ISRO - UoP SPACE TECHNOLOGY CELL

University of Pune

ANNUAL REPORT
2013-14

JPC Members in a discussion

ISRO-UoP
Space Technology Cell

University of Pune

SUMMARY

This document presents the details of the activities of ISRO-UoP Space Technology Cell (STC) at University of Pune, during the year 2013-14. A brief report on completed projects, giving summary of findings, is included in the document. Similarly details of ongoing projects highlighting objectives of the research projects approved under ISRO-UoP Joint Research Programme are given. A list of the suggested research topics has been included for the guidance of prospective Investigators.

Contents

1. Introduction

Starting with ground based and balloon borne experiments in 1940s, the Indian space science research activities were actually initiated with the launching of sounding rockets from Thumba Equatorial Rocket Launching Station (TERLS) in 1963 to measure the equatorial electrojet parameters. Since then large number of rocket and balloon borne experiments have provided new data on upper atmospheric phenomena, cosmic rays and energetic x-ray & gamma rays. To promote development and application of space science and technology for socio-economic benefits, Government of India established the Department of Space in 1972. Indian Space Research Organization (ISRO) is the primary agency under the Department of Space for executing space programmes. During the seventies, India undertook demonstration of space applications for communication, broadcasting and remote sensing; designed and built experimental satellites – Aryabhata, Bhaskara, APPLE and Rohini – and experimental Satellite Launch Vehicles – SLV-3 and ASLV. Today, India has established space systems that form an important element of the national infrastructure. India successfully sent its Chandrayaan-1 spacecraft to moon in November 2008 and became the fourth individual country to send a probe to the lunar surface. India's 100th Space Mission took place in September 2012 during which the country's workhorse Polar Satellite Launch Vehicle (PSLV) successfully placed French SPOT-6 and Japanese PROITERES satellites in the required orbits. The year 2013 has witnessed landmark achievements in the Indian Space programme with the launch of India's first interplanetary Mars Orbiter Mission and successful flight testing of indigenous Cryogenic Upper Stage. Besides this, launch of IRNSS-1A, the first satellite of the Indian Regional Navigation Satellite System, has laid the foundation for indigenous satellite navigation system. These projects provide exciting opportunities to attract young research scientists and students to space science arena and Indian Space Research Organization (ISRO) has evolved a programme called RESPOND through which financial support is provided for conducting research and development activities related to Space Science, Space Technology and Space Application to academia in India.

The aim of RESPOND is to encourage quality research in areas of relevance to the Indian space programme. Under RESPOND, projects are taken up by universities and academic institutions in the country. Apart from this, ISRO has also set up Space Technology Cells at premiere institutions like Indian Institute of Technologies (IITs) - Bombay, Kanpur, Kharagpur & Madras; Indian Institute of Science (IISc), Bangalore and Joint Research Programme with University of Pune (UoP) to carry out research activities in the areas of space science, space technology and applications. These STCs and JRP are guided by Joint Policy Committees (JPC) chaired by Director/Vice Chancellor of the respective institution and with members from ISRO/DOS (Senior Scientists/Engineers) & the respective institution. Under the STC/JRP, projects are taken up by the faculty of the Institute/University. RESPOND Programme is helpful in establishing strong links with academic institutions to carry out research and developmental projects and deriving useful outputs of such R&D to support ISRO programmes. A Memorandum of Understanding (MoU), initiating Joint Research Programme (JRP), was signed between Chairman ISRO and Vice Chancellor University of Pune on 21 January 1998. To begin with, the Joint Research Programme focused on research areas comprising (i) Origin of life (ii) Space Radiation (iii) Wind measurements & modeling (iv) Optical coatings & sensors and (v) Rural development & developmental communication. The co-operation between the two organizations had been found beneficial and as a result, while renewing the MoU on 24 February 2006, these areas were enlarged by identifying six new disciplines. Additional areas where more emphasis could be laid on are (i) Geo-informatics (ii) Remote sensing applications (iii) Material Sciences (iv) Biodiversity (v) Instrumentation and (vi) Image processing. JRP programme is believed to enhance academic base, generate quality human resources and infrastructure at the academic Institution to support the space programme.

2. Management of Joint Research Programme

Under ISRO-UoP Joint Research Programme, emphasis has been on promoting research and applications in Space Science and Technology. A Joint Policy Committee (JPC), constituted jointly by Vice Chancellor, University of Pune and Chairman, ISRO with appropriate representation from both ISRO and University of Pune supervises the overall management of the Interaction Programme, recommends the funds requirement for the approved and the planned programmes to ISRO HQs and suggests new areas of activities as and when necessary. The Hon. Director, ISRO-UoP STC, is responsible for the administration, fund utilization and day-to-day functioning of the STC. Following were the JPC Members during the year 2013-14 with Vice Chancellor, University of Pune, as ex-officio Chairman.

