with built-in features as mentioned above for simultaneous measurement of bonding force between snow grains (vertical to snow layers) and temperature of different snow layers. The equipment offers high spatial resolution at high speed. It comprises a stainless steel rod having a conical tip of 20 degrees, equipped with sensors.



A 490mm deep hardness and temperature profile measured the CSIO Multi-Parameter Probe

The unit can easily be inserted into any snowpack to acquire the hardness and temperature profile. A DC motor of 120 Watt drives the steel rod inside the snowpack with user selectable speed (1 – 20 mm/sec) through a rack and pinion arrangement. The instrument offers combined measurement of hardness and temperature, aiding various snow based studies. The photograph shows an on-site installation of the unit which was subjected to long term trials for data capture, analysis and prediction.



Engineered unit of the multi parameter probe in use during field trials

Ministry of Earth Sciences towards setting up more observatories in the Himalayan region for national level information recording and retrieval.

The feedback from user trials conducted at SASE observatories at Manali were incorporated in the design and its final version was frozen. Subsequently four units were fabricated and supplied to SASE labs at Chandigarh for long term installation and field applications.

The above R&D activities have brought the laboratory to a level of technical acceptance both with IMD and SASE, thereby introducing indigenous units to meet the ever growing demands of the

### Agri-Instrumentation/ Agrionics

Agri-instrumentation research has been given special attention in the laboratory in view of its relevance to agriculture and the agro-based sector in a largely agrarian country. The focus of Agrionics research has been on the development of instruments, systems and processes which are of use to the farming community in applications like soil quality characterisation, pre harvest and post harvest technologies, plant health monitoring and efficient storage of agricultural produce. The aim is to produce devices at affordable prices that are easy to operate in field conditions.

This year, the Agrionics team has worked on developing technologies for plant health based on photosynthesis measurements, soil health by monitoring soil salinity (a major cause for land turning infertile), quantification of quality of tea and honey using opto-vision, e-nose and e-tongue measurement techniques. A prototype automation system for post harvest storage under controlled conditions has been developed and experimental trials in potato storage are in progress.

During the past year four of our technologies, namely: Grain Moisture Meter, Iodine Value Meter, Oil Spectrophotometer and Formaldehyde Measuring System were transferred to Chemo Electronic Lab, a unit of United Phosphorus Ltd (UPL) in Vapi, Gujarat.

Rajasthan Electronics and Instruments Limited (REIL) entered into an agreement to commercialise the Rice Grading and Classification System developed earlier by the laboratory.

The expertise developed in the laboratory for potato storage under controlled conditions is proposed to be applied to mushroom cultivation in collaboration with Directorate of Mushroom Research, Solan.

## R&D Achievements

### Quantification of Black Tea Quality

#### Hybrid e-tongue and e-nose equipment for quantification of quality of Indian Tea:

Due to the large number of organic compounds present in tea, it is difficult to process tea to an absolute standard. The aroma and taste of tea depend upon certain volatile organic compounds and polyphenols (theaflavins and thearubigins) which develop during the fermentation process. In conventional tea tasting, it is difficult to keep a consistency in the standard of tea quality which varies from batch to batch during production.

Fabrication of multi array sensors: An *electronic nose (e-nose)* for aroma detection and *electronic tongue (e-tongue)* for taste detection in tea are under development. The electronic nose is being designed using 6 to 12 numbers of solid state sensors which are non specific in nature.

In another study for developing an e-tongue, sensors having conducting polymers on Indium Tin Oxide (ITO) coated surfaces doped with different anionic dopants have been fabricated. The electrochemical behaviour of these sensors in different solutions has been evaluated in Cyclic Voltametric (CV)/ impedance mode. Metal and semi conductor nanoparticles have been doped to enhance the efficiency of polymer sensors.

## Central Scientific Instruments Organisation, Chandigarh

Pattern Generation: Each odour or taste generates a characteristic pattern or fingerprint on the sensor array. e-noses and e-tongues are sensor types intended to simulate a sensory response, a specific flavour, sourness, sweetness, saltiness and bitterness. Various Indian tea samples have been studied using this sensing set up.

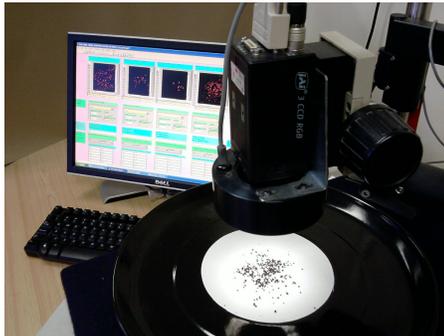
An experimental set up for e-tongue has also been designed using metal and conducting polymer sensors to collect taste data is being taken in impedance measurement mode.

Current R&D is focussed on optimisation of sample preparation, sensor data analysis and development of feature extraction algorithms.

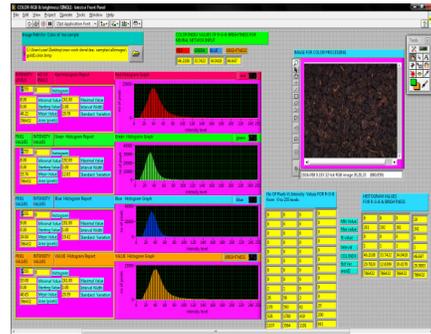
### Physical properties of black tea for quantification of quality

Physical parameters play an important role in the quantification of black tea quality. Hence a related set of studies of this project involves determining the physical properties of black tea samples like colour, particle size, brightness and moisture for estimation of tea quality. Image processing techniques are used for extracting these parameters.

A two step image capturing process was adopted for image analysis: The first step was *Metric Analysis* consisting of acquisition of tea sample images keeping the grains at sufficient distance apart without overlapping. After correction on acquired camera images to remove lens distortion and perspective error, the acquired images were calibrated for conversion of camera information into real world units. Particle information from the acquired image was obtained by applying pre-processing tools like convolution, thresholding and reversing. The analysis provided tea grain characteristics such as: total count, average size, perimeter, circularity and slenderness ratio of tea grains.



A view of the experimental setup



Results after processing of image

The second step was *Colour Analysis* for which 32 bit colour images of the tea samples were acquired. The illuminant used was pure white LED Ring Lights embedded over the camera lens. To avoid the effects of external ambient light, the experiment was carried out by under the setup under black covers. The RGB model was used for colour processing of acquired images as it is an additive model, easily understood to machine and the machine vision can give direct values of the colour in terms of numbers. From the 32-Bit colour image, the colour processing algorithm converts 24-Bit colour information into three colour planes Red, Green and Blue as per the RGB colour model. Information corresponding to each colour containing 256 intensity levels was calculated for each pixel and represented as a histogram.

The average colour index value of the image was calculated with the formula:

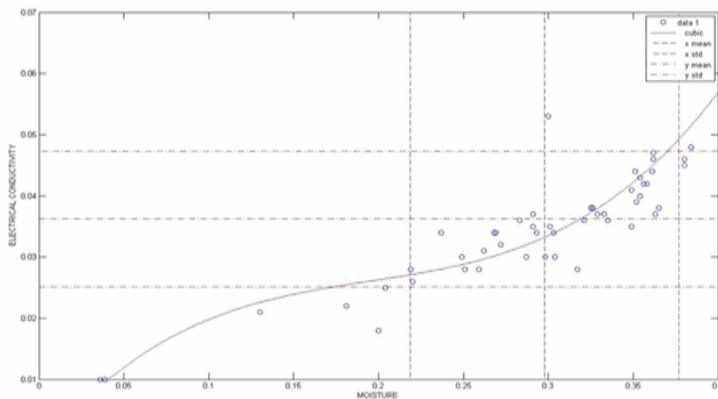
$$\text{Colour Index} = \frac{\sum \{P_1 \times I_1 + P_2 \times I_2 + \dots + P_n \times I_n\}}{\text{Total No of Pixels}}$$

where  $P_n$  is the pixel at  $n^{\text{th}}$  location and  $I_n$  is the colour intensity of that pixel, ranging from 0 to 255. The above formula was used to calculate Red, Green, Blue and brightness values of the tea sample image.

## Sensor and Instrumentation for Soil Properties

This research involves the development of different types of sensors to monitor soil salinity; appropriate electronics for sensing and measurement and the development of algorithms to interpret the sensed data from the soil fields. This data will further be correlated with other soil characteristics like total dissolved salts, moisture, soil temperature and texture.

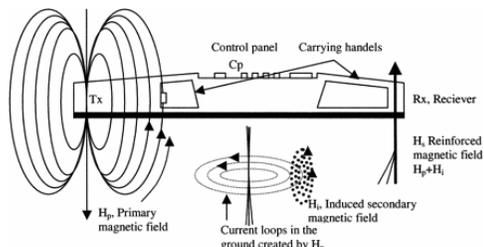
This year the following R&D activities were carried out: development of sensors - both contact and non-contact type; selection of various soil sites in association with Punjab Agriculture University (PAU) Ludhiana, generating soil salinity data both in the lab as well as in the field.



of EC Vs Moisture Plot

Electro-chemical (EC) conductivity measurements and surveys and generation of EC maps help in understanding physio-chemical properties of soil in enhancing agricultural productivity. From the EC data, various prediction models and other soil property mapping are also being carried out to build up site specific models for studies.

The sensor was composed of a transmitter and a receiver coil installed 1 meter apart on a non-conductive bar at opposite ends. The transmitter coil was energized with an alternating current, generating a time varying magnetic field in the earth which produced proportionate emf in the receiver/ secondary coil, representing soil EC.



Schematic diagram and experimental setup for measuring soil conductivity of soil using non contact methods

EM coils of various geometries have been fabricated. Experiments have been conducted to study sensor response by varying signal frequencies to optimise the design parameters. Field measurements have been carried out with DSP based gauss meter.

## Central Scientific Instruments Organisation, Chandigarh

From the EC data various prediction models and other soil property mapping are being carried out to build up site specific models. GIS modelling to understand spatial variability of soil is in progress.

Various soil sites have been selected in association with Punjab Agriculture University (PAU) Ludhiana and a fair amount of soil salinity data has been generated, both in the lab as well as in field.

## Instrumentation System for maintaining Quality of Potatoes during Storage

In conventional cold storages, potatoes are not stored at suitably low temperatures polysaccharides (starch) in the potatoes convert to sugar. At these higher temperatures sprouting occurs followed by weight loss, resulting in spoilage and loss. To avoid the conversion of starch into sugar and other related problems, a modern storage house having sensors and electronic controls has been developed to maintain the quality of potatoes under optimum environmental storage conditions.



*Potato Storage chambers with sensors and electronic controls*

Under this program, four storage chambers along with an air handling system have been installed and tested. Each chamber is fitted with temperature, Relative Humidity (RH), CO<sub>2</sub> sensors, electronic control and data acquisition system.

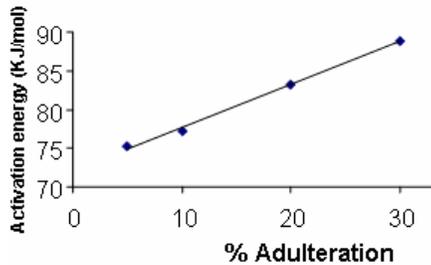
Potato baskets of different varieties are stored in the chambers at preset environmental conditions. The samples are regularly drawn from the chambers and analyzed for sugar content, dry matter content, weight loss (if any) and sprouting. The storage parameters

will be altered in the subsequent season to derive the optimum environmental storage parameters for specific varieties in close consultation with scientists of the Central Potato Research Institute, Shimla.

The data generated will be used to establish optimum storage environment parameters for different varieties of potatoes. The knowledge base thus acquired will be embedded into the monitoring and control software as per the desired agro-climatic conditions. The system analyzes and computes desired environmental conditions and accordingly activates appropriate controls, thereby maintaining the quality of the potatoes with minimal possible weight loss.

The facility created and techniques developed for the estimation of specific gravity, dry matter content reducing sugar (dextrose, sucrose) and chip colour are being standardized jointly with Central Potato Research Institute (CPRI) Shimla.

## Quantification of quality of honey



Variation of activity energy with percentage adulteration

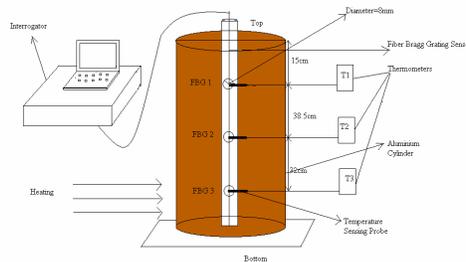
at progressive degrees of adulteration indicate the possibilities of detection of adulteration in honey.

This study deals with the characterisation of honey in terms of its physical properties such as moisture content, colour index and viscosity.

Measurement models are being worked out to quantify the quality and deterioration in quality due to adulteration. Expertise available in the laboratory on Infra Red (IR) and near Infra Red (NIR) spectroscopy is applied along with other sensing techniques to develop an instrument with immense applications in the herbal medicine industry. A typical plot showing activation energy in KJ/mole

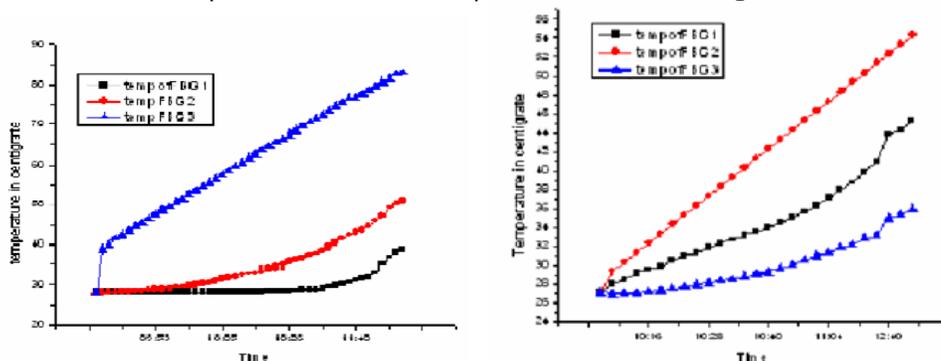
## Lab study for temperature measurement in agri-soil using Fiber Bragg Grating (FBG) sensors

FBG sensors developed in the laboratory showed promising results for distributed temperature measurements in soil owing to their several advantageous technical features.



Experimental and schematic set up for distributed temperature monitoring of soil.

The study involved three FBGs at Bragg wavelengths 1545.941, 1550.781 and 1555.750 nms with an inter-separation of 300 mm. These were fabricated, characterized and used to monitor soil temperature at different depths as shown in the figure.



Temperature response of soil at three locations where soil has been heated from below (left graph) and in the middle (right graph) of the soil column

A structure was fabricated to house FBG sensors at specific depths to record the moisture retention capability of soil based on thermal mapping. Such studies are useful to soil scientists for characterising the suitability of soil for appropriate crops. Discussions with scientists of Punjab Agricultural University (PAU) in Ludhiana are in progress to use this information for different plantation practices. The results obtained are shown in the accompanying figure.

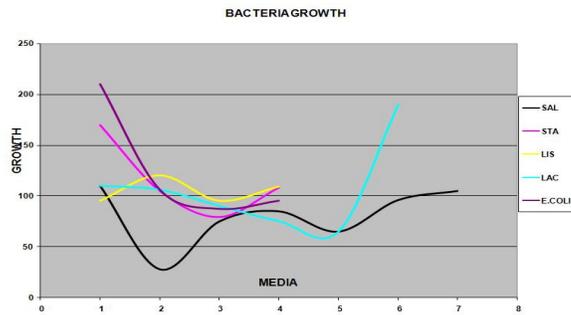
## **Sterilisation of Processed and Semi-processed Foods using the Pulsed Electric Field (PEF) technique**



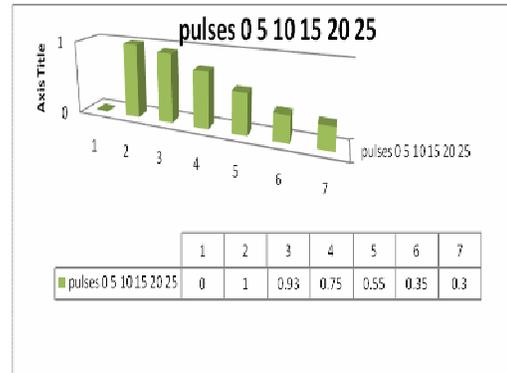
*Assembly of static chamber*

Pulsed electric field (PEF) technique is a non-thermal method for food preservation which uses very short duration high voltage pulses for microbial inactivation. A stainless steel static chamber was designed with dimensions 38 mm height, inner diameter 125 mm (5"), and electrode surface area of 75.4 cm<sup>2</sup>. All these components were assembled and tested.

Bacterial growth kinetics were used to measure the concentration of bacteria in a particular liquid food using the turbidity method. The bacteria was isolated from milk and then inoculated in a specific broth. The sample was incubated for 24 hours to allow for the growth of the microbes. Bacterial growth was counted using the colony counter method.



*Bacterial growth on different media such as E.Coli in EMB media, lactobacillus in MRS Agar, salmonella in deoxycholate media, Staphylococcus in chapmann agar media*



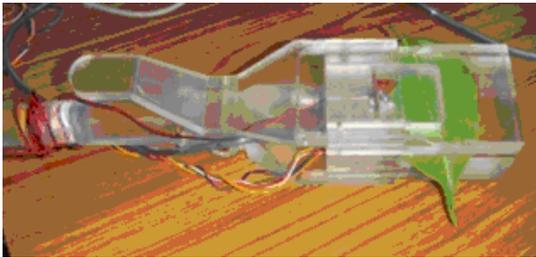
*Impact of pulsed electric field on bacterial cells*

Electrical stimuli were applied at room temperature for inactivating the micro organisms, at varying time intervals and voltages. The effects of such excitations on bacterial growth on different media, and the impact of the pulsed electric field on the bacterial cells are illuminated in the adjoining figure. This study has been carried out under a networked project with the Central Food Technology Research Institute, Mysore.