Joint Policy Committee (JPC)

Prof (Dr) W N Gade, Vice Chancellor, UoP	Chairman
Dr MYS Prasad, Director, SDSC/ISRO	Member
Dr JA Kamalakar, Director, LEOS/ISRO	Member
Dr S Aravamuthan, Dy Director, PCM, VSSC/ISRO	Member
Shri VS Palsule, Director, DECU/ISRO	Member
Dr CBS Dutt, Group Director, ESAG, NRSC/ISRO	Member
Shri MS Anurup, Dy Director, LVPO, ISRO HQs	Member
Dr K Ganesh Raj, Dy Director, RESPOND, ISRO HQs	Member
Prof S Ananthakrishnan, Adjunct Professor & Raja Ramanna Fellow	Member
Shri P P Kale, Director, VLSI	Member
Dr V B Gaikwad, Director BCUD, UoP	Member
Dr Dilip D Dhavale, Head, Dept of Chemistry, UoP	Member
Dr P Pradeep Kumar, Head, Dept of Atm and Space Sciences, UoP	Member
Prof S I Patil, Head, Dept of Physics, UoP	Member
Dr AD Sahasrabudhe, Director, College of Engineering, Pune	Member
Smt Vidya K Gargote, Finance & Accounts Officer, UoP	Member
Shri M C Uttam, Hon Director, ISRO-UoP STC	Member Secretary

Preliminary Evaluation Committee (PEC)

The Preliminary Evaluation Committee (PEC) is a local Committee constituted to co-ordinate and assist in implementation of Joint Research Programme in University of Pune. This Committee carries out preliminary evaluation of new research proposals and interacts with the Investigators to make changes in the proposed study. The proposals recommended by the Committee are examined by the Joint Policy Committee for final approval. PEC also has the responsibility to periodically review the progress of the ongoing projects and take corrective measures. Following were the PEC Members during the year 2013-14.

Dr S Ananthakrishnan (Adjunct Professor & Raja Ramanna Fellow)	Chairman
Shri PP Kale, Director, VLSI	Member
Dr V B Gaikwad, Director BCUD, UoP	Member
Prof S I Patil, Head, Dept of Physics, UoP	Member
Prof Dilip D Dhavale, Head, Dept of Chemistry, UoP	Member
Dr (Mrs) Deepti Deobagkar, Head, Dept of Bioinformatics, UoP	Member
Smt Vidya K Gargote, Finance & Accounts Officer, UoP	Member
Shri M C Uttam, Hon. Director, ISRO-UoP STC	Member Secretary

This Committee has been reconstituted vide Office Order Ref No.VC/130 dated March 28, 2014. Composition of the new Committee is as follows:

Dr S Ananthakrishnan (Adjunct Professor & INSA Senior Scientist)	Chairman
Shri PP Kale	Member
Dr (Mrs) Deepti Deobagkar	Member
Director, BCUD	Member
Head, Dept of Physics	Member
Head, Dept of Atmospheric and Space Sciences	Member
Head, Dept of Chemistry, UoP	Member
Head, Dept of Electronic Science	Member
Head, Dept of Geography	Member
Head, Dept of Geology	Member
Head, Dept of Education and Extension	Member
ISRO Chair Professor	Member
Finance & Accounts Officer, UoP	Member
Shri M C Uttam, Hon. Director, ISRO-UoP STC	Member Secretary

3. Completed Research Projects

Beginning in 1998-99, a total of 143 research projects were undertaken by the various departments of the University and its affiliated colleges under ISRO-UoP Joint Research Programme and 108 of these projects were completed in the previous years ending in March 2013. During the year 2013-14 studies in respect of eleven more projects, as listed below, have been completed and final technical reports received from the Investigators. Summary of findings of these projects is given below. In order to bring the results of the study to the notice of ISRO Scientists/Engineers, brief details along with summary of findings of the completed research projects are published from time to time. Copies of full technical reports of the completed projects are also sent to concerned libraries of ISRO Centres.

1. Application of remotely sensed data for the evaluation of impervious surface growth and its effect on surface run off in two rapidly urbanizing watersheds of Western Maharashtra, India (Project No.104)
2. Modelling spatial patterns of fresh water reservoirs with special reference to plankton, mollusks and fishes using physico-chemical characteristics of water and remote sensing techniques (Project No.105)
3. Synthesis and applications of composites of TiO_2 with Carbon Nanotubes and Metal Chalcogenides (Project No.107)
4. Use of a Geographical Information System to study tuberculosis epidemiology and the factors affecting case detection in a rural population in Pune district, Maharashtra (Project No.109)
5. Study of invertebrate biodiversity of Swanga Lake region, Dist Amravati, Maharashtra (Project No.111)
6. Study of the direct radiative forcing of atmospheric aerosols over different environments (Project No.113)
7. Studies on structural, optical and electrical properties of transparent conducting thin film (TCO) (Project No.115)
8. Identification of critical areas of conservation concern using RS-GIS technique from northern Western Ghats of India (Project No.119)
9. Development of high performance Polycarbonate/Graphite nanocomposites with Low percolation for EMI shielding application (Project No.120)
10. Synthesis and characterization of Copper Chromite for propellant (Project No.121)
11. Preparation of Barium Magnesium Tantalate (BMT) and Barium Zinc Tantalate (BZT) with and without dopants for microwave dielectric application (Project No.122)

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PROJECT NO	**104**
TITLE	Application of remotely sensed data for the evaluation of impervious surface growth and its effect on surface run off in two rapidly urbanizing watersheds of Western Maharashtra, India
INVESTIGATORS	Dr (Mrs) Anargha Wakhare, Department of Geography, Nowrosjee Wadia College, Pune
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	9,66,000
SUMMARY OF FINDINGS	The study aimed at developing and validating a model for estimation of surface runoff integrating the variations in the land use land cover and imperviousness within two rapidly urbanizing basins of Maharashtra. The study areas chosen are Mula-Mutha basin and Bhima-Indrayani basin. Impervious surface extraction and surface runoff estimation are carried out for 20 years span period, for both the basins. Impervious surface was calculated at pixel level with the help of regression model and considering parameters such as band values, NDVI, tasseled cap, population density etc. Estimation of surface runoff was carried out by SCS-CN method. This method computes direct runoff through an empirical equation that requires rainfall, soil, land cover and the curve number (CN). In the last 20 years, the built up area has increased from 14% to 26% for Mula-Mutha basin, and from 5% to 15% for Bhima-Indrayani basin. Impervious surface prevents the infiltration of water into the soil which is considered as important measure of overall health of the watershed. 40% of the area of Mula-Mutha basin is in the degraded category and 57% under impacted category, imperviousness ranging from 40 to 60%. These values indicate fully urbanized status of the watershed. Bhima-Indrayani basin is in developing phase with 24% area under impacted zone (imperviousness ranging from 10 to 25%). Pune city expanded radially and most of the developmental activities are concentrated in the vicinity of city. The surrounding areas of Pune such as, Katraj, Hadapsar, Warje, Singhgad Road show higher values of runoff (25 to 30 mm). The surface runoff calculated with the SCS-CN method is validated statistically with the measured data. The measured and simulated runoff values have good correlation. The present work highlights the fact that there is a strong positive relationship between the percent imperviousness of the watershed and the amount of runoff generated.

PROJECT NO	**105**
TITLE	Modelling spatial patterns of fresh water reservoirs with special reference to plankton, mollusks and fishes using physico-chemical characteristics of water and remote sensing techniques
INVESTIGATORS	Dr Pandit Sangeeta V, Dept of Zoology, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	13,68,000
SUMMARY OF FINDINGS	A three year study was conducted in two reservoirs, Panshet and Varasgaon to evaluate the changes in water quality parameters, Zooplanktons, Fish diversity and also to use remote sensing and GIS techniques for mapping water quality of the study area. Study showed that concentrations of metals in the reservoirs were within acceptable limits with reference to potability of water. Other parameters such as Spatial Distribution of pH, Electric Conductivity, Total Dissolved Solids, Hardness, Alkalinity, Acidity, Dissolved Oxygen Temperature, Salinity, Phosphate, Nitrate and Sulphate contents in these reservoirs were studied. Fish diversity was dominated by family Cyprinidae of which 11 species were identified. Other abundant groups of fish species belong to families such as Notopteridae, Mastacembelidae, Siluridae, Ambassidae, Hemiramphidae and Belonidae. Fish diversity of the reservoirs, according to Simpson Diversity index, was rich. Zooplankton population of the reservoir was dominated by Copepod followed by Rotifer and Cladocera. Spatial distribution of parameters like pH, Electric conductivity, Hardness, Calcium, Magnesium, Acidity, Nitrate, Phosphate content, TDS etc were found to be within permissible limits. However spatial distribution maps of Chloride and Sulphate were found beyond permissible limits in monsoon season. In this study, LISS III sensor data was used to predict SDT of entire reservoir at pixel level i.e., 24 m X 24 m by developing regression equations based on sampling and radiance data from satellite imagery. Data was useful in measuring transparency of water.

PROJECT NO	**107**
TITLE	Synthesis and applications of composites of TiO_2 with Carbon Nanotubes and metal chalcogenides
INVESTIGATORS	Pragati R Thakur, Dept of Chemistry, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	14,52,000

SUMMARY OF FINDINGS

Aim of the study was to synthesize, characterize, and investigate photocatalytic activity of TiO_2 and their composites with Carbon Nanotubes (CNTs) and metal chalcogenides for degradation of model pollutants such as methyl orange dye (MO), p-Chlorophenol (PCP) and p-Nitrophenol (PNP). Synthesized nanocomposite was characterized using various analytical tools. Photocatalytic efficiency of synthesized TiO_2-MWCNTs nanocomposite was studied using multilamp photoreactor and mineralization of pollutants was checked by Chemical Oxygen Demand (COD) values. Rate of degradation of MO dye using 10% MWCNTs-TiO_2 nanocomposites calcined at 300^oC, as photocatalyst, was found to be 10 times higher as compared to TiO_2. COD values show substantial mineralization of model pollutants when nanocomposite was used, compared to bare TiO_2, showing better efficiency of the composite. Enhanced photocatalytic efficiency of TiO_2-MWCNTs could be due to MWCNTs acting as adsorbent, dispersing agent and electron reservoir and thus facilitating separation of the photo-generated electron-hole pairs at the TiO_2-MWCNT interface. This also leads to faster rate of photocatalytic oxidation. Synthesis of nanoparticles of Sb_2S_3 by wet chemical method under refluxing conditions and TiO_2-Sb_2S_3 nanocomposite by hydrothermal and mechanical mixing method was also carried out. These materials were characterized using analytical tools. Sb_2S_3 particles under visible light irradiation photodegraded 95 % of MO dye solution within 30 minutes. This was much faster under visible light than under UV light irradiation. Nanocomposite showed higher photocatalytic degradation and mineralization of model pollutant compared to bare TiO_2 nanoparticles. Enhanced photocatalytic efficiency of composite may be attributed to semiconductor-semiconductor heterojunction between TiO_2 and Sb_2S_3, which improved charge separation and thereby enhancing the lifetime of hole. Nanocomposites synthesized under present investigation have potential application in environmental remediation as well as in solar cell application.
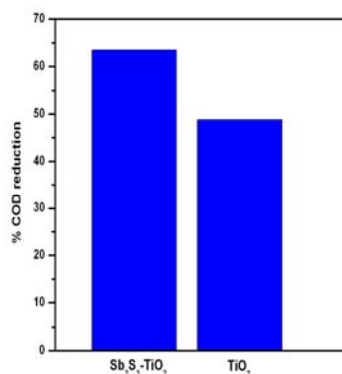
COD Reduction using 10%Sb_2S_3-TiO_2 nanocomposite and TiO_2 nanoparticles for photocatalytic degradation of MO dye