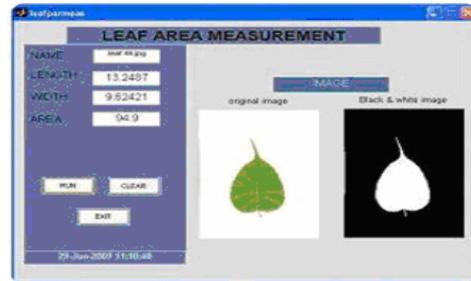
## Sensor and Instrumentation for Crop Growth (Photosynthesis)

The net photosynthesis rate of a plant is expressed as the rate of carbon dioxide uptake in the presence of sun light. A system is being developed to measure the photosynthetic activity of plant leaves on the oxygen exchange principle to determine the optimized environment required for plant growth.

A light, transparent and air tight chamber was designed to hold single leaves of varying dimensions. The sensor monitors the flow of CO<sub>2</sub> using CO<sub>2</sub> adsorption sensor (NDIR analyser). The leaf can simultaneously be exposed to atmospheric air and sun light for adsorption of CO<sub>2</sub> so as to calculate the photosynthesis rate. Algorithms for data acquisition, sequential control of gas flow and for calculations of the photosynthesis rate were developed on the LabVIEW platform. A modular system has been assembled and is currently under testing. The gadget finds extensive applications in precision farming.



A view of the leaf sensor head in use



A screen from the software application

## Medical Instrumentation



*Prototype Surgical Microscope for Cataract Surgery in use*

Medical Instrumentation has been an important area of R&D at CSIO. With two operational 6 MV LINACs and 513 patients treated at the two locations, CSIO is now working on 4 additional, improved LINACs with Beam Intensity Control in XYZ directions with advanced field and range optics.

A prototype unit of the Electronic Portal Imaging Detector (EPID) has been fabricated and system integration including synchronisation of imaging modes is in progress.

The surgical microscope developed for cataract surgery was put on patient treatment by the Ophthalmology Department, Government Medical College and Hospital at Patiala. Nearly 50 cataract

operations were successfully performed using this unit at an Eye Camp held at Shah Satnam Multi-specialty Hospital, Sirsa during December 13 to 15, 2008.

During the past year, our Hydraulic Artificial Knee Joint and Pulse Oximeter were transferred to PB Motors and Mono Blocks, Amritsar and to Rajasthan Electronics and Instruments Limited (REIL), Jaipur, respectively.

## R&D Achievements

### 6 MV Medical LINAC



*Jai-Vigyan 6MV Medical LINAC Installed at MGIMS, Wardha*

The Department of Information Technology (DIT) under the aegis of Jai Vigyan National S&T mission project initiated the development and deployment of 6MV integrated medical LINAC (Linear Accelerator). This project was formulated with a view to establish a manufacturing facility in the country based on field-proven technology. Under this program, 6 machines were to be fabricated and deployed in 6 different cancer hospitals in the country. During the first phase of the program, two machines have been developed and installed at Mahatma Gandhi Institute of Medical Science, Wardha in 2007 and Regional Cancer Centre, Adyar, Chennai in 2008. In the next four years, under the second phase, remaining four machines will be installed in four other cancer hospitals in the country. The lower cost and indigenous availability is expected to spur the latent

demand in the country to the level of 10-15 machines per year.

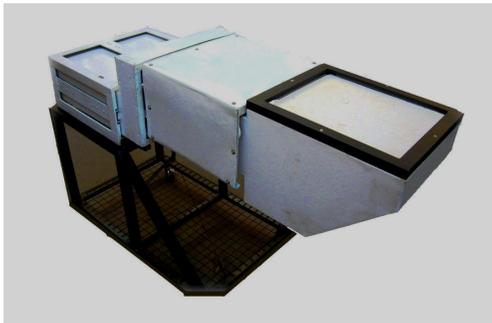
Our second 6 MV LINAC was installed at Cancer Institute, Chennai and inaugurated on April 8 2008 by the Chief Minister of Tamil Nadu. The two LINAC's have treated over 600 patients.

## Research and Development Achievements

The development of two integrated oncology systems using 6 MV Medical LINAC “SIDDHARTH” and their type approval by the Atomic Energy Regulatory Board (AERB) has given a major boost to the national medical LINAC programme. Machines installed in phase II of the programme will have the additional feature of Beam Intensity Control in XYZ directions. It is further planned to take up development of Field and Range optics, along with improved field optics and optical distance indicator to enhance the performance.

### Electronic Portal Imaging Device (EPID)

In order to accurately deliver a prescribed radiation dose to cancerous tumours while sparing the surrounding healthy tissues, one needs a suitable portal device for appropriate treatment planning. The geometric accuracy of patient positioning relative to treatment beam is crucial and there are a number of factors which affect this accuracy.



*The Electronic Portal Imaging Device*

Incorrect patient alignment relative to the treatment beam, mis-alignment of the light field versus radiation field, shift of skin marker and patient movement are some of the prime factors.

The Electronic Portal Imaging Device (EPID) being developed in the laboratory promises the above features and facilitates checking proper dosage. This device will complement the existing CSIO LINAC systems for enhanced performance.

During the year, work was carried out on physical fabrication of a camera-based EPID, Graphical User Interface (GUI), synchronisation and implementation of different image acquisition modes of operation and integration of EPID positioning, etc.

### Development of Electronic Knee

R&D activities on prosthetic devices included the electronic knee with various features required as per specific patient needs. Active association with organisations like the National Institute for Orthopaedically Handicapped, Kolkata, the Artificial Limbs Manufacturing Corporation of India (ALIMCO), Kanpur and Saket Hospital, Panchkula led to freezing of various design parameters which are being incorporated in various models of knee.

**Gait Pattern Studies:** The initial experiments carried out with polyvinylidene fluoride (PVDF) film did not produce encouraging results. A prototype Force Sensitive Resistor (FSR) sensor mechanism was developed to study gait patterns. Information derived was utilised to develop a rugged and robust sensor mechanism for prosthetic shoe design. This will help in determining the gait parameters for precise control of intelligent prosthetic devices.



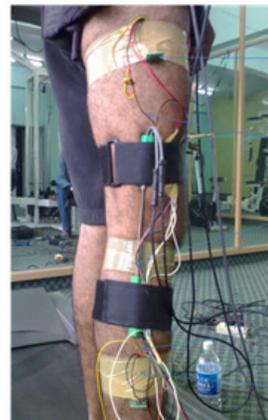
*Placement of FSR sensors (at left)*

*The CSIO Electronic knee (at right)*



**Swing acceleration studies:** A sensing mechanism for precise measurement of acceleration of human body segments and knee joint angle for gait analysis was developed and tested. This mechanism consists of two indigenously developed tri-axis accelerometers. Experimental trials were conducted for walking at different speeds on electric treadmill to acquire knee flexion-extension angles and acceleration of normal subjects. Experimental results were correlated to establish the relation between knee angle and acceleration of lower limb.

**Device design and fabrication:** Mechanical design of pneumatic knee was carried out and fabrication of the first prototype electronic knee was completed. The unit has three walking modes: slow, normal, and fast. Real time dynamic swing control of knee was generated for governing the gait of amputee.



*Experimental setup for Accelerometer*

## Development of Above-elbow Prosthesis



*Elbow joints of different design*

In the Above Elbow Prosthesis developed at CSIO, the elbow assembly has been fabricated using worm and worm gear mechanism. The gear is attached to a DC motor for elbow movement. The device has a robust structure, providing a consistent speed of 45 degrees per second with a load carrying capacity of 500 grams. The maximum working rotation angle of this joint is  $0^{\circ}$ – $135^{\circ}$ . This

mechanism gave no backlash with the arm movements easily controllable with the help of EMG signals of the amputee.

Electrodes pick up the surface EMG signals on the residual limb which after processing control the DC motor of the hand for closing and opening operations.



*The CSIO above-elbow prosthesis and myoelectric hand*

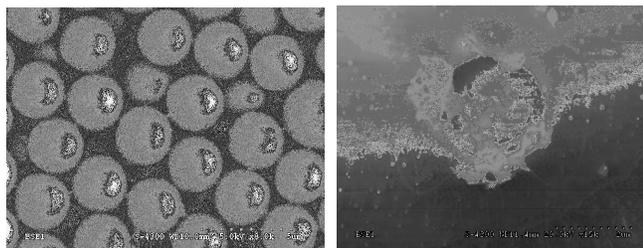
## Transportation of Drug-Polystyrene conjugate by Actomyosin Motor System

Various research activities were conducted to understand the bio-nano technological aspects leading to the development of bio-sensors based on several approaches. A multi-disciplinary team having active coordination with academic and research institutes investigated the basic mechanisms to facilitate further in the field of nano-sensors design.

Studies were carried out on the transportation of Mesalamine / 5-aminosalicylic acid / 5-ASA drug through molecular motors to observe the action behaviour. Mesalamine is an anti-inflammatory drug used to treat Crohn's disease and ulcerative colitis. Conjugate of Mesalamine and polystyrene beads (Dia.:  $3\ \mu\text{m}$ ) were prepared by amide linkage and the results were confirmed by FT-IR spectroscopy technique as depicted in the micrograph.

## Research and Development Achievements

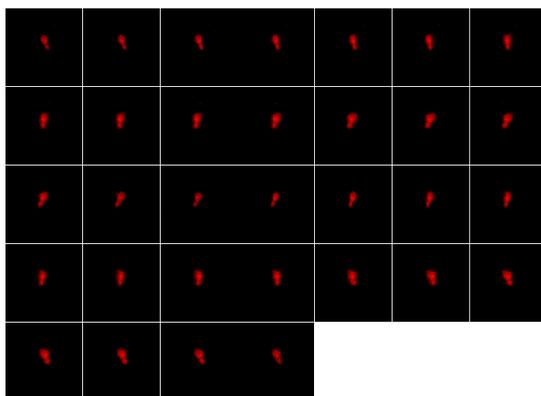
UV-vis spectroscopy revealed that about 93% of 5-ASA was loaded on polystyrene beads.



(A)

(B)

FE-EM images of (A) carboxylated polystyrene beads and (B) 5-ASA loaded polystyrene beads



(Left) Confocal images of drug loaded bead tailed actin filaments with rotational motion. 3-D view of actin filament attached to polystyrene beads showing the attachment of single bundle of actin filament to drug loaded beads.

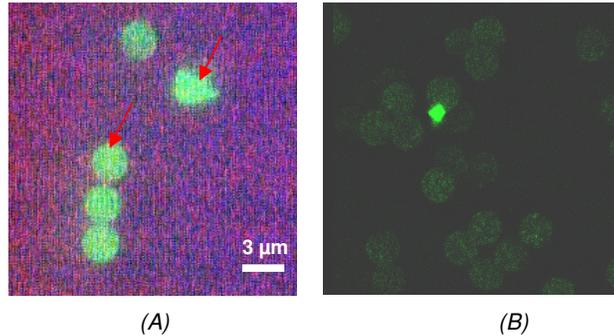
This conjugate was then covalently attached to actin filaments. Velocity of drug loaded beads attached with actin filaments in *In-Vitro* motility assay reduced to  $0.89 \mu\text{m/s}$  as compared to the velocity of free actin,  $4.64 \mu\text{m/s}$ . This work provides an insight into the actin-myosin based molecular motor mechanism as an efficient tool for drug transportation.

## Effect of Electric Field on Orientation of Actin Filaments Aligned on APTES Microtracks

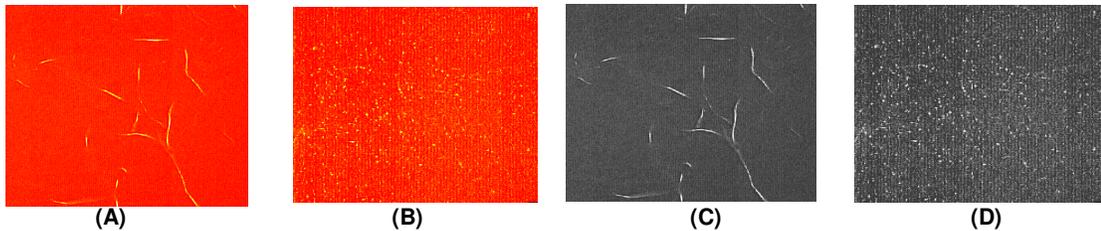
A cost efficient nanoassembly procedure was developed to selectively assemble actin filaments onto specific locations. Studies have been carried out on the effect of surface patterning, self-assembled actin filament tracks and electric field on motility assay confinement and unidirectional control of myosin. Nanotracks were fabricated as a patterned surface using 3-aminopropyltriethoxysilane (APTES) on glass surface. Patterned surfaces were prepared with a spot size of  $80 \mu\text{m}$  with an interspacing of  $50 \mu\text{m}$  using microarray spotter. Structural polarity of F-actin was attained by capping negative end with biotinylated gelsolin which inturn convert F-actin into biotinylated F-actin. F-actin was visualized as long fluorescent filaments while biotinylated F-actin was observed as fluorescent dots on optical tweezer. To use myosin as a fomites and aligned actin as a track, velocity of fluorescein isothiocyanate (FITC) labeled myosin sliding over actin filaments was estimated using tracking program developed in MATLAB. Velocity of myosin on nitrocellulose coated surface and APTES coated surface was found to be  $3.50 \mu\text{m/sec}$  and  $2.97 \mu\text{m/sec}$  respectively. Lateral alignment of immobilized actin filaments along the desired direction was attained by applying  $5.0 \text{ V}$  electric field. Present study for nano- micro fabrication is efficient in governing control over molecular motor systems

## Central Scientific Instruments Organisation, Chandigarh

which can lead to promising applications such as sensing, nano-mechanical drivers, and biocomputation.



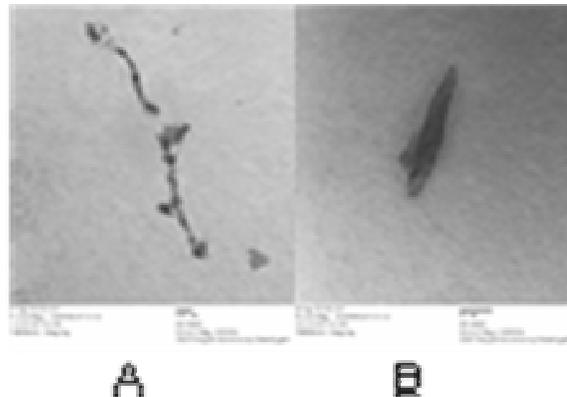
Attached myosin to carboxylated polystyrene bead. A, B for 3 μm bead represent fluorescent image, threshold image????? PLS FURTHER EXPLAIN THE PHOTOGRAPHS



Fluorescence Image showing non biotinylated actin filaments bound to thin glass surface (A) and biotinylated actin filaments bound to streptavidin patterns generated on APTES nanotracks (B). Grey scale images of unaligned and aligned actin filaments (C&D)

## In-Vitro Transportation of Drug Molecule by Actin Myosin Motor System

In this approach, binding of 5-ASA to actin filament was achieved by streptavidin-biotin cross linking. Here, succinimido group of NHS-Biotin will be attached to free amine group present on 5-ASA forming drug-biotin conjugate. Biotinylation of F-actin was attained by capping negative end with biotinylated gelsolin, which inturn convert F-actin into biotinylated F-actin.



TEM images of actin filaments. 'A' represents 5-ASA molecules on actin filaments while 'B' shows actin filaments without 5-ASA molecules

## Research and Development Achievements

Attachment of drug with actin filament was attained by reacting drug-biotin conjugate with streptavidin. Biotinylated actin filaments were reacted with drug-biotin-streptavidin complex to achieve drug-biotin-streptavidin-actin complex. As streptavidin has four biotin specific sites, two sites will attach to drug-biotin conjugated while the remaining two will be available for biotinylated actin filaments. Confirmation and quantitation of attachment of drug was done by UV-vis-spectroscopy, Transmission Electron Microscope, Atomic Force Microscopy and High Performance Liquid Chromatography. Transportation of drug attached to actin filaments was directed by applying a weak electric field. Velocity of actin filaments attached to drug was calculated by tracking program developed in MATLAB. Present study provides an insight into the actin-myosin based molecular motor system for drug transportation.

### Length based separation of CNTs

CNTs of varying length have been separated to obtain specific lengths by employing liquid-liquid extraction of their aqueous dispersion with a solvating extractant cyanex 923. Lower extractant concentration separates smaller CNTs. Stepwise increase in the cyanex 923 concentration results in grouping of CNTs according to their lengths. This study is useful for establishing end user application of CNTs in fabrication of bio-nano sensors, probe tips and targeted drug delivery.

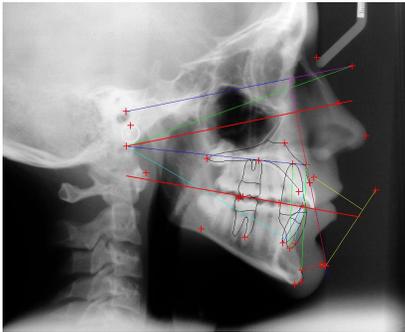
### Modular Reconfigurable Micro Manufacturing System (MRMMS) for Multi Material Desktop Manufacturing Capabilities

Manufacturing systems have advanced to a significant level of precision to cater to the growing needs of the 'soft manufacturing' sectors heavily influenced by the state-of-art in Mechatronics research. This has facilitated the scaling down of operational characteristics from macro level to micro, meso and nano levels.

The rationale behind the miniaturization is material saving, lower drive power due to low inertia and high degree of process control and displacements of mechanical systems. Micro products also lead to small, smart and handy products. The micro systems have found wider applications in automobiles, space, medical, process control etc.

CSIO has taken up the development of control systems for desktop micromachines: microlathe, micromilling and microEDM. CEERI Pilani, NAL Bangalore and CMERI Durgapur are the other CSIR labs participating in this networked project. The laboratory focussed mainly on instrumentation aspects in terms of hardware assembly and testing of micro-motion in X, Y and Z directions through suitable driver control modules. Control algorithm configurations were studied for initial simulation studies.

## Computerized Cephalogram Analysis for Orthodontics



*A view of the cephalogram images tool developed at CSIO*

A cephalogram or a cephalometric radiograph is an x-ray image of the structures of the head. The aim of this project is to devise an automated tool for marking landmarks on lateral x-ray images. The system generates structure from such images using the landmarks and special curves extracted from the images. Patient images acquired during different stages and the analysis therein help in treatment analysis and planning.

The intermediate stage of the project includes collaboration with AIIMS, Delhi. A one year collaborative work for testing and validation has also been initiated. A typical view of cephalogram image

tool developed in the laboratory show these features.

## Portable Reading Machine for Blind

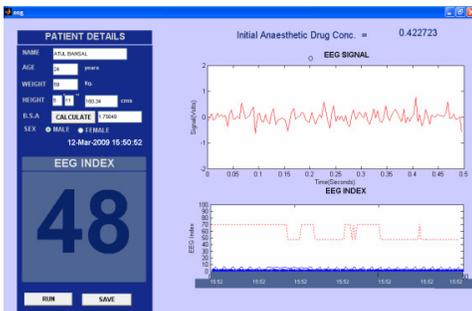


*(Left) The CSIO portable reading machine in use*

The broad portable reading machine for blind persons is aimed at development of a portable device which will assist blind persons to read printed text (documents and books). The device is standalone and ergonomically designed to suit the reading process in steps. A novel step-scanning algorithm for scanning and reading a document without any moving part has been implemented in the device which is shown in the photograph.

The design aims towards light weight and reduced size using compact imaging mechanism and aspheric lens philosophy ultimately leading towards a configuration for societal applications.

## On-line Depth of Anaesthesia Delivery



*A view of the result screen of the Online Depth of Anaesthesia software*

The need for appropriate anaesthesia administration and its regulation during the course of a surgical operation has been long felt. The prevailing practice of occasionally looking at the clinical signs and administering of anaesthetic drug by anaesthetist's experience is hardly convincing. Awareness with explicit recall of pain still occurs (although such incidents are rare) and is often reported by victims as the worst experience of their life. There is a need to provide technical assistance for better management.

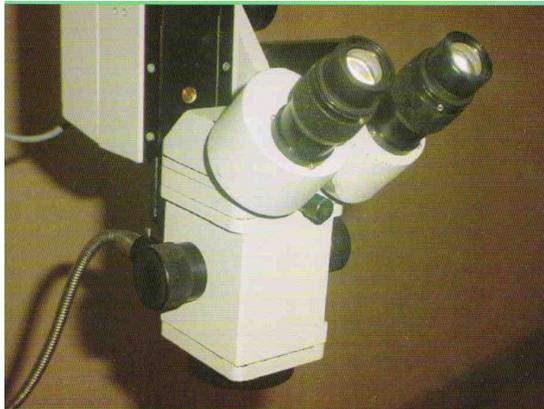
## Research and Development Achievements

The aim of this project is to predict the anaesthetic dose to be administered to the patient all throughout the surgery. This involves testing of existing anaesthesia ventilator in hospital, monitoring the depth of anaesthesia based on EEG, modelling the transfer characteristics between dose and anaesthesia index and calculating the dose based on this transfer function. All the above testing will be done on sub-human primates. Application for Ethical Clearance for data collection from AIIMS, New Delhi is under active consideration.

The algorithms for determination of Online Depth of Anaesthesia Monitor have been written based on EEG parameters and testing is under progress.

### Surgical microscope for Cataract Surgery

An indigenous microscope for intra-ocular lens transplant surgery was developed based on optimised lens assembly associated with electronic and mechanical modules. The optical design is based on the principle of telescopic magnifier having five steps



*The CSIO surgical microscope*

magnification changer. The four steps of magnification are achieved by introducing telescopes of desired power between CMO and tube lens while the fifth step of magnification change is achieved by direct viewing through magnification changer. The viewing head is binocular to achieve a stereoscopic view of the field with sufficient depth of focus, a desirable requirement of eye surgery. The optical design so achieved comprises the basic technical requirement of large working distance at relatively low magnification.

Televising surgery through a CCTV can further enhance the standard of teaching, documentation and coordination apart from the actual surgery. The sub-assembly incorporating beam splitter has been designed to fix the CCTV camera to capture desired instances under on-line conditions.

A separate illumination system using fiber bundle and halogen lamp by designing optics for efficient co-axial object illumination has been incorporated.

Some salient features of this microscope are: Sufficient large working distance between operation field and microscope; A true stereoscopic observation for reliable acquisition of 3 dimensional structure of the object field; Good resolution with adequate contrast; brilliant and uniform illumination of the field of operation and also in depth of cavity; position and diameter of the Exit Pupil to portray an easy and reliable acquisition of entire field of operation at different angles also for spectacle wearers; adequate useful magnification range to guarantee a rapid change over from low power to high power for detailed observations.

The clinical trials of the microscope this were successfully completed in the Shah Satnam Multi Specialty Hospital, Sirsa, during an eye camp in which around 50 surgeries were performed using this microscope. Request for technology transfer has been received and the process has been initiated.

## Polycarbonate Low Vision Aids (LVAs) for Reading

The research pertained to development of Polycarbonate Aspheric Lens Visual Reading Aids which will cater to the requirement of near vision tasks for visually challenged persons. Spherical glass magnifiers of high dioptric powers cause distortion of the reading material at the periphery of the lens, thereby reducing the field of vision.

The powers 12D and 26D cover the two extreme ends of requirements. Aspheric lenses with optical grade new materials have dual advantages in terms of better aberration-correction with fewer elements and offer a weight reduction factor of 3.

Fabrication and clinical trials of the lenses are in progress at AIIMS, New Delhi, National Institute for Visually Handicapped (NIVH), Dehradun and Shankar Netrayalay, Chennai.

## Dual format Aspheric-based zoom Tele-microscope for low vision persons (LVPs)

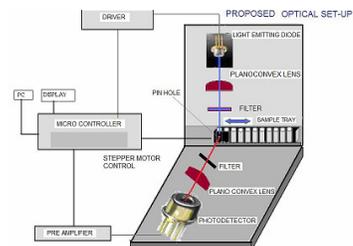
High cost Tele-microscopes are available in the international market with fixed magnification. R&D was undertaken to develop PAL-based zoom Tele-microscopes for near and medium distances. Variable magnification will be in the 2X to 6X range. The lenses will have a dual handheld or spectacle mountable format.

System Analysis and Optical Design of the proposed Tele-microscope has been completed and the work on the mechanical design is in progress.

## Development of an Instrument for Antibiogram (MDR in bacteria)

The objective of this work is to develop a simple method to assess the susceptibility/resistance of bacteria to antibiotics and build a sensor-based instrument for high throughput analysis useful in surveillance. An antibiogram is a spreadsheet/ table of culture and antibiotic sensitivity data in the microbiology lab. This table used to identify the best suited antibiotic for a particular disease. Since microorganisms are resistant to different antibiotics (MDR), identifying a suitable antibiotic by conventional techniques is time consuming. CSIO along with Centre for Biotechnology, Anna University, Chennai is developing an instrument for early identification of the microorganisms which are

resistant to antibiotics. The block diagram of the system is shown alongside.



Block diagram – Instrumentation for Antibiogram

software was developed to download the output: susceptibility of the antibiotic to particular bacteria.

Fluorescence detection/Image processing methodologies and its application for the above problem were studied and the fluorescence technique for development was selected. A signal conditioning system for detecting fluorescence level with 24 Bit A/D converter and microcontroller was designed and tested.

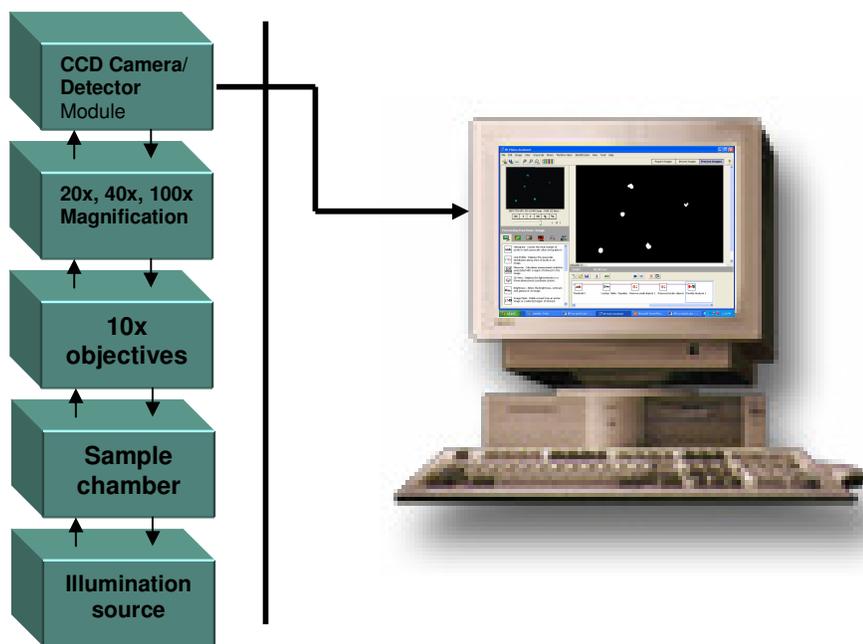
A stepper motor controller was designed to control the movement of optical detection unit and interfaced to microcontroller. A serial interface with a PC and

### Development of Instrument for parasite detection using fluorescence and image processing

This work aims to develop an indigenous design of fluorescence image capturing and digital signal processing to identify the species of malarial parasite in the buffy coat separated from a small volume of (55-110  $\mu$ l) of blood sample.

Malaria is caused by protozoan parasites of the genus Plasmodium. It is the most serious widespread parasitic disease of humans with high morbidity rate. Of the four species known to infect humans, Plasmodium Falciparum is the most virulent. Manual diagnosis by light microscopy is the most prevalent technique for Malaria diagnosis. However, this is time-consuming, cumbersome and mostly relies on the expertise of the technician.

Rapid, reliable and precise determination of the parasite is necessary for malaria research and clinical diagnosis. Our proposed parasite detection Instrument is a semi-automated system using image processing and fluorescence technique for the detection of malaria parasite (species and stage) in blood samples. This system consists of Illumination source, sample chamber, 10x objective, 20x,40x, 100x magnification and CCD camera with USB 2.0 interface. The design, as illustrated in the accompanying figure, consists of 4 stages: image acquisition, pre-processing, advanced morphological operation and classification.



*Optoelectronic System*

*PC with Image Analysis*

This system would be a rapid, reliable diagnosis system to monitor the efficacy of the therapy. This will also be a replacement for the existing time consuming and tedious microscopic examination. The digital data will be useful for statistical analysis/epidemiological databases.



## Technical Services and Infrastructure

CSIO is catering to the need for quality technical services including Annual Maintenance Contracts (AMCs) and Calibration Services in the country through its Service & Maintenance Centres located at Delhi and Chennai.

### New Infrastructure

#### Virtual Instrumentation (VI) Lab

Virtual Instrumentation (VI) Lab recently set up at Central Scientific Instruments Organisation (CSIO), Chandigarh was formally inaugurated by Prof. Samir Brahmachari, Director General, CSIR on 20<sup>th</sup> June, 2008. It is a centralized facility, having all modern facilities with customizable software and modular measurement hardware to create user defined measurement systems called virtual instruments as their appearance and operation imitate physical instruments.



*Prof Samir Brahmachari, Director General, CSIR, inaugurating the Virtual Instrumentation Lab*

Equipped with industrial PCs having 10 PCI slots, RAID-5 interface and multiple ports for external connection purpose, the VI Lab also has the facilities like WINCE based

Embedded Trainer System having vortex 86 CPU, ARM 7 AND PIC16F877 based microcontroller kits and development tools along with C-Compiler, Universal VLSI Trainer Systems having XILINX ISE Foundation and Altera Quartus II along with GPIO boards and user code composer studio. Embedded kits with 12, 14, and 24 bit multifunction cards, digital as well as analog I/O and converter cards etc are also available in the lab. Different types of data Acquisition Cards (Motion and Vision), PC Lab cards and DSP Learning Kits, LabVIEW Ver 8.2 Developer suite, Matlab Ver 7.3 and Oracle 10g are the other highlights of VI lab.



*A view of the VI Lab*

Utility benefits of the facility: This state-of-art facility with a comprehensive set of tools is very useful to scientists for acquiring, analyzing, displaying and storing data using latest tools to help them troubleshoot their code they write. It has different virtual and real time environment software for checking the feasibility of the experiments made by the scientists.

## Advanced Optical Metrology Lab



*Advanced Optical Metrology Lab at CSIO inaugurated by Shri Kapil Sibal, Hon'ble Minister for Science & Technology and Earth Sciences, Govt. of India and Vice President, CSIR on 30th October, 2008*

A new environmentally controlled Advanced Optical Metrology Laboratory having several ultra-modern and state of the art optical metrology equipments suitable for measurement and testing of different quality evaluation parameters of fabricated spherical and aspherical optical components and assembled systems has been established. Shri Kapil Sibal, Hon'ble Minister for Science and Technology & Earth Sciences,

Government of India and Vice President of CSIR inaugurated the facility on October 30, 2008. The lab is equipped with a range of equipments which are used for performance evaluation of spherical and aspherical optical components as well as electro-optical & optomechanical systems. Different capabilities include Zygo and Kugler interferometers, contact and non-contact surface profilers, surface characterization, MTF

of optical system, centering error and focal length measurements, laser centering device.

## Semiconductor Characterization System



The 4200-SCS Semiconductor Characterization System performs device characterization, real-time plotting, and analysis with high precision and sub-picoamp resolution. It will be used for characterization of semiconductor devices, resistive or capacitive MEMS drive characterization and Materials research.

*The 4200-SCS Semiconductor Characterization System (at left)*

## Video Conferencing Facility at CSIO

Under the CSIR/ ICT initiative aimed at connecting all CSIR laboratories through video conferencing in order to have interactive sessions to affect overall functioning, a video conferencing facility was established at CSIO and became functional from October 2009.

A shared 6 Mbps leased line and a 384 Kbps ISDN line are being used for video conferencing. Major features of the facility include a Polycom- Video Conferencing equipment, Samsung- 50" Plasma Screen, Onida- Document Camera and Polyvision- Interactive White Board. This equipment is housed in a custom made soundproof video conferencing room. A number of successful interactive sessions have been conducted since installation of the facility.

## Network/ Spectrum/ Impedance Analyser

## Central Scientific Instruments Organisation, Chandigarh

The impedance analyzer is a useful tool for testing a wide variety of components and materials under various test conditions in the Intelligent Instrumentation Decision Unit. It has the the following characteristics:

- Network Analyser: operates from 100 kHz to 1.8GHz with 1mHz resolution, its integrated synthesized source provides -60 to +20 dBm of output power with 0.1db resolution. Dynamic magnitude and phase accuracy are +/-0.05 db and +/-0.3 deg allowing it to measure gain and group delay flatness.
- Spectrum Analyser: operates in the 2 Hz to 1.8 GHz resolution bandwidths (RBW s) spanning 1 Hz to 3 MHz in a 1-3-10 sequence. A fully synthesized local oscillator enables frequency analysis. Direct A/D conversion allows +/- 1.0 dB level accuracy.
- Impedance Analyzer: measures impedance (inductance, capacitance and resistance) at spot frequencies or across a range of frequencies. DC bias and the AC signal level swept measurement functions are available to evaluate the device under actual operating conditions. Also offers temperature characteristics measurement solution in temperature ranges from -55 c to 150 C.

## Confocal Microscope with Correlation Spectroscopy



The Confocal Microscope with Correlation Spectroscopy has the following features: Single molecule detection and molecular interaction in 3D; Multi-channel laser scan fluorescence imaging; Capability for acquisition of spectroscopic data from solutions in multi-well plates and tissue preparation on slides.

*The Confocal Microscope with Correlation Spectroscopy(at left)*

## Field Effect Scanning Electron Microscope (FESEM)



The Field Effect Scanning Electron Microscope has the following characteristics: Electron Beam :0.5 to 30 KV (variable at 100V/ step); Magnification : x 20 to x 500,000; Resolution : 1.5 nm; The microscope will be applicable to insulating materials and biological samples.

*A view of the Field Effect Scanning Electron Microscope (at left)*

## Spectroscopic Ellipsometer

Spectroscopic ellipsometer (model-M2000) is used for characterization of materials: dielectrics, semiconductors, metals, organics and more. It uses polarized light to probe the dielectric properties of a sample to find the thickness and optical constants (n and k) of thin film and multilayer. Spectral ranges covered are from UV to far IR.