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PROJECT NO	**109**
TITLE	Use of a Geographical Information System to study tuberculosis epidemiology and the factors affecting case detection in a rural population in Pune district, Maharashtra
INVESTIGATORS	Dr Anita Kar, Director Interdisciplinary School of Health Sciences, UoP
DURATION	2 years (Started on: April 2010)
BUDGET (₹)	9,61,500
SUMMARY OF FINDINGS	Aim of the study was to examine the strains of tuberculosis circulating in a peri-urban industrial area and study transmission dynamics of tuberculosis in that population. All health care facilities in the area were mapped using a Garmin 76CSx hand held device and the data was imported using ArcGIS 10.0. Tuberculosis surveillance was established by involving all practitioners to provide address and sputum samples from suspected tuberculosis cases. Sputum was cultured and species confirmation was done from positive cultures using MPB64 verification. Genotyping of 51 culture positive samples was done using PCR amplification of the 15 MIRU-VNTR loci and strains were identified using the MIRU-VNTR*plus* database. All culture positive patients were mapped at their place of residence. Cluster analysis was done to test for distribution of tuberculosis cases and strain types in the population. The field mapping of health care facilities provided the metrics of healthcare in a peri-urban setting. The data showed that the majority of health care services in this area are being provided by young, male graduates from the traditional medicine sectors who were mostly non-residents in this area. There was a 32% increase in these practitioners over 11 years even as the number of practitioners from modern medicine had remained constant. There was no difference in the services provided by practitioners from traditional and modern medicine services. The 51 culture positive samples from the tuberculosis surveillance yielded ten strains (Delhi/CAS, EAI, Beijing, LAM, West African 1, TUR, Haarlem, Uganda II, Uganda I and NEW-1 using 15 MIRU-VNTR loci. One strain could not be typed. GIS analysis revealed there was a significant clustering of tuberculosis cases in the community, however, the distribution of strains in the population was random, so that whether infection was obtained from within or from outside the community could not be ascertained. This study is a first report from India that shows that there were at least 10 different genotypes of *M. tuberculosis* circulating in the community. This observation has to be kept in mind during treatment, as there have been previous reports that different genotypes may vary in drug susceptibility. Apart from the diversity of circulating genotypes within a community, several unique strains were also identified, which could possibly be attributed to the high levels of migration, a significant characteristic of industrialized, peri-urban communities. Community transmission was not identified in this study, due to the random distribution of strains in the population.

PROJECT NO	**111**
TITLE	Study of biodiversity invertebrate of Swanga Vithoba Lake region, Dist Amravati, Maharashtra
INVESTIGATORS	Varsha Wankhade, Dept of Zoology, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	13,18,000

SUMMARY OF FINDINGS

The role of invertebrates in the food chain is important either directly as food for reptiles, birds, mammals or indirectly as agents in the recycling of soil nutrients. Invertebrates are also the indicator of ecosystem health. In the present study, status of ecosystem of Sawanga Vithoba Lake was assessed with reference to diversity of few arthropods such as order Odonata, Lepidoptera, Coleoptera and Araneae and bacteria in soil and water samples of the lake. Sawanga-Vithoba lake is a freshwater lake created in 1972. Lake sediment plays significant role in maintenance of the quality of local, regional and global environment. Physicochemical parameters such as pH, nitrogen, phosphorus, organic carbon and potassium present in the lake water influence growth of flora and fauna. These parameters were assessed and found to be in normal range.

Twenty eight species of butterfly belonging to five families were observed and studied. Butterfly exhibits seasonal variation in distribution of species. Some species such as Papilio machaon, Parnara guttata, Cepora nerissa, Pieris brassicae, Junonia almanac, Junonia lemonias, Phalanta phalanta and Acraea terpsicore are not observed in summer. Species richness in some cases like Catochrysops Strabo and Eurema hecabe is found to be higher in all the seasons. Family Nymphalidae is the most represented family at Sawnga Vithoba lake. Thirty three species of odonata were observed and studied. Family Lebellulidae is found to be the most represented family. Species such as Diplacodes lefebvrii, Orthetrum glaucum, Tholymis tillarga, Aethriamanta brevipennis, Aciagrion pallidum and Lestes elatus were not observed in summer. Twenty seven species of beetles belonging to 7 families are observed in the present study and family Scarabidae is found to be the most represented family. Sawanga-Vithoba Lake holds forty two species of spiders belonging to 14 families. Family Araneidae is the most represented family. Species belonging to five types of guild structure were observed with most represented guild as a "web builder".