## Technical Services and Infrastructural Facilities

The instrument has rotating compensator ellipsometry with high-speed CCD detection, allowing collect data from entire spectrum in a fraction of a second with an array of configurations. It can be used to determine optical constants, multilayer thickness, alloy composition, surface and interfacial roughness, band gap and electronic transitions, constituent and void fractions.



*A view of the Spectroscopic ellipsometer*

## Technical Services

### Mechanical Workshop

The Central Mechanical Workshop is an infrastructure support facility for design and development of scientific instruments, mainly in the area of optical, mechatronics and electronics. It is a centralized facility for the development, fabrication of precision mechanical components for projects undertaken by the organization.

During the year, some major jobs undertaken were: Prabha Electronics, Industrial Area, Chandigarh has utilized design tools for the development of LOT valves for gases distribution, resulting in a bulk order for its fabrication; Deep Industry, Industrial Area, Chandigarh has utilized our design and fabrication expertise for the development of gear and gear train (assembly of 147 gears) required for Radar transmission system for defence applications. The prototype of the gear box has been successful; CSIO provides local industries and institution with calibration facilities for measuring equipments and standards in linear dimensions measurements. Our clients include Godrej, BBMB, Tata Motors and Ranbaxy.

### Quality System Initiative

CSIO is certified for establishing and maintaining a quality system as per ISO-9001:2000 standard in respect of three areas/ divisions: Central Mechanical Workshop, Indo Swiss Training Centre (ISTC) and Standards and Calibration Division.

Since the standard is getting obsolete throughout the world, it is felt necessary to up date standards with that of new version ISO 9001: 2008. Efforts are being made to update the quality management system, Audits will be conducted by the certifying agency.

The scope of the certification will be:

To fabricate mechanical components and assemblies, systems & sub systems required for scientific instruments; To impart technical training in the field of instruments Technology, Die and Mould Making, Mechatronics and Industrial Automation, Calibration services.

### CSIO Chennai Centre

As part of the Energy Management System for BHEL, Ranipet, CSIO Chennai Centre had developed an Energy Management System and software. Under Phase II the EMS is being tuned to monitor their critical equipments and to connect the EMS to their LAN by WEB enabled services. The system has been successfully installed and evaluation of the system is under observation.

## **Central Scientific Instruments Organisation, Chandigarh**

CSIO Chennai Centre has a well established testing and calibration laboratory equipped with high accuracy and sophisticated calibration standards (secondary standards) for measuring electrical parameters, pressure, temperature, speed, length, mass and analytical parameters etc. Three areas viz. Electro-Technical, Mechanical & Thermal & Optical were identified for NABL Accreditation. It is serving regional public and private institutions and has more than 550 customers.

CSIO Chennai Centre has established testing facilities for conducting energy studies. CSIO conducts selective energy studies in addition to other ongoing energy R&D projects. During this period CSIO along with CLRI executed a project on "Feasibility study of energy bench marking for leather industries". Also, it has carried out energy studies at DST, Technology Bhavan, New Delhi and CSIO including ISTC, Chandigarh.

## Business Development Activities

Business Development occupies an important place with the emergence of free international trade, cutting edge technological competition and fast rate of obsolescence. The activities of business development in the Institute have shifted its approach from product oriented R&D to development of need based market driven technologies. In order to achieve this goal, concerted efforts have been made to foster new linkages with academia and industrial partners by entering into memorandum of understanding (MoU) to synergise their individual strength to achieve best R&D results. The initiative has led the academic fraternity and its students to carry out high science experimental work in the state-of-art R&D labs and the industry to use our facilities to make up for the much needed technological support. The approach has also opened up new vistas for cooperation with academia & industry in a public-private-partnership (PPP) mode to transform the collective intellectual inputs and technical expertise into world class, cost-effective, viable indigenous technologies that could meet the expectations of the end users and culminate into total customer satisfaction.

Hand holding of the industry by providing technological solutions in its core areas of strength or associating it in a new R&D project development by token contribution and undertaking industry specific R&D activity through well focused consultancy/contract agreements also forms an integral and important part of the business development activity at CSIO.

### Memoranda of Understanding

The Institute has always accorded high priority to building strong R&D-Academia-Industry linkages by entering into a number of MoUs with leading academic institutes and industrial partners in its pursuit to develop quality manpower, networking of resources, sharing of expertise and use of infrastructural facilities for mutual benefits.

### Rajasthan Electronics and Instruments Ltd

A Memorandum of Understanding (MoU) was signed between CSIO and Rajasthan Electronics and Instruments Ltd (REIL), a Rajasthan Government Public Sector Undertaking on September 26 2008 for joint exploration of market potential of CSIO developed technologies in a public-public partnership mode.



*MoU being signed by Dr Pawan Kapur, Director, CSIO and Shri SP Singh, Additional General Manager REIL*

Under this new model of MoU, REIL would use its business strategy to find a market for the potential technologies developed by CSIO. Based on the customer response, the investment would be made by REIL to bring out the products in the shortest possible time with technical inputs from CSIO and launch them in the market. This new model of cooperation between CSIO and REIL would help immensely in bridging the time gap between technology development to product launching.

## **Panjab University, Chandigarh**

A Memorandum of Understanding was signed with Panjab University (PU), Chandigarh on the occasion of 49<sup>th</sup> CSIO Foundation day on October 30 2008 to promote joint research work and human resource development. The areas identified for co-operation



*MoU being signed by Dr Pawan Kapur, Director, CSIO and Dr RC Sobti, Vice Chancellor, Panjab University*

included Health Monitoring, Geo-Seismic and Disaster Management Instrumentation, Medical Instrumentation, Sensors/ Transducers, Virtual Instrumentation, Soft Computing Techniques, Image Processing, Optical and Photonics based Instrumentation, Physics based Instrumentation, Material Science, Nanotechnology, Chemical and Biosensors, Chemistry and HRD.

Students of MSc, BTech, and MTech in the respective areas of specialization at PU will be allowed to pursue their project work at CSIO and staff members from CSIO can be registered for Ph D programs at PU,

Chandigarh with joint supervision on emerging areas of research and applications.

The MoU will help in building stronger linkages between academia and R&D institutions towards quality manpower generation and utilization in various niche areas. It will also help in optimal utilization of R&D facilities in high priority area programmes of science and technology.

## **Punjab Engineering College**

CSIO entered into an MoU with Punjab Engineering College (PEC), Deemed University, Chandigarh on August 1 2008.



*MoU being signed by Dr Pawan Kapur, Director, CSIO and Prof Manoj Dutta, Director PEC*

The main objectives of this MoU include undertaking of joint research work in the areas of mutual interest, impart training to staff, students and technical personnel within the areas of cooperation and undertaking joint sponsored and consultancy projects. This will also enable both the Institutes to exchange researchers on well focussed tasks. According to the terms of reference of the MoU, CSIO and PEC will jointly organize conferences, workshops and training courses within the area of cooperation and it will give the facility to both the parties to share their respective important R&D facilities, access to labs, library and

exchange of software etc. The MoU will initiate with Electronics and Communication and Information Technology. Other areas shall be added subsequently.

The MoU was signed by Dr Pawan Kapur, Director-CSIO on behalf of CSIO and Prof Major Datta, Director, PEC on behalf of PEC.

### National Institute of Technology, Srinagar

A Memorandum of Understanding (MoU) was signed between CSIO and National Institute of Technology, Srinagar, on April 24 2008 for promoting academic and research cooperation in the fields of Material Research Science, Electronics and Communications, Optics and Mechatronics and Bio Sciences.

### Anna University, Chennai

CSIO entered into an MoU with Anna University, Chennai on May 15 2008 to promote academic and research cooperation in the areas of Biosensor based instrumentation.

### IRDE, Dehradun

A Memorandum of Understanding was signed between with Instruments Research and Development Establishment (IRDE), Dehradun on March 27 2009 for conducting joint research in the areas of Holography, Holographic Optical Elements, Holographic Interferometry and Holographic NDT Techniques, Integrated optics, Optical Design, Thin Film & Nanotechnology, Optical fabrication and testing, Design and fabrication of optomechanical assembly, Optical Sensors, Image Processing, MEMS based instrumentation, Laser based instrumentation.

## Project Contract agreements

Honouring the commitments made with the funding agencies for timely deliverance of the end-products remain the prime concern of the Institute. In order to fulfill this objective, suitable industrial partners are associated by the Institute in different project activities to ensure that the end-products are brought out within the pre-fixed time schedule contemporary to international standards. Such association through public-private-partnership mode also helps in minimising the technology absorption and technological upgradation by the industry to remain vibrant in the international arena.

### ERDA, Vadodara

Central Scientific Instruments Organisation (CSIO) has created necessary facilities in the area of photonics to write FBG sensors for various applications including hot spot detection in electrical equipment. A project for development of FBG sensor system for



*Project Agreement Signed between CSIO and ERDA, Vadodara*

detection and location of hot spots in electrical equipment (power transformer) has been granted by the Department of Information Technology, Govt of India, New Delhi to CSIO in association with Electrical Research and Development Association (ERDA), Vadodara and M/s Alstom Projects India Ltd, Vadodara and M/s Ardisons Associates, Mohali. To execute this project an agreement was signed today between CSIO and ERDA at CSIO. Implementation of this project will facilitate long operational life of power transformers and also help in reducing their breakdown through monitoring of hot spot temperature

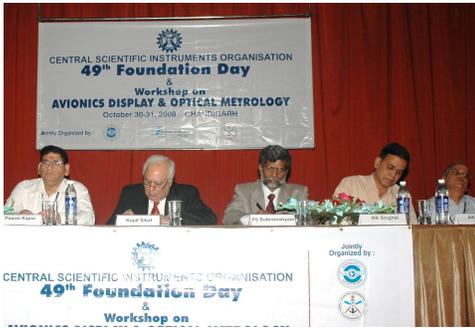
resulting in an uninterrupted power supply to the public and industry.

## **Transfer of Technology**

In pursuit of its mandate to design and develop indigenous instrument technologies for varied applications, the Institute always remains focused on its attempt to transfer more and more number of technologies developed by it to Indian Instruments Industry. The ultimate goal is to ensure that the cost effective indigenous technologies are finally absorbed by industry for their techno-economic growth and overall benefit of our society. The prime objective of the Institute is not to earn profit but to ensure that the technologies developed by its scientists after putting in lot of persevering and diligent efforts make headway to industrial sector. To promote, increased number of transfer of technologies, the Institute also offers lot of concessions to tiny/small scale industries.

The following technologies were transferred to Industry during the Year 2008-09:

### **Bharat Electricals Limited, Panchkula**



The Head Up Display (HUD) technology was transferred on October 30, 2009 to Bharat Electronics (BEL) Panchkula in presence of Honourable Minister of Science and Technology Shri Kapil Sibal.

*Senior functionaries of BEL exchanging ToT documents with Dr Pawan Kapur, Director, CSIO (at left)*

### **PB Motors & Mono Blocks, Amritsar**



In the area of Medical Instrumentation, the CSIO Artificial Hydraulic Knee Joint was transferred to PB Motors & Mono Blocks, Amritsar.

*Signing of ToT by Shri VP Giridhar, Head, Business Development Group, CSIO and the Shri Gurbachan Singh of PB Motors (at left)*

### **RAMS Automation, Chennai**

The technology of Low Cost Oxygen Monitor (LCOM), developed by Chennai Centre of CSIO as an in-house project, was transferred on April 25 2008 to m/s RAMS Automation, Chennai. The CLOM is a microcontroller based Oxygen monitoring system in oil fired boilers using LSM-11 Bousch Lambda sensor. The system is useful for measuring the oxygen percentage in stack gas monitoring which in turn gives combustion efficiency of oil fired boilers used in various industries, ultimately leading to a cleaner environment. The system was earlier field tested successfully at M/s Orchid Pharmaceuticals, Chennai.

## Human Resource Development

The major HR activity this year has been the formulation of a new post graduate course in Advanced Instrumentation Engineering under the new CSIR-Post-Graduate Research Training Programme (PGRTP), starting in the 2009-2010 academic year. Initial enrolment will be 10 students, all course curricula and materials have been readied. The course will be of two years duration, those who qualify with distinction will be considered for induction into CSIO and other CSIR laboratories.

Other Human Resource Development efforts at CSIO include manpower planning, development and training. Under this, the following activities are carried out: Assess manpower requirements in different Decision Units (DUs)/ Groups /Sections of the institute at all levels, periodically review and recommend redeployment keeping in view the on-going R&D programmes, plan and recommend filling up of posts, advise on R&D-academia linkages and add new or review of old Memoranda of Understanding (MoUs), recommend training our staff to outside institutions, plan in-house training programmes for continuing education of CSI staff members and to provide inputs for the creation of panels of experts for assessment reviews.

## CSIO geared up to start CSIR PGRTPE

CSIO became part of the nationwide Post Graduate Research Training Programme for Engineers (PGRTPE) of CSIR for training and inducting fresh Engineers into the CSIR laboratories. The programme has 8 specialisations which would run at 7 laboratories (CSIO, CEERI, CMERI, NEERI, IMMT, SERC, IIP). CSIO has chosen to provide post graduate training in the field of *Advanced Instrumentation Engineering*. Instrumentation Engineering is a synergistic combination of mechanical engineering, electronic engineering, control engineering, systems design engineering and computer engineering to achieve measurements and control. It is a multidisciplinary field involving material science, sensors & actuators, optics, signal processing, statistics, computation and communications. The applications for this field are mostly visible in Health, Agriculture, Aviation, Safety, Security, Space, Manufacturing and Processing Sectors.

This post graduate research training programme on Advanced Instrumentation Engineering aims to provide in-depth exposure to the engineering concepts, scientific principles, research methodology and hands-on experience on advanced real-life R&D projects in different specialisations of advanced instrumentation engineering. Due to its multidisciplinary nature, graduates from wider branches of engineering can enrol into this course. The engineers undergoing the course will be designated Scientist Trainees. On completing this two-year programme they will be fully research-enabled and industry-ready.

The first semester of the programme focuses on core subjects and associated laboratories. The second and third semesters of the programme provide further sub-specialization in the areas of:

- Agrionics
- Photonics
- Biomedical Engineering

The third and fourth semesters give the opportunity to the candidates to effectively utilize the knowledge acquired through the courses towards advanced R&D project work and dissertation in their specialisation areas.

## **MTech Mechatronics programme**

In collaboration with CMERI, Durgapur; CEERI, Pilani and BESU, Shibpur, the MTech (Mechatronics) programme is continuing into the second year. The programme is based on a unique operational model with a rich blend of high academic and state-of-art lab work at the three locations. CSIO scientists serve as adjunct faculty in the programme.

## **Indo-Swiss Training Centre (ISTC)**

Indo-Swiss Training Centre (ISTC) is a constituent unit of Central Scientific Instruments Organisation (CSIO), Chandigarh. It is ISO 9001:2000 certified.

Established under the patronage of Swiss Foundation for technical assistance, the centre was inaugurated



*New Block of ISTC*

on 18<sup>th</sup> December, 1963 by the then Prime Minister, Pt Jawaharlal Nehru and is dedicated to serve the industrial sector by producing highly skilled and competent manpower for the manufacturing sector. `ISTC` in the true sense stands for "Innovative-Scientific-Technological-Commitment" to the nation as a whole and the industry in particular.

## **Training Courses**

The following AICTE-approved programmes are conducted by ISTC:

- 3-Year Diploma in Instrument Technology
- 4-Year Advanced Diploma in Mechatronics and Industrial Automation
- 4- Year Advanced Diploma in Die and Mould Making

Admission to ISTC is open to both boys and girls and is through a national level entrance test.

## **Major Activities**

Notable activities of the centre during the year were:

### **Infrastructure Development**

The ISTC main block was operationalised, with new furniture added in the classrooms, labs and auditorium. The Conference Room of ISTC was also made operational. The ISTC website launched at URL <http://www.csio.res.in/istc>

### **Visit of AICTE Delegation**

A three member team visited the centre on 16<sup>th</sup> March, 2009 for extension of AICTE approval to ISTC courses beyond the year 2009. They also visited the Labs/Workshops. Later they interacted with the students and staff members and appreciated the quality education being imparted at ISTC.

### ISO 9001:2000 certification

ISTC is an ISO 9001:2000 certified Centre. Internal quality audit was conducted on 19<sup>th</sup> and 20<sup>th</sup> Feb. 2009 for the review of ISTC quality system as per ISO certification.

### Placements

Reputed companies like Anand Nishkawa, Trident, Sard Metals, Godrej, Philips, Schlumberger Asia Services Ltd, Rockwell India, GE Motors India Ltd, Abhishek Industries Pvt Ltd, Elin Electrics Ltd, Carborundum Universal Ltd, Glaxo Smith Kline, GM Partitions and Moserbaer selected most of the students after Campus interviews. Handsome packages were offered to the selected students.

### 43<sup>rd</sup> ISTC Convocation

The 43<sup>rd</sup> convocation of ISTC was held on August 1 2008. Prof Manoj Datta, Director, PEC (Deemed University) was the Chief Guest on this occasion. He motivated the



*Prof Manoj Datta, Director, PEC delivering the convocation address*

passing-out students by quoting the inspiring words of late Ms Kalpana Chawla, “The path from dreams to reality does exist. May you have the vision to find it, the courage to meet onto it and perseverance to follow it”. He emphasized that in the new technology-oriented world, special skills are in great demand. India is bestowed with the largest population of young minds in the world and it is great asset to us, the only need is to explore it in the right spirit, he said. He also advised the passing out trainees to adopt the spirit of an entrepreneur to sustain in the competitive world.

Dr Pawan Kapur, Director, CSIO talked about the success stories of ISTC and described it as an institute of excellence for imparting technical training. Sh RC Arora, Principal, ISTC while presenting the annual report of the Training Centre, informed the gathering with pride that all the passing-out graduates have already been picked up for placement by various industries of repute. He informed that the centre had produced so far over 2882 graduates in various streams.

Graduating students were awarded Diplomas and Advanced Diplomas by Dr Pawan Kapur, while the Prof Manoj Datta gave away prizes and medals to the meritorious students. The programme concluded with a formal vote of thanks proposed by Sh HS Gupta, Senior Scientist.

### Extra Curricular Activities

#### Sports



*Inter-class Volley Ball match in progress*

Inter-class tournaments for indoor and outdoor games were organized for the trainees. Girl students also participated enthusiastically in all the events.

## Central Scientific Instruments Organisation, Chandigarh

### NCC

NCC is a regular activity in ISTC. Forty NCC cadets participated in Annual Training Camp held at CCET Campus, Sector 26 Chandigarh during September 26 to Oct 5, 2008 and won first prize in line layout competition.



Twelve ISTC cadets also appeared for NCC 'B' Certificate held on March 8 2009.

Guards of honour were presented to Prof Samir K Brahmachari, Director General, CSIR and Secretary DSIR on his visit to ISTC; to Dr Pawan Kapur, Director CSIO on Independence Day and to Prof Manoj Datta, Director, PEC on ISTC's convocation day.

*Guard of honour to Prof Samir K Brahmachari, Director General CSIR (at left)*

### ISTC Freshers Day



*Students Performing Gidha*

ISTC Freshers day was celebrated on October 16 2008 to welcome the new comers. In the morning students, including the girls participated enthusiastically in a cross country race.

A quiz competition was also organized, followed by the cultural programme. Prizes were distributed to the winners and participants in various sports-indoor and outdoor by Smt Poonam Kapur, the chief guest on the occasion. Dr Pawan Kapur and Shri RC Arora gave their blessings to the students.

### Training Programmes/ Workshop Organized

As part of a Management Development Programme on Operation, Maintenance and



*Dr Pawan Kapur, Director CSIO interacting with the Delegates of ITEC/SCAAP Programme*

Repair of Biomedical Equipment ,16 experts from countries like Botswana, Ghana, Nepal, Sri Lanka, Afghanistan, Uzbekistan trained at CSIO from September 10 to November 4 2008.. The Programme was under the ITEC/ SCAAP Programme (Indian Technical and Economic Cooperation/ Special Commonwealth Assistance for Africa Programmes) sponsored by the Ministry of External Affairs, Government of India.

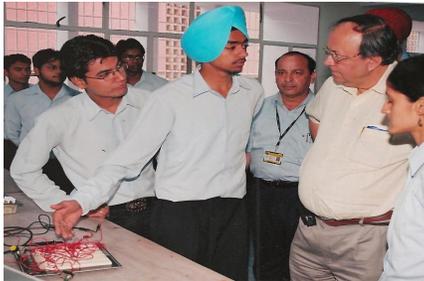
The 3<sup>rd</sup> Management Development Programme on Operation, Maintenance and Repair of Optical/ Ophthalmic Equipment for the delegates of Third World Countries was

## Human Resource Development

organized from December 10, 2008 to February 3, 2009. In this eight week programme the participants spent the last four weeks at CSIO. 11 delegates from 7 countries: Tanzania, Malawi, Zambia, Afghanistan, Ghana, Togo and Ivory Coast participated in this programme sponsored by the Ministry of External Affairs, Government of India under ITEC/SCAAP Programme. The course consisted of theoretical as well as practical hands-on sessions followed by study tour related to the course. The Participants were taken to different divisions of CSIO to show them the latest research and development activities in and to interact with the scientist. The training program includes lectures followed by practical training in repair and maintenance of instruments. In the afternoon session education tours were conducted to show and demonstrate the instruments at site on which lectures were held. The faculty was drawn from the scientists and technical officers from CSIO, doctors from Government Medical College and Hospital, professors from Punjab University and engineers from Industries.

### Important Visitors

#### Prof Samir K Brahmachari visits ISTC



*Prof Samir K Brahmachari, Director General CSIR discussing with ISTC students*

Prof Samir K. Brahmachari, Director General, CSIR & secretary DSIR, Govt. of India, visited the Indo-Swiss Training Centre on June 14 2008. Prof Brahmachari inaugurated the newly constructed ISTC Main Block Building. He also visited the various laboratories and workshops of ISTC and interacted with students. Later he addressed ISTC faculty. He appreciated precision based training being imparted to students. Earlier Shri RC Arora, Principal, ISTC while welcoming the DG, explained major achievements, recent developments and future plans of the Centre.

#### Three member Chinese delegation



*Chinese Delegation examining components fabricated by students*

A three member delegation from China visited CSIO on September 15 2008 and praised the ISTC model of teaching. They also went around workshops and appreciated the technical skills acquired by the students.

## Central Scientific Instruments Organisation, Chandigarh

### MP's Visit to ISTC

A delegation of MPs led by Dr V Matrian along with other delegates of Parliament Standing Committee in Science and Technology, Environment and Forests visited ISTC on 21<sup>st</sup> June, 2008.



*Dr Pawan Kapur with Dr V Matrian, MP and part of Parliamentary Committee*

They visited workshops and labs and saw the students working on highly sophisticated machines & other instruments. They appreciated the various precision components fabricated by the students.

The chairman, impressed by the ISTC model, remarked that more ISTCs should be opened in the country. A sapling was planted by Dr Mantrian on behalf of the visiting team.

### CSIO Chennai Centre

The Centre conducted a two week training program on the "Maintenance and Repair Of Bio-Medical Instruments for Hospital Doctors and Technicians", at Tirunelveli Medical College and Hospital from April 21 to May 2 2008. 9 doctors and 16 technicians attended and were trained for handling of the medical instruments. During the course they had hands on experience to attend minor repairs after identifying the faults. During the training programs 44 instruments of their own departments were rectified by the participants.



*A theory session being conducted as part of the program on the "Maintenance and Repair Of Bio-Medical Instruments for Hospital Doctors and Technicians"*



*The inaugural session of the programme on the "Maintenance and Repair and Maintenance of Analytical Instruments" in progress*

The Technology based Entrepreneurship Development Programme (TEDP) in Repair and Maintenance of Analytical Instruments, sponsored by Department of Science and Technology, New Delhi was conducted at CSIO Chennai Centre conference hall from August 11 to September 19 2008. 21 candidates were selected to participate in the TEDP Program. The programme was inaugurated by Dr N Lakshmanan, Director, SERC and Coordinating Director, CSIR Madras Complex. The six week programme was conducted by organizing expert lectures on technical and management techniques for starting enterprises in repair and maintenance of analytical instruments.

The Technology based Entrepreneurship Development Programme in "Repair and Maintenance of Biomedical Instruments", sponsored by National Science and Technology Entrepreneurship Development Board, Department of Science and

## Human Resource Development

Technology was conducted at CSIO conference hall from February 2 to March 9 2009.



22 candidates were selected to participate in the TEDP Program by the screening and selection committee. The programme was inaugurated by Dr Nagesh R Iyer, Director, SERC and Coordinating Director, CSIR Madras Complex. The six week programme was conducted by organizing expert lectures on technical and management techniques for starting enterprises in repair and maintenance of biomedical instruments. We organised one lecture from banking sector, so that the participants can

have first hand interaction in respect to financial support. The program concluded with valedictory address by Dr AB Mandal, Director, CLRI, Chennai on March 20 2009. In an encouraging outcome of the training, three participants started their own enterprises after the programme.

## Honours

Shri SK Mittal, Scientist, was awarded '19th IETE-Hari Ramji Toshniwal Gold Medal



Award 2008' in recognition of his distinguished contribution in the design and development of research, design and development of advanced electronic instruments for scientific and industrial applications for public safety during an award ceremony on the occasion of 51st Annual Technical Convention of IETE at New Delhi.

*Shri SK Mittal receiving the award from Prof NR Narayana Murthy, Chairman, Infosys Technology Ltd on September 29 2008*

He has been engaged in design, development and fabrication of scientific instruments and systems for different applications with specific use in geo science, snow and avalanche study, railway safety and land slide monitoring.

Shri Satish Kumar, Scientist, was awarded the Raman Research Fellowship for the year 2009-10 for 4 months.

Dr Kulvinder Singh, Scientist G, was elected Fellow of the Institution of Engineers(India) on March 31, 2009

## **Qualifications Acquired**

- Dr KD Chattopadhyay, Technical Officer was awarded a Doctorate from Panjab University, Chandigarh in September 2008
- Shri VD Shivling, Scientist, completed his MTech in Electronics and Communication Engineering from Punjab Technical University, Jalandhar

## **Visits Abroad**

- Dr Pawan Kapur, Director, visited Nepal to attend committee council meeting & seminar on "Constraints in Spectrum Management Cellular Communication" from July 11 to 13, 2008.
- Dr Lalit M Bharadwaj, visited Ecol Polytechnique Federale Lausanne (EPFL), Texas Instruments Dallas, USA Switzerland Health Science and Technology (HST), Clemson University, Clemson, South Carolina, USA, Massachusetts Institute of Technology (MIT), Cambridge, USA and Biodesign Programme, Stanford University, USA for understanding global trends in the area of bio-nanotechnology based devices and instrumentation for healthcare and agriculture from June 15 to 29 2008
- Shri Amol Bhondekar, Scientist and Shri Manish Kumar, Technician attended training on 'Electronic Nose' in France for one week from December 2 to 7 December 2008 at Toulouse, France.
- Dr Amit Lochan Sharma, Scientist, visited Taiwan from September 1 to 5, 2009 under the National Programme for Training of Scientists and Technologists working in the Government Sector
- Smt Jaspreet Kaur, Scientist, presented a paper entitled "A novel technique for flow measurements using thermistor with real time graphical display for anesthesia ventilator" at a conference at UCLA, Los Angeles, USA from July 11 to 13, 2008.
- Smt Harsimran Kaur, Senior Research Fellow, presented a paper on "In-Vitro Transportation of Drug Molecule by Actin Myosin Motor System" at the 13th International Conference on Biomedical Engineering: ICBME 2008, 3-6 December 2008 at Singapore

## Events and Activities at CSIO

### ADOM-2008 Workshop

A two day workshop on Avionics Displays and Optical Metrology (ADOM-2008) was organized in the laboratory on October 30, 2008. The workshop focused on two broad aspects, namely Avionics Displays involving electro-optical devices and systems and on Optical Metrology. One of the aims of the workshop was to provide a common platform for scientists, engineers, researchers and industrialists to discuss and deliberate on emerging technologies of Cockpit Display Instrumentation and Optical Metrology.



*Shri Kapil Sibal, Hon'ble Minister for Science and Technology and Earth Sciences, Government of India and Vice President, CSIR inaugurating the ADOM-2008 workshop*

Inaugurating the workshop, Shri Sibal appreciated the role played by CSIO in the area of instrumentation. He lauded the efforts of CSIO scientists for making India the fifth nation in the world having the capability of developing Head Up Displays.

The workshop was jointly organized by CSIO Chandigarh, RCMA Chandigarh, BEL Panchkula and AeSI, Chandigarh branch. The workshop was attended by representatives from industry, R&D organizations and academic institutions. Overall, four technical sessions were held.

### Photonics Lab Inaugurated

A new Photonics laboratory was inaugurated by the Director General of CSIR, Prof Samir Brahmachari on June 15, 2008. The facility has a Teraxion Flex 500-I FBG/LPG writing system which will enable single and multiple Fiber Bragg Grating (FBG) fabrication, recoating, annealing and characterization for wavelength stability, as also Long Period Fiber (LPG) fabrication.



*Prof Samir Brahmachari at a demonstration of the Fiber Bragg Grating System at CSIO, soon after inaugurating the facility (at left)*

## **Conference on Technical Education**

A one day conference on “Impact of Technical Education on Manufacturing Sector-Need for Quality Education” was organised at CSIO=ISTC on March 6 2009.

The objective of the conference was to address the issue of shortage of skilled technical manpower at the shop-floor level to boost the manufacturing sector in general and instrumentation industry in particular. The workshop stressed on the modernisation of polytechnic/ ITI-based institutions to provide professional education of relevance to present day industrial demands. An exhibition was organized by ISTC entrepreneurs and industry on the occasion.



*Director Dr Pawan Kapur and Smt Tejinder Kaur inspecting the ISTC entrepreneur's exhibition*

The conference was inaugurated by Smt Tejinder Kaur, Principal Secretary to Government of Punjab, Department of Technical Education and Industrial Training, Chandigarh. Padamshree Chander Mohan, Chairman Board of Governors, Punjab Engineering College was the guest of honour.

The conference had two technical sessions, besides a visit to the Exhibition and the Training centre. The detailed deliberations during the day led to the following recommendations: Industry and Institute should work together on common industrial problems to expose the students and the faculty to the industrial environment; Institutes

should have flexibility in their curriculum to adopt market-driven technologies; ‘Training the Trainer’ programmes should be initiated for improving the competencies of the faculty; Students should be imparted soft skills along with technical competencies; E-education techniques should be planned to reach to the rural masses; Practice-oriented training for sector wise employability should be imparted; Proper work culture should form a part of the curriculum; Teachers should work and act as role model for the students.

## **Hindi Sangoshthi on “Technology: in aid of the disabled”**

A two day Hindi seminar on “Technology: in aid of the Disabled” was organized at CSIO on March 3 and 4, 2009. Chief Guest Dr Raj Bahadur, Director - Principal, Government Medical College and Hospital (GMCH), Chandigarh in his address to the delegates emphasized that sufficient aids for disabled person will be readily available only when all stakeholders: educational institutes, research organisations and industry work together coordination with hospitals. He reiterated that the country does not lack in technical expertise in this field.

Delegates highlighted the shortage in availability of aids and pointed out that the aids that are available in the market are expensive and therefore unaffordable to



*Dr Raj Bahadur, Director - Principal, GMCH, Chandigarh and the Chief Guest addressed the delegates*

## Events and Other Activities at CSIO

poorer sections of our society. There is a pressing need to produce high quality and affordable but effective aids in the country. A need for clearer policy directions on this issue was expressed by a number of delegates. There is also a lack of awareness on the availability of the aids, a need for a directory containing details of all hospitals and institutions which advise and supply such devices was expressed.

Prof Sneha Anand of IIT Delhi briefly described research being carried out on prosthetic limbs at IIT Delhi. Dr Pawan Kapur while welcoming the guests and delegates elaborated on research being conducted at CSIO on prosthetic limbs and aids for visually disabled persons. The vote of thanks was delivered by Dr Neeru, Senior Hindi Officer and co-organizer of the Sangoshti.

## National Technology Day

National Technology Day was celebrated in the laboratory on 11<sup>th</sup> May, 2008.



2A view of the Dias, from Left - Dr Chander Mohan ; Dr Pawan Kapur; Dr SC Laroia and Shri AK Dimri

All the labs of CSIO were kept open for general public in the forenoon. A large number of visitors including students from various Engineering colleges, universities and general public went around various laboratories of the Organisation. They interacted with scientists who gave them exposure to the technologies being developed at the laboratory. Prof SC Laroia, Director, National Institute of Technical Teachers Training and Research, Chandigarh delivered a lecture on "Role of Web in Manufacturing". Prof Laroia, in his address, highlighted that manufacturing technology is a dynamic discipline and is heavily influenced by state of the art

developments in the areas of electronics, IT and Mechatronics. E-Manufacturing is a promising area which will grow significantly in the years to come. It will encourage table-top manufacturing by various traditional industries. Prof Laroia touched on the modelling languages, web-compatible fabrication techniques and virtual reality

Earlier, Dr Pawan Kapur, Director, while welcoming the chief guest highlighted the significance of the National Technology Day. He reminded the house of the vision of Dr APJ Abdul Kalam, former President of India, with the quotation "Technology is strength and strength respects technology".

Dr Chander Mohan, Chairman, Governing Council, Gyan Jyoti School of TQM and Entrepreneurship, Mohali was also present and expressed his views about the importance of Technology Development on the occasion.

## National Science Day

The laboratory marked National Science Day by conducting an "open day" on February 27 2009, with the Institute. All the labs were kept open for general public in the forenoon. Nearly 700 visitors including students from various schools, colleges and universities visited the laboratories of the Organisation. They interacted with the scientists and were exposed to the technologies available and being developed.

## Central Scientific Instruments Organisation, Chandigarh



*Dr SR Gowariker, Guest of Honour of Science Day celebrations delivering a lecture on the Large Hadron Collider*

Dr SR Gowariker, former Director CSIO and currently Chairman, Board of Studies, University of Pune and the Guest of Honour of Science Day celebrations delivered a lecture on the Large Hadron Collider.

*Dr SR Gowariker, Guest of Honour of Science Day celebrations delivering a lecture on the Large Hadron Collider*

Dr RS Khandpur, Director General, Pushpa Gujral Science City, Kapurthala delivered a lecture on "Telemedicine : Emerging Trends" on the occasion. He underlined the importance of telemedicine and emphasized its need for a country like India for bringing health care delivery to the doorsteps of the patients.

Earlier, Dr Pawan Kapur, Director, CSIO highlighted the significance of National Science Day and touched on our rich scientific heritage. He appealed to younger colleagues to continue on lines further.

## CSIR Foundation Day

CSIO celebrated the CSIR Foundation Day on September 26, 2008 by holding an Open Day when the laboratory was kept open for the general public.