PROJECT NO	**113**
TITLE	Study of the direct radiative forcing of atmospheric aerosols over different environments
INVESTIGATORS	Dr G R Aher, Dept Environmental Sciences, UoP
DURATION	3 years (Started on: April 2010)
BUDGET (₹)	13,64,800

SUMMARY OF FINDINGS

The project envisages independent ground-based radiometer measurements under clear-sky conditions simultaneously with comprehensive measurements of aerosol microphysical and optical properties. The short-wave global solar flux shows systematic seasonal diurnal variation pattern which is symmetric around local noon. The variation is represented by Gaussian distribution law at all the observing sites and is found to be dependent on the optical state of the atmosphere. The diurnal cycle in AOD at NWC and the observing sites is found to be related to the prevalent meteorological conditions, surface-based nocturnal temperature inversion in atmospheric boundary layer and influx of aerosols from different source regions as revealed by the wind trajectory analysis. Magnitudes of Ångström parameters, α and β suggest transformation of aerosols over NWC, during winter from high accumulation-mode dominance ($\alpha > 1$) to increased coarse-mode dominance ($\alpha < 1$) during pre-monsoon. This indicates that in winter, submicron aerosols are produced mainly from bio-fuel burning and fossil fuel combustion sources whereas during pre-monsoon, aerosol scenario is controlled by the combination of pollution and dust generation from strong surface heating and high winds. ADRF shows significant day-to-day variation and co-varies with AOD. Cause of day-to-day variation is an anti-correlation between ADRF/AOD and daily RH and temperature range. Winter days generally show low surface forcing as compared to the pre-monsoon days at NWC. ADRF is minimum in winter and maximum during pre-monsoon. The minima and maxima in ADRF are found to correlate well with seasonal variation of AOD. The SBDART model derived top of the atmospheric forcing is found to be considerably lower taking values in the range -15 W/m2 to - 30 W/m2. As a result of this, averaged atmospheric forcing is seen to be maximum in March and minimum in the month of May. For other months, averaged atmospheric forcing values are assumed in this range. For observing year 2011-12, the average atmospheric forcing is relatively less as compared to that during 2010-11. The large difference in the TOA and BOA during 2010-11 and 2011-12 demonstrate that the solar radiation is absorbed within the atmosphere causing warming of the atmosphere and at the same time there is a cooling effect at the earth's surface. This can substantially alter atmospheric stability and influence dynamic system of the atmosphere. The overall TOA forcing at NWC, Pune are comparable, but the BOA forcing are stronger (more strongly negative) during 2010-11.
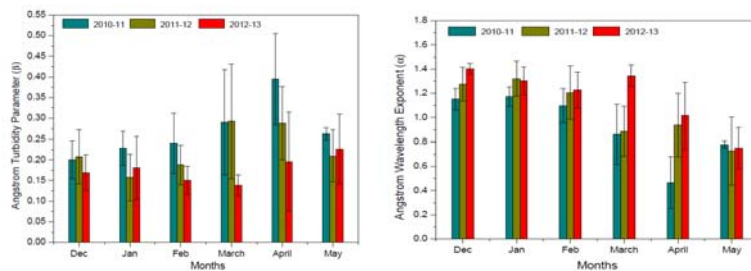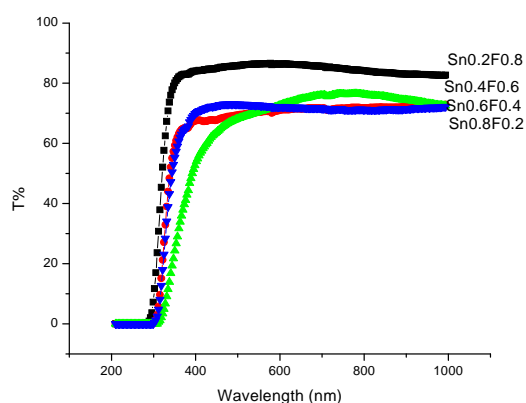

Seasonal variation of Angstrom wavelength exponent and Angstrom turbidity parameters at Pune

PROJECT NO	**115**
TITLE	Studies on structural, optical and electrical properties of transparent conducting thin film (TCO)
INVESTIGATORS	Dr Arle Ramdas Nivrutti, Jijamata College of Science and Arts, Bhende
DURATION	2 years (Started on: July 2011)
BUDGET (₹)	3,30,000
SUMMARY OF FINDINGS	Thin films of ZnO have been deposited by chemical spray technique using mixed aqueous solutions of Zinc acetate. The effect of deposition parameters on thin film formation has been investigated and deposition parameters such as volume of solution, substrate temperature, substrate to nozzle distance, nozzle diameter, spray rate etc. have been optimized. The X-ray diffraction pattern of the deposited films shows hexagonal wurtzite crystal with mean crystallite size in the range of 30nm to 52nm. The film exhibits increasing c- axis orientation along (002) with change in molar concentration of spray solution. The films have been characterized using optical and electrical measurements. The effect of various Al doping concentrations on the thin film formation has been investigated. The variations in the Al doping concentrations affect the optical and electrical properties. The optical and electrical properties were verified using spectrophotometer and two-probe method. The related optical data are recorded in the wavelength of range 200-999 nm. Study shows that the films deposited at substrate temperature higher than 5500C were of highly conducting nature and strongly adherent to substrate. Al doping in ZnO thin films affects the electrical and optical properties of the films. F doping in SnO_2 thin films also affects the electrical and optical properties of the films. The formed thin films are Transmittance and absorbance of the SnO_2: F thin films found to be useful in solar cell as window layer and conductive layer.