*Dr Pawan Kapur, Director and Dr RP Bajpai, Vice-Chancellor, Kurukshetra University at the inauguration of the CSIR Foundation Day*

About 1000 visitors, including students from various schools, engineering colleges, university and general public went around various laboratories of the organisation. This provided them a unique opportunity to see the live demonstration of the instruments developed at CSIO and a chance to interact with the scientists.

Dr RP Bajpai, Vice-Chancellor, Kurukshetra University, Kurukshetra delivered the foundation day lecture on "Science and Technology in Emerging Areas". He traced the 60 years journey of S&T developments and emphasized

that we have to strengthen our basic sciences like physics, chemistry and mathematics to meet the emerging challenges of the future effectively. He opined that biological systems offer very high speed performance and techniques need to be developed for integration of biological and physical material systems. These systems will need lot of instrumentation and CSIO can be a trendsetter in these new emerging areas for farming of new technologies and new products.

Dr Pawan Kapur, Director, CSIO while welcoming the chief guest highlighted the aims and goals of CSIR and its contribution in the field of science and technology. He informed of new schemes of CSIR for young people.

## Events and Other Activities at CSIO

### CSIR Programme on Youth for Leadership in science

The laboratory organised a two day CSIR Programme on Youth for Leadership in Science (CPYLS) on November 5 and 6, 2008. About 70 persons comprising students and their parents/teachers, from different schools of Haryana, participated in the programme



*Prof KR Sarma, former Director, CSIO during an interactive session with the students*

During the programme, the participants were apprised of the scenario of Science and Technology in the country and the various activities undertaken at the lab. Popular science lectures by scientists, multimedia science quiz competition and creativity session were organized to inspire and motivate them to develop a scientific temper. The participants had an opportunity to see some science models and get information

about laboratory programmes while interacting with the Scientists/ Technologists, during visit to various labs, including the Indo-Swiss Training Centre (ISTC).



*Prof KR Sarma, former Director, CSIO handing over a certificate to one of the participants*

During the valedictory session, Prof KR Sarma, Advisor, Technology, SAMTEL Group of Industries and former Director, was the Chief Guest. Addressing the students, Prof Sarma mentioned that science is an exciting journey and it makes us learn about the unknown. Although a lot of efforts have been made by man to unravel the mysteries of nature, environment, planet earth, etc. still there is lot more to know in this direction. Advances are being made almost every day, he mentioned. He talked about some areas on the scientific horizon like energy, alternative

sources of energy for organic photo-voltaic for tapping solar energy, MEMs and their use in aircraft, automobiles, clinical and biotechnology research, etc. He also discussed the development of instruments to find ground water level depletion. He mentioned that the journey of science is full of challenges but very exciting and satisfying. He exhorted the students to join the science stream to unravel these mysteries and to gain knowledge so as to reduce our ignorance. The participants were awarded the certificates, medals and mementos.

Dr Pawan Kapur, Director, while welcoming the Chief Guest said that CSIO enjoyed interacting with the young students in the last two days and advised the students to be in touch with CSIO for any further guidance. Shri RC Arora, Coordinator of this programme presented the highlights and mentioned the salient features of the CPYLS scheme. The participants assured to make the optimum use of the knowledge gained through this programme. They expressed the hope that this programme had helped them in broadening their outlook and now they have the courage to look and think beyond books also.

Shri M.R. Masan, Controller of Administration, proposed the vote of thanks.

## Central Scientific Instruments Organisation, Chandigarh

### Chinese Delegation visits CSIO, Chandigarh

A Chinese delegation visited CSIO on 15th September, 2008 to get an overview on Scientific Instrumentation and get a general understanding of management of scientific equipment and the sharing of instrumentation among the institutes.



*Chinese delegation members interacting with the Director and senior scientists of the laboratory*

The delegation comprised the Counsellor, Science Office, First Secretary and Second Secretary of the Science Office of the Chinese Embassy.

They were introduced to various R&D activities of the organisation during a presentation and thereafter interacted with senior scientists and explored the possibility of co-operation with Chinese research institutes.

### CSIO Foundation Day

“Measurement Sciences and Instrument Technology are the key components in almost all engineering applications of manufacturing sector and CSIO by virtue of its strengths can meet the targets”, remarked Shri Kapil Sibal, Hon’ble Minister for Science and Technology and Earth Sciences, and Vice President, CSIR while addressing the gathering on the occasion of 49<sup>th</sup> Foundation Day of CSIO. He stressed on the need of cloning more CSIO’s to cater to the need of the Agro-based Sector and special emphasis should be laid on the development of technologies, which change the quality of life of 800 Million people. He said that science and technology are the two sides of a coin and they have to work hand in hand with complete synergy.



*Students being shown around the laboratory on the occasion of the CSIO Foundation Day*

He complimented Dr Pawan Kapur, Director, CSIO for the efforts and dedicated work done on Head Up Display which has placed India in the forefront of technologies pertaining to the strategic sector.

While welcoming the Chief Guest Dr Pawan Kapur, Director, CSIO informed about the various on going programmes of the Lab and the achievements made during the year. He mentioned about the new programmes on Agrionics and Biomedical instrumentation in a network mode and also the proposal for advanced courses on Agrionics and Lightwave Engineering.

A workshop on “Avionics Display and Optical Metrology (ADOM-2008)” was also inaugurated by the Hon’ble Minister. Hon’ble Minister also released the Annual Report of CSIO and the Souvenir of the ADOM-2008 workshop.

Later during the video conferencing with Director General, CSIR, Prof Samir K Brahmachari, he congratulated CSIO on its 49<sup>th</sup> Foundation Day and HUD achievement. He said that there are many more miles to cover so that the dream of every aircraft having CSIO HUD could be realized.

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## Events and Other Activities at CSIO

The programme concluded with a formal vote of thanks of Sh. A. K. Dimri, Scientist, CSIO. Later in the evening a colourful cultural programme was presented by CSIO Staff Club and Ladies Club.

## Pride of India Expo (96<sup>th</sup> Indian Science Congress, 2009)

The 96<sup>th</sup> Indian Science Congress was held from 3<sup>rd</sup> to 7<sup>th</sup> January 2009 at North East Hills University, Shillong.



*CSIO scientist Shri Amol Bhondekar explaining the working of the portable reading machine for the blind to Dr Swaminathan, doyen of the Green Revolution, at the pride of India Expo*

Under the umbrella of this event an expo was organised to display and demonstrate the nation's technological capabilities and advancements to the people of North East region. CSIR participated in this expo with CSIR-800 theme. Shri Amol P Bhondekar and Shri Baban Kumar represented CSIO at the CSIR pavilion.

The pavilion was visited by dignitaries namely Honourable Minister for Science and Technologies- Mr. Kapil Sibal, Chief Minister of Meghalaya Dr Donkumar Roy, DG CSIR, Dr Swaminathan (the doyen of green revolution), policy makers, vice chancellors of various universities, professors and civil servants. The dignitaries appreciated the efforts of CSIO for development of technologies for societal applications and empowering the masses.

There was an encouraging response from people belonging to various sections of the North Eastern society, particularly for the technologies developed by CSIO, namely Myoelectric arm, Portable Reading Machine For The Blind and Digital Moisture Computer.

## Visit of Parliamentary Committee

The Standing Parliamentary Committee (SPC) on Science and Technology, Environment and Forests headed by Dr V Maitreyan, MP (Rajya Sabha) visited the laboratory on August 21, 2008. The distinguished Parliamentarians were taken around the laboratory where they took keen interest and discussed at length with the scientists.



*3 Members Parliament being taken around the Photonics laboratory during their visit in August 2008*

The Committee appreciated CSIO's charter to stimulate growth of indigenous instruments by developing contemporary technologies and providing back-up S&T support. Dr Maitreyan advised that Engineering Labs have more difficulty in raising their IPR wealth as compared to science based labs.

The Committee was of the opinion that CSIO's current focus of clustering of R&D

## Annual Report 2008-2009

## Central Scientific Instruments Organisation, Chandigarh

programmes in a networking mode will have major impact in terms of deliverables. They expressed concern over the diminishing S&T manpower and migration of younger scientists to MNC's and felt that we need to strengthen/ improve our recruitment and retaining mechanism. They advised the laboratory to bring more visibility to CSIO's activities by multilingual CDs. The unique role of ISTC in producing quality shop floor manpower was a matter for appreciation, in their opinion.

### Visit of Director General, CSIR

Prof Samir K Brahmachari, Director General of CSIR and Secretary, Department of Scientific and Industrial Research (DSIR) visited CSIO on June 15 2008. During a busy day, he inaugurated the new CSIO Photonics Facility, Virtual Instrumentation Laboratory, Video Conferencing Facility, Health and Fitness Centre and the ISTC Main Building.



*Prof Samir Brahmachari interacting with young scientists during a visit to CSO in June 2009*

Prof Brahmachari visited some important labs of CSIO and ISTC and took keen interest in talking to young scientists and scholars. Prof Brahmachari lauded CSIO on the achievement of developing the Head Up Display (HUD) technology and found ISTC a unique and replication-worthy HR model. He stressed on decentralisation and democratic decision making it a participative process so that the R&D pace would increase. He was confident that a formula of *Energy of young + Experience of seniors + hard work* would place CSIR on top in the coming years.

### Meetings of the Management Council of CSIO

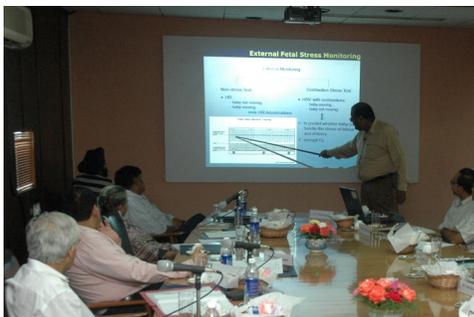
The 30<sup>th</sup> and 31<sup>st</sup> Meetings of the Management Council were held on August 30 2008 and March 27 2009 respectively, under the Chairmanship of Dr Pawan Kapur. The Council reviewed the progress of completed and ongoing externally funded projects, Supra Institutional Projects, examined new project proposals submitted, reviewed progress of Network Projects was by the respective nodal laboratories (CGCRI, CFTRI and CEERI) and approved the formation of Committees for the assessment of Group III Staff.



*The 30th Management Council meeting in progress*

### Meetings of the Research Council of CSIO

The 34<sup>th</sup> and 35<sup>th</sup> meetings of the Research Council of CSIO were held on August 30 2008 and March 27 2009 respectively, under the Chairmanship of Prof Surendra Prasad, Director, IIT, Delhi. Progress in current research being undertaken at the laboratory was reviewed and future projects in Agrionics,



*4Dr Amod Kumar, Scientist, CSIO making a presentation before the 35th Research Council of CSIO (at left)*

## Events and Other Activities at CSIO

Medical Instrumentation and Gems and Jewelry sector were presented and discussed, valuable additions, advice and offers of help were received. Both meetings discussed the impending golden jubilee celebrations of CSIO in detail, with a number of suggestions from the Council members based on their Institution's experiences. The urgent requirement of filling up of Scientific and Technical posts through lateral entry in CSIO was discussed at length.

## Blood Donation Camps



*Students taking part in a Blood donation camp at CSIO in October 2008*

Two blood donation camps were organized during June 2008 and October 2008 in the campus, sponsored by State Bank of India Sector 30 Chandigarh with the assistance of the Post Graduate Institute of Medical Education and Research (PGIMER), Chandigarh and Government Medical College and Hospital (GMCH) Chandigarh.

Over 250 students and staff members donated blood during the camp. Besides, students are always on emergency rolls of PGIMER and GMCH, Chandigarh and have been saving lives of the patients by donating blood in emergency cases.

## Staff Welfare Activities

Director General of CSIR and Secretary, Department of Scientific and Industrial Research (DSIR), Prof Samir K Brahmachari inaugurated the new CSIO Health and Fitness Centre located in the CSIO Community Centre.



*Director General Prof Samir K Brahmachari inspecting equipment at the CSIO Health and Fitness Centre soon after inaugurating the facility*

The CSIO Staff Club organized a popular science lecture on 'Quest for Scientific Renaissance in the Post Modern Era' by Prof Buddhanand, Visiting Faculty, Indian Institute of Advanced Study (IIAS), Shimla. The lecture was followed by a lively interactive session.

Staff and family attended in large numbers the screening of a popular scientific film,  $E=mc^2$ , a presentation on Albert Einstein's life and legacy, organised by the Club in March 2009.

The staff Club has been organising Taekwondo classes at the Community Centre for the past year and a half. This year, children of CSIO staff garnered five state level and one National level award

## Appendix: Patents

### Granted Abroad

NF No: 0007NF2001/CN

Title: A New Multifiber 2d-Array Device For Sensing And Localizing environment Perturbations Using Speckle Image Processing

Inventors: Sardana HK, CHHABRA JK, Bandyopadhyaya S, Goel PK

Comp Filing Date: 04/11/2003

Application No: 01823210.8

Status: IF

Grant Date: 14/05/2008

Patent No: ZL01823210.8

NF No: 0204NF2000/AU

Title: An Opto-Electronic Device For Angle Generation Of Ultrasonic Probe

Inventors: Ahluwalia Surjit Singh (Chandigarh, IN)

Comp Filing Date: 30/12/2003

Application No: 2003290413

Status: IF

Grant Date: 29/05/2008

Patent No: 2003290413

NF No: 0152NF2004/KR

Title: Synthesis Of Platinum, Palladium Quantum Well Size Nano-Particles In Ethyl Glycol Medium, In Which Ethylene Acts As Reducing Agent As Well As Stabilizing Agent To Avoid Agglomeration

Inventors: Madan Lal Singla, Mewa Singh, DVS Singh, Ram Kishore, Ram Prakash Bajpai

Comp Filing Date: 30/10/2006

Application No: 10-2006-7022724

Status: IF

Grant Date: 22/09/2008

Patent No: 10-0860610

NF No: 0007NF2001/KR

Title: A New Multifiber 2d-Array Device For Sensing And Localizing Environment Perturbations Using Speckle Image Processing

Inventors: Sardana HK, Chhabra JK, Bandyopadhyaya S, Goel PK

Comp Filing Date: 27/03/2007

Application No: 10-2008-7001521

Status: IF

Grant Date: 13/11/2008

Patent No: 10-0869517

NF No: 0203NF2002/KR

Title: A New Process For Controlled Blood Transfusion With Disposable Valve Circuit

Inventors: Chattopadhyay KD, Verma S, Raj P, Gupta J

Comp Filing Date: 25/09/2004

Application No: 2004-7015464

Status: IF

Grant Date: 10/02/2009

Patent No: 10-0884023

## Central Scientific Instruments Organisation, Chandigarh

NF No: 0457NF2001/KR

Title: Fiber Optic Temperature Switching Immersion Probe

Inventors: Singh N, Jain SC, Aggarwal AK

Comp Filing Date: 30/09/2004

Application No: 2004-7015482

Status: IF

Grant Date: 19/02/2009

Patent No: 885756

## Granted in India

NF No: 0006NF2001/IN

An Improved Antiglare Optical Device

Inventors: Deep Singh Chhabra, Parinam Krishna Rao, Bipin Dev Sharma, Sudhir

Kumar Gupta, Dharambir Singh Dodd, Virender Singh, Sanjay Sharma

Comp Filing Date: 24/09/2003

Application No: 01532DELNP2003

Status: IF/2010

Grant Date: 27/05/2008

Patent No: 220363

NF No: 0004NF2001/IN

Improved Semiautomatic Pick And Place Machine For Assembly Of Components

Inventors: Vyakaranam Mohana Lakshmi Narasimhan, Randhir Bhatnagar, Bipin Dev

Sharma, Shravana Kumar Ramarao Rayagond, Anmol Kumar Mediratta

Comp Filing Date: 16/10/2003

Application No: 01690DELNP2003

Status: IF/2010

Grant Date: 03/07/2008

Patent No: 221759

NF No: 0408NF2003/IN

Portable System For Total Gossypol Measurement

Inventors: Madan Lal Singla, Mewa Singh, Prasant Kumar Mahapatra

Comp Filing Date: 31/03/2004

Application No: 00818DELNP2004

Status: IF/2010

Grant Date: 17/09/2008

Patent No: 223607

NF No: 0407NF2003/IN

Fiber Optic Point Temperature Sensor

Inventors: Sc Jain, Nahar Singh, Gopal Chandra Poddar, Rajneesh Talwar, Ashu

Kumar Bansal, Ram Prakash Bajpai

Comp Filing Date: 20/02/2004

Application No: 00390DELNP2004

Status: IF/2010

Grant Date: 04/12/2008

Patent No: 225944

NF No: 0581NF2002/IN

A Ceramic Mixture Having Negative Temperature Co-Efficient, A Thermistor  
Containing The Ceramic Mixture And A Process For Preparing Thereof

Inventors: Madan Lal Singla, Baldev Raj, Vijay Rajaram Harchekar, Ram Prakash  
Bajpai

Comp Filing Date: 29/09/2004

Application No: 02934DELNP2004

Status: IF/2010

Grant Date: 20/01/2009

Patent No: 227829

NF No: 0400NF2001/IN

Cu-Zn-Al(6%) Alloy With Low Martensitic Temperature And Its Process

Inventors: Vijay Rajaram Harchekar, Madanlal Singla

Comp Filing Date: 16/10/2003

Application No: 01691DELNP2003

Status: IF/2010

Grant Date: 16/02/2009

Patent No: 229248

NF No: 0203NF2002/IN

A Blood Transfusion System

Inventors: Chattopadhyay Kashi Das, Verma Sanjeev, Raj Pirithi, Gupta Jitender

Comp Filing Date: 06/09/2004

Application No: 02611DELNP2004

Status: IF

Grant Date: 18/03/2009

Patent No: 232577

## Appendix: Papers Published in Journals

- Angra SK, Dimri AK, Kapur P, Non destructive Brix evaluation of apples of different origin using near infrared (NIR) filters based reflectance spectroscopy, *Instrumentation Science and Technology*, Vol 37, Number 2, pp 241-53, March 2009
- Arora Shailja, Singla ML, Kapor Pratibha, Evidence of monoalkoxide species on the surface of palladium nanoparticles synthesized in ethylene glycol, *Materials Chemistry and Physics*, Vol 114, pp 107-112, 2009
- Kaur Harsimran, Das Tapan, Kumar Rajesh and Bharadwaj Lalit M, Covalent attachment of actin filaments to Tween 80 coated polystyrene beads for cargo transportation, *Biosystems*, Vol 92(1), pp 69-75, April 2008
- Kumar Neelesh, Sharma VK, Agnihotri RC, Pankaj Dinesh, Effect of frequency and amplitude of fes pulse on muscle fatigue during toning of muscles, *Journal of Scientific and Industrial Research*, Vol 67, pp 288-290, April 2008
- Mehta SK, Bhasin KK, Dham Shilpee, Singla ML, Micellar behavior of aqueous solutions of dodecyltrimethylammonium bromide, dodecyltrimethylammonium chloride and tetradecyltrimethylammonium chloride in the presence of  $\alpha$ -,  $\beta$ -, hp  $\beta$  - and  $\gamma$ -cyclodextrins, *Journal of Colloid and Interface Science*, Vol 321, pp 442-451, 2008
- Mittal SK, Singh Manjeet, Kapur Parkhi, Sharma BK, Shamshi MA, Design and development of instrumentation for landslide monitoring and issue an early warning, *Journal of Scientific and Industrial Research*, Vol 67, pp 361-65, May 2008
- Mittal SK, Singh Manjeet, Garg RK, Sharma BK, Design and development of multi parameter probe to measure temperature and hardness inside snow microstructure, *Journal of Scientific and Industrial Research*, Vol 67, pp 428-431, June 2008
- Mittal SK, Singh Manjeet, Garg RK, Development of an instrument to measure density and moisture content of snow, *Journal of Scientific and Industrial Research*, Vol 68, pp 188 - 191, March 2009
- Mondal Samir K, Mishra Vandana, Tiwari Umesh, Poddar GC, Singh Nahar, Jain Subhash C, Sarkar SN, Kapur Pawan, Embedded dual fiber Bragg grating sensor for simultaneous measurement of temperature and load (strain) with enhanced sensitivity, *Microwave and Optical Technology Letters*, Vol 51, pp 1621 – 1624, 2009
- Rastogi Richa, Kaushal Rahul, Tripathi SK, Sharma Amit L, Bharadwaj Lalit M, Kaur Inderpreet, Comparative study of carbon nanotube dispersion using surfactants, *Journal of Colloid and Interface Science*, Vol 328, pp 421-428, Decmeber 2008
- Singla ML, Shafeeq Muhamed M, Kumar Manish, Optical characterization of ZnO nanoparticles capped with various surfactants, *Journal of Luminescence*, Vol 29, pp 434-438, 2009
- Singh Inderpreet, Bhatnagar PK, Mathur PC, Bharadwaj LM, Optical absorption spectrum of single walled carbon nanotubes dispersed in sodium cholate and sodium dodecyl sulfate, *Journal of Materials Research*, 23 (2008) 632-636
- Singh Inderpreet, Bhatnagar PK, Mathur PC, Kaur Inderpreet, Bharadwaj LM, Pandey Ravindra, Optical and electrical characterization of conducting polymer-single walled carbon nanotube composite films, *Carbon*, 46 (2008) 1141-1144
- Tiwari Umesh K, Thyagarajan K, Shenoy MR, Simulation and experimental characterization of Raman/EDFA hybrid amplifier with enhanced performance, *Optics Communications*, Vol 282, pp 1563-1566, April 2009
- Yadav Vinod, Sharma Neetu, Prakash Ranjana, Raina KK, Bharadwaj LM, Prakash NT, Generation of selenium containing nano-structures by soil bacterium *Pseudomonas Aeruginosa*, *Biotechnology*, Vol 7, pp 299-304, 2008

## Appendix: Conference proceeding, talks, training

### Papers Presented at Conferences and Seminars

- Aulakh Navneet Singh, Kler RS, Bhatnagar R, Singh Nahar, Jain SC, Kapur Pawan, Fiber Optics Bragg Grating Interrogator with Microbend Attenuation Compensated Edge Filtering Technique, International Conference on Fiber Optics and Photonics (Photonics-2008), December 13 to 17 2008, Indian Institute of Technology Delhi
- Awasthi Sajeela, Srivastava Alok, Singla ML, Cyclic voltmetry study of PPY/Hexacyanoferrate (II) towards aqueous solution of five basic taste, 25<sup>th</sup> Annual Meeting of the Polymer Processing Society (PPS), 1 to 5 March, 2009, Goa
- Dhawan Aseem, Kumar Neelesh, Pankaj Dinesh, Kunju Nissan, Kumar Amod, Lower Body Gait Analysis using Biometrics Twin Axis Goniometers, National Conference on Biomechanics, 7 to 8 March 2009, Indian Institute of Technology Roorkee
- Ghanshyam C, Verma Vijay Kumar, Bhondekar Amol, Design of an embedded system using wireless instrumentation for the production of traditional Indian food items, International Conference WECON-2008, October 18 to 19 2008, Chitkara Institute of Engineering and Technology, Rajpura District
- Ghanshyam C, Ojha RU, Das S, Identification of bacteria for pulsed electric field applications, CHASCON-3, February 26 to 28 2009, Panjab University, Chandigarh
- Ghanshyam C, Ojha RU, Bhondekar A, Das S, Preparation and characterization of microbes for pulsed electric field applications, International Conference on Microbial Biotechnology (Micron-2009), March 3 to 4 2009, Panjab University, Chandigarh
- Jain Subhash C, Bhatnagar Randhir, Kumar Sushil, Singh Nahar, Singh Manpreet, Kumar Raj, structural health monitoring using fiber Bragg grating sensors, National Seminar on Recent Advances in Aerospace Technologies, Maintenance and Optimisation (AEROTECHNOLOGY 2008), November 14 to 15 2008, Terminal Ballistic Research Laboratory (TBRL), Chandigarh
- Kumar Amod, Kumar Neelesh, Development of Mobile Robot with Wireless Ethernet Connectivity, All India Seminar on Trends on Wireless Technology, 13 to 14 March 2009, Doaba Institute of Engineering and Technology, Kharar
- Kumar Neelesh, Pankaj Dinesh, Singh Davinder Pal, Gill Harpinder Kaur, Kumar Amod, Sohi BS, Intelligent prosthetic device: an embedded system approach, International Rehabilitation Conference 2008 (IRC 2008), 3 to 5 December 2008, Department of Rehabilitation, Science Holy Cross College, Tiruchirappalli
- Kumar Manish, Singla ML, Synthesis, Characterization and L-B Thin Film Deposition of Ni-Co alloy nanoparticles, International Conference on Clusters and Nanomaterials (ISCANM), 9 to 11 February 2009, Harish Chandra Research Institute, Allahabad
- Kumar Neelesh, Kunju Nissan, Kumar Amod, Sohi BS, Optimal control strategy for above knee prosthetic control using semg and flexion angle, Accepted in XXII Congress of the International Society of Biomechanics, Cape Town, South Africa
- Kumar V, Bhadoria JS, Singh N, Mishra V, Jain SC, Kapur Pawan, Condition Monitoring of Steel Rope and Water Barrier Pillar using FBG Sensors, International Conference on Fiber Optics and Photonics (Photonics-2008), December 13 to 17 2008, Indian Institute of Technology Delhi
- Kunju Nissan, Kumar Neelesh, Pankaj Dinesh, Dhawan Aseem, Kumar Amod, EMG Signal Analysis for Identifying Walking Patterns of Normal Healthy Individuals, National Conference on Biomechanics, 7 to 8 March 2009, Indian Institute of Technology Roorkee
- Mishra Sunita, Das Shilpa, Kaur Jaspreet, Angra SK, Kapur Pawan, Preliminary results of detection of adulteration of honey using FTIR, accepted for presentation in International Diffuse Reflectance Conference (IDRC) 2008, August 3 to 8, 2008, Wilson College, Chambersburg, PA, USA

## Central Scientific Instruments Organisation, Chandigarh

- Mishra Sunita, Boiragi Indrajit, Ghanshyam C, Kapur Pawan, Effect of UV Radiation on Nanocrystalline SnO<sub>2</sub> Gas Sensor, International Conference on Transport and Optical Properties of Nanomaterials, January 5 to 8 2009, University of Allahabad
- Mondal Samir K, Mitra Anupam, Tiwari Umesh, Pant Jayshreekar, Jain Subhash C, Mishra Vandana, Poddar GC, Singh Nahar, Kapur Pawan, Embedded dual fiber Bragg grating sensor for temperature load (strain) discrimination, International Conference on Microwave – 08 (IEEE Explorer), 21 to 24 November 2008, University of Rajasthan, Jaipur
- Mondal Samir K, Tiwari Umesh, Jain Subhash C, Mishra Vandana, Singh Nahar, Paul AK, Kapur Pawan, Thinned fiber Bragg grating refractive index sensor for strain and temperature discrimination, International Conference on Fiber Optics and Photonics, December 13 to 17, 2008, Indian Institute of Technology Delhi
- Pandey VS, Mahapatra PK, Singla ML, NTC Based thermal sensor for Air Worthy Applications, Recent Advances in Aerospace Technologies, Maintenance and Optimization (AEROTECHNOLOGY 2008), 14 to 15 November 2008, Terminal Ballistic Research Laboratory (TBRL), Chandigarh
- Pant Jayshreekar, Mitra Anupam, Tiwari Umesh, Mondal Samir K, Singh Nahar, Jain Subhash C, Kapur Pawan, Temperature compensated transverse load sensor based on dual FBG sensor, International Conference on Microwave – 08 (IEEE Explorer), 21 to 24 November 2008, University of Rajasthan, Jaipur
- Poddar GC, Kumar Asha, Mishra Vandana, Tiwari Umesh, Chhachhia DP, Jain Subhash C, Kumar Sushil, Singh Nahar, Kapur Pawan, EFPI and FBG sensors for blast pressure monitoring applications, 1st National Symposium and Exhibition Trends in Explosive Technology (TEXT-2008), November 5 to 6 2008, Terminal Ballistic Research Laboratory (TBRL), Chandigarh
- Singh Suman, Singla ML, Singh Jagvir, Kapur P, Preparation and Characterization of Polypyrrole using Electrochemical Quartz Microbalance, 25<sup>th</sup> Annual Meeting of the Polymer Processing Society (PPS), 1 to 5 March, 2009, Goa
- Tiwari Umesh, Mishra Vandana, Jain Subhash C, Kesavan K, Ravisankar K, Singh Nahar, Poddar GC, Kapur Pawan, Investigations of FBG sensor technology for health monitoring of aerospace structures, Recent Advances in Aerospace Technologies, Maintenance and Optimization (AEROTECHNOLOGY 2008), 14 to 15 November 2008, Terminal Ballistic Research Laboratory (TBRL), Chandigarh
- Tiwari Umesh, Mishra Vandana, Jain Subhash C, Kesavan K, Ravisankar K, Singh Nahar, Kapur Pawan, Investigations of FBG Sensor Technology for Health Monitoring of Aerospace Structures, National Seminar on Recent Advances in Aerospace Technologies, Maintenance and Optimisation (AEROTECHNOLOGY 2008), November 14 to 15 2008, Terminal Ballistic Research Laboratory (TBRL), Chandigarh
- Tiwari Umesh, Thyagarajan K, Shenoy MR, Characterization of a Novel Raman/EDF Hybrid Amplifier with Enhanced Performance, International Conference on Fiber Optics and Photonics (Photonics-2008), December 13 to 17 2008, Indian Institute of Technology Delhi
- Verma Vijay Kumar, Bhondekar Amol, Ghanshyam C, Development of a system using wireless and virtual instrumentation for the production of traditional food items, National Symposium on Instrumentation NSI-33 of Instrument Society of India, December 8 to 10 2008, College of Engineering, Andhra University, Visakhapatnam

## Invited Talks and Lectures Delivered

- Bharadwaj LM, Bio-Nanosensors for Healthcare, Italy-India Forum, FICCI, New Delhi, April 18 2008
- Bharadwaj LM, Nanoscience - Nanotechnology based Global Economy-2020, National Conference on NANO - The Next Revolution, DAV college Hoshiarpur, December 4 2008
- Bharadwaj LM, Bio-Nano Hybrid Sensors for Healthcare and Agriculture, National Symposium on Instrumentation -33, Visakhapatnam, December 9 2008
- Bharadwaj LM, Bio-Nano Materials, International Conference on Nano Materials and Devices, Indian Institute of Technology Roorkee, December 11 2008
- Bharadwaj LM, Hybrid Devices for Healthcare and Defence, DST Workshop on Nano Sensors-08, Indian Institute of Technology Delhi, December 12 2008
- Bharadwaj LM, Nanotechnology Revolution, National Conference on Nanomaterials: Synthesis and Applications, DAV College, Jalandhar, February 6 2009
- Bharadwaj LM, Societal Transformation through Nano Biotechnology, Workshop Nanobiotechnology, Panipat, February 7 2009
- Bharadwaj LM, Hybrid Materials for Nanosensors, National Conference on Nanomaterials, DAV College, Amritsar, February 10 2009
- Bharadwaj LM, Impact of Nanotechnology on Energy Generation, National Conference on Energy and Nanotechnology, Jaipur Engineering College Jaipur, February 15 2009
- Bharadwaj LM, Nanotechnology for Defence, National Science Day Lecture, Instruments Research & Development Establishment (IRDE), Dehradun, February 27 2009
- Ghanshyam C, Development of Foul Odour Sensor, UGC Sponsored National Conference on Recent trends in Material Science, Dayanand Anglo Vedic (DAV) College, Amritsar, February 10 2009
- Ghanshyam C, Development of Thin Film Sensors, National Conference on Advanced Materials and Nanotechnology, Sarup Rani Government College for Women, Amritsar, February 16 2009
- Ghanshyam C, Nanoscience-Gas Sensors, UGC sponsored Special Winter School, Guru Nanak Dev University, Amritsar, December 23, 2008 to January 12 2009
- Jain SC, Fiber Fabrication and Cabling Techniques, Short Course on 'Optical Fibers and their Applications', NITTTR, Chandigarh, March 17 2009
- Jain SC, Interferometric Fiber Optic Sensors, Short Term Course on Fiber Optics Sensors, NITTTR, Chandigarh, February 2 2009
- Jain SC, Optical Fiber: Fabrication, Cabling and Joints, MHRD-AICTE Winter School, Jind Institute of Engineering and Technology, December 23 2008
- Kumar Amod, ANN Applications in Instrumentation, AICTE Sponsored Summer School on ANN and Fuzzy Logic, NITTTR, Chandigarh, July 29 2008
- Kumar Amod, Determination of Depth of Anaesthesia, Workshop on Faculty Induction, Rayat and Bahra College of Engineering Mohali Campus, August 8 2008
- Kumar Amod, EEG Signal Processing for Determination of Depth of Anaesthesia and Prosthetic Instrumentation, JMIT Radaur, March 6 2009
- Kumar Sushil, Lasers and Holography, September 25 2008 and January 22 2009, NITTTR, Chandigarh
- Kumar Sushil, Lasers in Holography, NITTTR, Chandigarh, August 7 2008
- Sardana HK, Agro Products Inspection using Image Processing, 18th January Seminar on Image Processing, Rayat and Bahra College, Kharar, January 12-23 2009
- Sardana HK, Building Institutional Climate for Excellence, Faculty Development Programme, NITTTR Chandigarh 16-20 March, 2009, March 17 2009
- Sardana HK, Case studies on Image Processing Applications, Institute of Engineering and Technology, Bhaddal, November 21 2008
- Sardana HK, Case Studies on Image Processing, NITTTR Chandigarh, July 1 2008
- Sardana HK, Computational Aspects in Instrumentation, Seminar on "Advances in Instrumentation", IET Bhaddal, March 26 2009
- Sardana HK, Content-Based Information Retrieval, National Conference on "Emerging Trends in Communication", Swami Vivekanand Institute of Engineering and Technology SVIET, February 20-21 2009

## **Central Scientific Instruments Organisation, Chandigarh**

- Sardana HK, Industrial Applications of Image Processing, Institute of Engineering and Emerging Technologies (IEET), Baddi (HP), September 5 2008
- Sardana HK, Institutions' excellence: Faculty and Leadership Roles, Seminar on Strategic Management for Excellence, Indo Global College of Engineering, Abhipur, January 21 2009
- Sardana HK, Medical Imaging and Processing, Seminar on Image processing, Rayat and Bahra College, Kharar, January 12-23 2009
- Sardana HK, Research and Applications Areas in Embedded Real-time/DSP Systems, IMS Workshop on Nanoelectronics and VLSI Development (in association with IEEE Chandigarh Sub-Section), University Centre of Instrumentation and Microelectronics(UCIM), Panjab University, Chandigarh, October 18 2008
- Sardana HK, Societal Applications of Image Processing, National Institute of Technology, Kurukshetra, November 27 2008
- Sardana HK, Soft Computing and Machine Intelligence, National Conference on Advancements in Computer Engineering 3-4 April, BBSBEC, Fatehgarh Sahib, April 4 2008
- Sardana HK, Wearable Systems, IMS Workshop on Nanoelectronics and VLSI Development (in association with IEEE Chandigarh Sub-Section), University Centre of Instrumentation and Microelectronics(UCIM), Panjab University, Chandigarh, October 18 2008
- Singla ML, Ceramic Sensors in Ferroelectric and Dielectrics, National Seminar on Ferroelectric and Dielectrics (NSFD-15), November 6 2008
- Singla ML, Nanomaterial and Synthesis Applications, Nano 2009, Dayanand Anglo Vedic (DAV) College, Jalandhar, February 7 2009

## Conferences, Seminars and Workshops Attended

- Shri NS Mehla, Shri SC Jain, Dr Sushil Kumar, Shri R Bhatnagar, Shri NS Aulakh, Shri Umesh Tiwari and Dr Samir Mondal participated in the 'International Conference on Photonics' (Photonics-2008) at Indian Institute of Technology Delhi in December 2008
- Dr ML Singla and Smt Suman Singh participated in a national seminar on 'Ferroelectric and Dielectrics' (NSFD-15) at Thapar University from 6 to 8 November 2008
- Dr ML Singla participated in a conference on 'Open Access to Scientific Publications Policy Perspective: Opportunities and Challenges' organized by CSIR at New Delhi on 24 March 2009
- Shri SC Jain and Shri R Bhatnagar attended a one day seminar on the 'Role of Instrumentation and Automation in Innovating Oil and Gas sector' organized by CII at Vadodara in December 2008
- Shri SC Jain, Shri Umesh Tiwari and Dr Samir Mondal participated in International Conference on Microwave – 08 at University of Rajasthan, Jaipur from 21 to 24 November 2008
- Dr Sunita Mishra attended a Hindi Seminar on CSIR Network Projects under Eleventh Five Year Plan at CEERI, Pilani from February 19 to 20 2009
- Shri BK Bansod participated in the 96<sup>th</sup> Indian Science Congress at North East Hill University Shillong, 3 to 7 January 2009
- Shri BK Bansod participated in the exhibition 'Haryana Vision' at Hissar from 6 to 8 March 2009
- Shri Manish Kumar and Ms Anupama Sharma attended a workshop on 'Material Characterization Techniques' at NPL, New Delhi from 7 to 11 July 2008
- Shri Manish Kumar participated in an International Conference on 'Clusters and Nanomaterials' (ISCANM) at Harish Chandra Research Institute, Allahabad from February 9 to 11 2009

## Training Programmes Conducted

- Dr HK Sardana conducted (as tutor) two of CSIR's Leadership Development Programmes (LDP) November, 2008 and February at Human Resources Development Centre (HRDC), Ghaziabad, each course of two weeks duration.