PROJECT NO	**119**
TITLE	Identification of critical areas of conservation concern using RS-GIS technique from northern Western Ghats of India
INVESTIGATORS	Dr Ankur Patwardhan, Abasaheb Garware College, Pune
DURATION	2 years(Started on: July 2011)
BUDGET (₹)	10,87,000
SUMMARY OF FINDINGS	The study aimed at preparing (a) biological richness maps and (b) thematic maps using GIS and RS tools.Multiple taxa approach was used to prioritize areas of conservation concern in northern Western Ghats of India.Woody plants, birds and butterflies were considered as focal taxa.There have been no such studies on congruence of these taxa and their use in conservation planning. Effective action in terms of conservation management calls for an understanding of 'spatial distribution' of the 'conservation value' of the forests besides knowing their vegetation types. A composite picture generated through understanding of thematic maps of multiple taxa such as birds, butterflies and plants is needed to identify critical areas for conservation of rare, endangered and threatened (RET) species. 2.5' X 2.5' grids were laid on the study areas. Belt transects (500m length and varied width) were laid in each grid for each taxa and in different habitats for sampling. Other taxa were recorded opportunistically. The focus on planning management strategies for biodiversity conservation increased in the recent times due to the development in GIS and RS techniques.
Therefore thematic maps of species richness, abundance, endemic species richness, threat status, and conservation value were prepared. New spatial distributions of some species have been recorded during the study. We have also provided inputs from the study to State Forest Department for further use and action while designing of ecological corridor of Sahyadri Tiger Reserve.

PROJECT NO	**120**
TITLE	Development of High Performance Polycarbonate/Graphite Nanocomposites with Low Percolation for EMI Shielding Application
INVESTIGATORS	Dr Rajendra Kumar Goyal, College of Engineering, Pune/ Dr (Mrs) R C Aiyer Ex Professor of Dept of Physics, UoP
DURATION	2 years (Started on: July 2011)
BUDGET (₹)	10,30,000

SUMMARY OF FINDINGS Main objective was to increase the electrical conductivity of the thermoplastic polycarbonate (PC) matrix by adding expended graphite (EG) using solution method followed by hot pressing technique. For comparison purpose, nickel (Ni) and cobalt (Co) powders were also added into the PC matrix. The experimental densities of the micro- and nanocomposites were found to be close to the theoretical density indicating samples free from porosity. Results of scanning electron microscope (SEM) confirmed that honeycomb structure of the EG particles was maintained in nanocomposites. It also showed the uniform dispersion of EG in the PC matrix. Three dimensional structure of EG in the PC matrix was observed after 2 % EG addition. Uniform dispersion of Ni and Co particles was also observed in PC matrix. The electrical conductivity increased from 3.97×10^{-16} S/cm for the pure PC matrix to 0.9×10^{-3} S/cm for the 10 % EG filled nanocomposite. This improvement in the electrical conductivity was nearly fourteen orders of magnitude than that of pure PC. The electrical percolation threshold for the PC/EG nanocomposites is found between 1 and 2 % EG, which is much lower than the reported value in literature. Cost of PC/EG is lower than PC/CNT nanocomposites. The dielectric constant of PC/EG nanocomposites containing 5 and 10 % EG is measured to be 56 and 387 respectively at 1 MHz. This is a high value compared to CNTs and metal filled polymer matrix nanocomposites. The dc electrical conductivity of pure PC increases to 1.7×10^{-1} S/cm for 60 wt % (~17 vol.%) Ni composite. This improvement in the electrical conductivity is nearly fifteen orders of magnitude than that of pure PC. For a given volume %, the PC/EG nanocomposites showed higher electrical conductivity than that of PC/Ni composites. In case of PC/Co composite, the rate of increase in electrical conductivity was lower than those of PC/EG and PC/Ni composites. The theoretical EMI shielding effectiveness (EMI-SE) was calculated using Simon formalism. EMI-SE of 2.8 vol % EG filled PC nanocomposites is 19 dB which increases to 30 dB at 1 MHz for 5.7 vol % of EG. Due to their good electrical conductivity, dielectric constant and dissipation factor these composites may be useful for the antistatic/EMI shielding applications.

PROJECT NO **121**

TITLE Synthesis and characterization of Copper Chromite for propellant

INVESTIGATORS Dr SL Bonde / Dr(Mrs) RP Bhadane, Nowrosjee Wadia College, Pune

DURATION 2 years (Started on: July 2011)

BUDGET (₹) 8,00,000

SUMMARY OF FINDINGS Aim of the project was to synthesize and characterize nano sized copper chromite. Copper chromite is synthesized by ceramic and co-precipitation method. But both the methods produce cupric chromite with associated impurities such as mixed oxides of chromium and copper due to the solid-state reaction. Hence combustion technique was used to prepare

nanosized copper chromite. In the initial experiments, the combustion synthesis method was used by forming paste of copper nitrate (2.41g), chromium nitrate (8.00g), glycine (0.75g), urea (0.6g), ammonium nitrate (0.8g) and starch (1.00g) in methanol as a solvent. X-ray diffraction pattern of the product showed the presence of mixture of copper chromium oxides such as $CuCr_2O_4$, $CuCrO_2$, $Cu_2Cr_2O_4$, $CuCrO_4$ etc. But we were interested in copper chromium oxide, $CuCr_2O_4$ alone. Hence the other method i.e. solution combustion synthesis was used. This method was tried using methanol, ethanol and water as solvents. As glycine and starch were insoluble in alcohols they were used only when water was used as a solvent. The reaction products obtained were characterized by XRD. The XRD pattern of these products showed the presence of $CuCr_2O_4$ alone. The role of glycine, urea, ammonium nitrate and starch in the preparation of copper chromite was studied. Glycine molecule can effectively form complex metal ions, helps in preventing precipitation and maintains the homogenity among the constituents. Glycine and starch act as a fuel and urea was used due to its high exothermicity. Ammonium nitrate was used as an auxiliary oxidant. The result obtained by solution combustion synthesis was confirmed by sol-gel method. In this method in addition to above chemicals, citric acid was used for the homogeneous transparent metal-citrate gel. The x-ray diffraction pattern of powder showed the presence of $CuCr_2O_4$ alone. The product $CuCr_2O_4$ was characterized by scanning electron microscope (SEM), transmission electron microscope (TEM), UV-visible spectroscopy, Fourier transform infra-red spectroscopy, thermogravimetry differential thermal analysis and BET techniques. Using SEM technique the particle size observed was between 25 and 100nm.

PROJECT NO	**122**
TITLE	Preparation of Barium magnesium tantalate (BMT) and Barium Zinc Tantalate (BZT) with and without dopants for microwave dielectric applications
INVESTIGATORS	Dr. Manisha Y. Khaladkar / Dr.(Mrs.) Rohini P. Mudhalwadkar, College of Engineering, Pune
DURATION	2 years (Started on: July 2011)
BUDGET (₹)	10,00,000
SUMMARY OF FINDINGS	Aim of the project was to prepare ternary and quaternary mixtures with perovskite structute of Barium Magnesium Tantalate (BMT) and Barium Zinc Tantalate (BZT) using co-precipitation as hydroxide or citrate as well as by solid state route and to study kinetics of decomposition of hydroxides/citrate by TG, DTA. Accordingly synthesis of ternary ceramics Barium Magnesium Tantalate (BMT) $Ba(Mg_{1/3}Ta_{2/3})O_3$ and Barium Zinc Tantalate (BZT) $Ba(Zn_{1/3}Ta_{2/3})O_3$ was attempted with and without addition of B_2O_3. The synthesis was finally carried out by two step solid state route as

co-precipitation did not give satisfactory results. By optimizing process parameters, sintering temperature could be successfully reduced by 300°C (from 1600 to 1300°C) and sintering time by 2 hours. Densification of the ceramic is achieved by addition of 2.5% B_2O_3 glass additives in BMT. The sample was tested and the results show 97.7% theoretical density, Dielectric constant-24, resonant frequency 8.8 GHz for pellets with 10mm diameter and 4 mm thickness. Kinetics of decomposition and phase formation from room temperature to 1400^0C in nitrogen atmosphere, using TG and DTA has been studied. The morphology and crystal was studied by XRD and SEM for different thermal history. Dielectric measurements were carried at SAC Ahmadabad. 15 pellets were delivered to SAC Ahmadabad for final approval on the basis of dielectric measurement.

4. Ongoing Research Projects

Presently there are 24 ongoing projects including eight projects sanctioned in November 2013 to January 2014 period. Progress of these projects is monitored through periodical progress reports and reviews by Preliminary Evaluation Committee (PEC) and Joint Policy Committee (JPC). Investigators are invited to make detailed presentation highlighting the technical milestones in their studies. Midcourse correction is suggested by PEC wherever necessary. Two PEC meetings chaired by Prof S Ananthakrishnan, were held to assess the progress of the ongoing projects and to make midcourse correction. JPC in its meeting held on 16 July 2013, reviewed the progress of the ten projects and suggested Investigators to have active interaction with ISRO scientists. Current status in respect of ongoing projects is given below. Detailed Progress review of the newly sanctioned Projects (No.136 to No.143) is planned after completion of six months period.

Sr No.	Project title, Name of Investigator Project cost & Duration	Current status of the study
1.	Novel electrochemical approach to prepare $CuInGaSe_2$ based solar cells using non-aqueous bath (Project No. 116) Dr N B Chaure Budget: ₹ 12.68 lakhs Duration:2 years (Started on: July 2011)	Request for extension of project duration by six months, without financial implications, has been agreed to. Study is completed and report is under preparation.
2.	Design and development of an odor tracking system. (Project No.117) Dr (Mrs) DC Gharpure Budget: ₹ 10.60 lakhs Duration:2 years (Started on: July 2011)	Request for extension of project duration by one year, without financial implications, has been agreed to. The basic odor compass has been designed and fabricated. Experiments are being conducted to study performance of the compass under various situations.
3.	Study of interferometric data and its applications for subsidence monitoring (Project No.118) Mrs Chaitali Abhijit Laulkar Budget: ₹ 6.56 lakhs Duration:2 years (Started on: July 2011)	Request for extension of project duration by one year, without financial implications, has been agreed to. Implementation of first two modules image display and baseline calculation is completed.
4.	Biodegradation of Ammonium Perchlorate by phytoremediation approaches (Project No.123) Dr Rekha Gupta Budget: ₹ 10.52 lakhs Duration:3 years (Started on: July 2011)	Studies related to phytoremediation and phytodegradation have been completed. Studies on biochemical parameters are planned. PI visited APEP, Alwaye to discuss with ISRO scientists for field trials.