## Training Programmes Attended

- Dr C Ghanshyam graduated, completing all four modules of the CSIR Leadership Programme in November 2008 at Human Resources Development Centre (HRDC), Ghaziabad
- Dr Sunita Mishra attended a short course on Spectroscopic Ellipsometry, September 19 to 21, 2008 at SN Bose Institute, Kolkata
- Dr Sunita Mishra attended a Training Programme on RTI Act at Human Resources Development Centre (HRDC), Ghaziabad, January 20 to 29, 2009
- Dr Sunita Mishra attended the CSIR Leadership Development Programme at Human Resources Development Centre (HRDC), Ghaziabad, February 1 to 13, 2009
- Smt Suman Singh and Ms Anupma Sharma attended a programme on Tea processing and GC analysis at Institute of Himalayan Bioresource Technology (IHBT), Palampur, 7 to 9 July, 2008

## Appendix: Personnel

Dr Pawan Kapur, Director

### Directors Secretariat

Dr Neeru, Senior Hindi Officer  
Miss Kavita Chauhan, Assistant Grade II  
Sh Atul Sethi, Assistant(G) Grade II  
Sh Jaspal Singh, Driver II(1)  
Sh Bharosa Singh, Record Keeper  
Sh Rakesh Chand, Peon

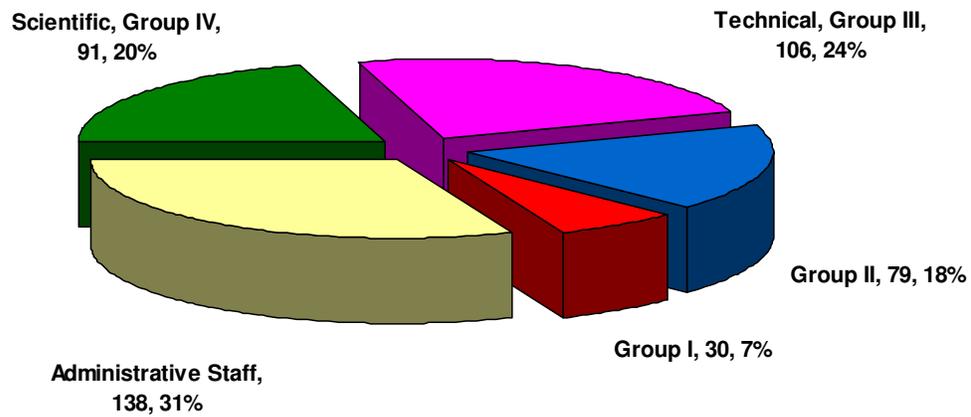
### Intelligent Instrumentation for Agro-based, Seismic, Condition Monitoring & Energy Management

Sh AD Kaul, Scientist G  
Sh BK Sharma, Scientist F  
Sh SS Randhawa, Scientist F  
Sh SK Mittal, Scientist F  
Sh Pradeep Kumar, Scientist F  
Sh DK Bandopadhyay, Scientist EII  
Sh Satish Kumar, Scientist EI  
Sh VD Shivling, Scientist EI  
Sh AG Sonkusare, Scientist EI  
Sh Amol P Bhondekar, Scientist C  
Sh BS Bansod, Scientist C  
Sh Manjit Singh, Scientist C  
Smt Jasjit Kaur, Technical Officer EI  
Sh VK Mohal, Technical Officer C  
Smt Bhupinder Kaur, Technical Officer C  
Smt Rajni, Technical Officer B  
Sh RS Shaunda, Technical Officer B  
Smt Bandana, Technical Officer B  
Sh Swaranjit Singh, Technical Officer B  
Sh Dhanna Lal Meena, Technical Officer B  
Sh Mehar Chand, Technical Officer B  
Sh Amit Gupta, Technical Officer A  
Sh Ajay Saxena, Technician II(3)  
Sh Ashok Kumar, Technical Assistant Grade III(1)  
Sh Kapil Verma, Senior Stenographer  
Smt Chameli Rani, Supporting Staff Grade I(4)

### Medical Instrumentation, Linear Accelerator, Medical Imaging & Prosthetic Devices for Disabled

Dr Amod Kumar, Scientist G  
Dr HK Sardana, Scientist G  
Dr PK Jain, Scientist F  
Sh RC Gupta, Scientist F  
Sh Vijay Sehgal, Scientist EII  
Sh Dinesh Pankaj, Scientist EI  
Sh Sanjeev Verma, Scientist EI  
Sh Neelesh Kumar, Scientist C  
Sh Jagdish Kumar, Scientist C  
Sh Sanjeev Soni, Scientist C  
Smt Jaspreet Kaur, Scientist B  
Sh Arindam Chatterjee, Scientist B  
Sh Amit Laddi, Scientist B  
Sh Sanjeev Kumar, Scientist B  
Smt Tirlochan Kaur Matharu, Technical Officer EII  
Smt Sudesh Bachhal, Technical Officer EI  
Smt Shashi Sharma, Technical Officer EI  
Smt Kanta Garg, Technical Officer EI  
Smt Saroj Batra, Technical Officer C  
Sh Chand Ram Sharma, Technical Officer B  
Sh Madan Lal, Technician Grade II(4)  
Sh SK Arora, Technician Grade II(4)  
Sh Naresh Kumar, Junior Stenographer (ACP)  
Sh Ganga Prasad Singh, Supporting Staff Grade I(4)  
Sh Pawan Kumar, Supporting Staff Grade I(4)

## Appendix: Manpower Profile



Total strength as on March 31, 2009: 444

## Appendix: Budget

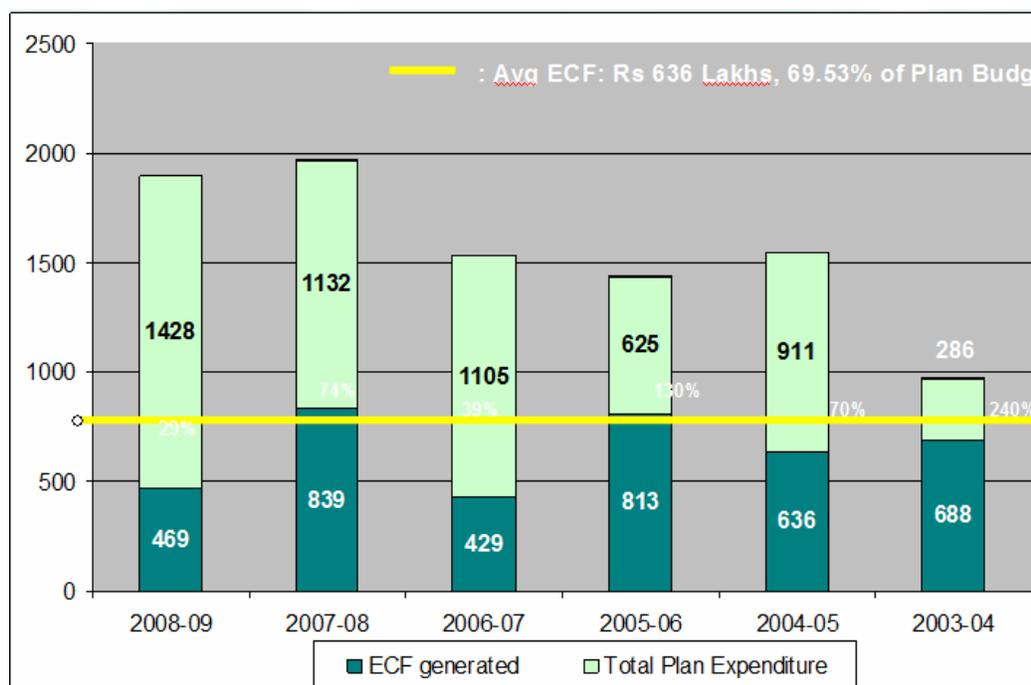
### Expenditure in the Year 2008-2009

*Rupees in Lakhs*

Head of Account	Source of Expenditure	
	CSIR Funds	Lab Reserves
<b>Recurring</b>		
Pay of Officers	990.581	125.350
Pay of Establishment	342.102	25.000
Dearness Pay	17.831	
Allowances	576.955	16.668
Contingencies	130.000	
Maintenance	69.997	29.859
Staff Quarters Maintenance	40.000	1.261
Chemicals & Consumables	28.003	19.457
Human Resources Development	3.000	1.795
Total Recurring	2198.467	219.390
<b>Capital</b>		
Works and Services		69.298
Apparatus & Equipment (including Computer Equipment and Software)	124.265	
Workshop Machinery		
Office Equipment	3.084	
Furniture & Fittings	4.000	0.721
Library Books & Journals	41.001	8.585
Vehicles		
Tools & Plants		
Models & Exhibits		
Staff Quarters (Construction)	13.000	9.559
<b>Total Capital</b>	185.350	88.163
<b>Total (Recurring + Capital)</b>		
IRR- Construction		3.493
IRR – ICT		
Networked Projects	959.476	
<b>Grand Total</b>	3343.295	311.046

**External Cash Flow (ECF) in 2008-2009**

Actual Receipts	Rs in Lakhs
ECF generated under Sponsored, Grant-in-Aid, Collaborative and Consultancy Projects	428.407
S&T Receipts from Royalties, Premia, Job Work, testing and Analytical Charges and Other Technical Services	40.473
Total External Cash Flow	468.830

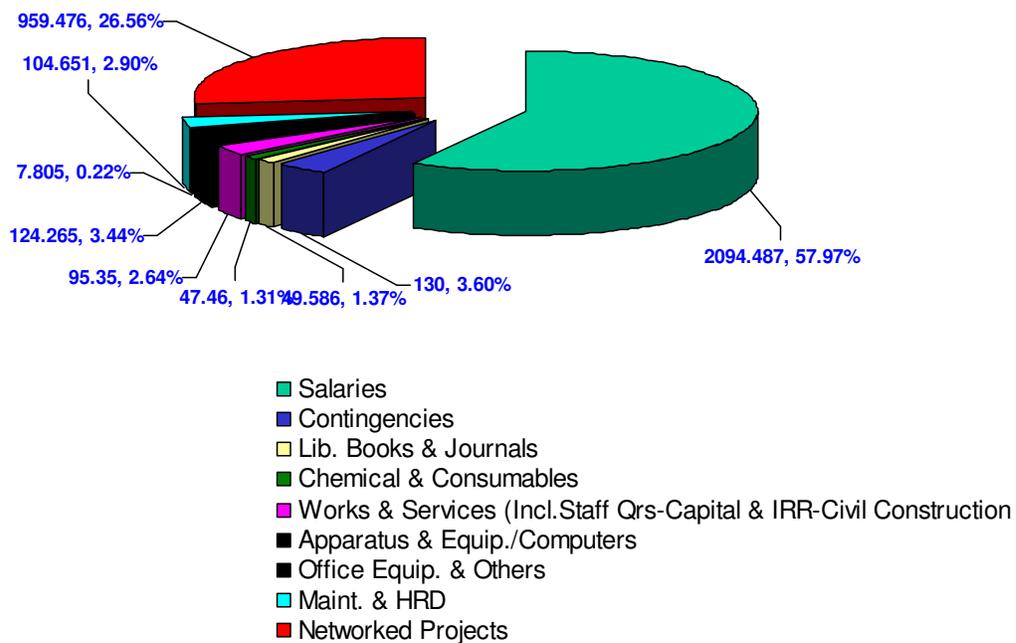


Average ECF                      Rs 10.3 Lakhs / scientist/ annum (of 62 scientists in R&D)

Average Plan budget money                      Rs 14.75 Lakhs / scientist/ annum

Total                                      Rs 25 Lakhs/ scientist/ annum

### Actual Expenditure (CSIR Funds & Lab Reserve)



## **Appendix: Project Funding**

Externally funded research projects described in this report have been funded by the following agencies (in alphabetical order):

Aeronautical Development Agency, Bangalore  
Bharat Heavy Electricals Limited, Ranipet  
Hindustan Aeronautics Limited, Bangalore  
Department of Information Technology, Government of India, New Delhi  
Indian Meteorological Department, New Delhi  
Snow and Avalanche Study Establishment, Defence Research & Development Organisation  
Department of Science and Technology, Government of India, New Delhi

## Appendix: Management Council (2008-2009)

### Chairman

Dr Pawan Kapur  
Director,  
Central Scientific Instruments Organisation,  
Chandigarh

### Members

Shri VR Dahake  
Scientist In-Charge,  
MERADO,  
Ludhiana

Shri NS Mehla  
Scientist,  
Central Scientific Instruments Organisation,  
Chandigarh

Dr Amod Kumar  
Scientist,  
Central Scientific Instruments Organisation,  
Chandigarh

Dr SV Ramagopal  
Scientist,  
Central Scientific Instruments Organisation  
Chandigarh

Smt Sukanya Bhasin  
Scientist,  
Central Scientific Instruments Organisation  
Chandigarh

Shri Amol Bhondekar  
Scientist,  
Central Scientific Instruments Organisation  
Chandigarh

Smt Shashi Sharma  
Technical Officer,  
Central Scientific Instruments Organisation,  
Chandigarh

Controller of Finance and Accounts  
Central Scientific Instruments Organisation,  
Chandigarh

Finance and Accounts Officer  
Central Scientific Instruments Organisation,  
Chandigarh

### Member Secretary

Controller of Administration or  
Administrative Officer  
Central Scientific Instruments Organisation,  
Chandigarh

## Appendix: Research Council (2008-2009)

### Chairman

Prof Surendra Prasad  
Director,  
Indian Institute of Technology,  
New Delhi

### Members

Prof ML Munjal  
Professor and Convener,  
Facility for Research in Technical Acoustics,  
Indian Institute of Science,  
Bangalore

Dr S Banerjee  
Director,  
Bhabha Atomic Research Centre,  
Mumbai

Dr SS Sundaram  
Member Director,  
Instrument Research & Development Establishment,  
Dehradun

Prof KK Talwar  
Director,  
Postgraduate Institute of Medical Education and  
Research,  
Chandigarh

Prof S Anand  
Centre for Biomedical Engineering,  
Indian Institute of Technology  
New Delhi

Prof MS Kang  
Vice Chancellor,  
Punjab Agricultural University  
Ludhiana

Shri Yogesh Kumar  
Technical & Business Consultant  
National Aeronautical Laboratories  
Bangalore

Shri Anil Sachdev  
Director (Personnel),  
Bharat Heavy Electricals Ltd  
Delhi

Dr GP Sinha (until 31/7/2008 FN)  
Dr Amitava Roy (from 31/7/2008 AN)  
Dr SN Maity (from 31/12/2008 AN)  
Director,  
Central Mechanical Engineering Research Institute

Dr MR Nayak  
Scientist,  
National Aerospace Laboratories,  
Bangalore  
*(Director General's nominee)*

Dr Naresh Kumar  
Scientist and Head,  
R&D Planning Division,  
Council for Scientific and Industrial Research,  
New Delhi  
*(Permanent invitee)*

Dr Pawan Kapur  
Director,  
Central Scientific Instruments Organisation,  
Chandigarh

# Organisation Chart