5.	Enhancing rural development through improved communication: case study western India (Project No.124) Prof Sanjeev Sonawane Budget: ₹ 10.12 lakhs Duration:2 years (Started on: July 2011)	Request for extension of project duration by one year, without financial implications, has been agreed to. Policy analysis, Development of data collection tool, Training on data collection programme completed. Data collection and Analysis of data planned.
6.	Measurement of plasma temperature and identification of species during re-entry of space shuttle, using plasma emission spectroscopy (Project No. 125) Dr V L Mathe Budget: ₹ 12.164 lakhs Duration:3 years (Started on: July 2011)	Optical emission spectroscopic data for different plasma species have been recorded and analyzed. Interaction of cold and thermal plasma with epoxy has been studied. Characterization of tile material completed. Study of interaction of atomic oxygen plasma with the tile material planned.
7.	Hazardous Nitrous Oxide gas leakage detection and monitoring system using wireless sensor network (Project No.126) Dr Arunkumar K Walunj Budget: ₹ 8.06 lakhs Duration:2 years (Started on: February 2013)	Established Wireless Sensor Networking setup, interfacing and testing of sensor modules for Temperature, Humidity, Light-Intensity and NO_2 Gas Sensor. In case of scale up of network, planned to develop and test the firmware.
8.	Development of conducting Polyaniline-ZnO nanoparticle composite paint coating for corrosion protection (Project No.127) Dr Praveen P Deshpande Budget: ₹ 9.50 lakhs Duration:2 years (Started on:January 2013)	Study done so far indicates that 2 wt% polyaniline-ortho phosphoric acid based paint coating offers maximum corrosion protection to low carbon steel. Addition of nano ZnO particles enhances corrosion protection performance of these coatings.
9.	Impact of flood hazards on human settlement in Pune region (Project No.128) Dr Vijaya Khairkar Budget: ₹ 6.44 lakhs Duration:2 years (Started on:January 2013)	Sources for Primary data are Toposheets & ASTER Data. Sources for Secondary data are Census of India, Planning Commission, Union Ministry of Agriculture and Pune Municipal Corporation. Study indicates that there is a need for wider participation in the Local Disaster Plans. Plan to bring out model of water discharge conditions causing floods.
10.	Splitting of carbon dioxide into oxygen and carbon moiety using biomimetics of biological catalysts involved in photosynthesis (Project No.129) Dr (Mrs) Waghmode Shobha Budget: ₹ 9.13 lakhs Duration:2 years (Started on:January 2013)	Project aims at synthesis & characterisation of biomimetics of photosynthesis and study mechanism in carbon dioxide splitting using Biomimetics. Study is in its initial stage.

11.	Development of transition metal oxide nanoparticle films for solar radiation protection and solar cells (Project No.130) Dr Jayashree Pant Budget: ₹ 10.00 lakhs Duration:2 years (Started on:January 2013)	ZnO nanoparticles have been synthesized at various microwave powers to study its effect on size and uniformity of the particles. Film of high power ZnO made by spin coating and uniformity checked by profilometer. XRD results of these samples are awaited. SEM images and analysis is in progress. Nanoparticles of NiO have been synthesized by both sol-gel and microwave technique and characterized by SR-XRD, FE-SEM, Raman spectrometer and dc-magnetometer. Transparency of coated film to be improved. Adhesion to the base surface to be checked.
12.	Preparation of Co_3O_4 films by using electrochemical and spray pyrolysis deposition methods for gas sensing applications (Project No.131) Dr Shelke Pandit Nivrattirao Budget: ₹ 14.25 lakhs Duration:2 years (Started on:January 2013)	Co_3O_4 films are deposited on various substrates (copper, stainless steel, glass) using electrochemical and spray pyrolysis deposition methods. The films deposited are of uniform thickness and have good adhesion to the substrates. The films are being characterized by different techniques such as X-ray diffraction, Scanning electron microscopy, Energy Dispersive X-ray analysis.
13.	Real time human detection using covariance matrix as human descriptor (Project No.132) Mrs S A Kakade Budget: ₹ 4.00 lakhs Duration:2 years (Started on: January 2013)	Installation of OpenCV and setting up of Visual Studio environment for studying OpenCV Syntax, completed. Implemented parallel approaches like human detection using HOG features and Haar Wavelets to check the performance. Plans of developing module for integral image representation of current image, finalized.
14.	Metallic surface Plasmon phenomenon as a biosensor for the identification of biomolecules (Project No.133) Dr V M Harpale Budget: ₹ 18.50 lakhs Duration:2 years (Started on:January 2013)	Literature survey completed. Technical details of the proposed Raman Spectrometer finalized and equipment under procurement. Details of biomaterial samples for SERS experiments have been worked out. Plans to install Raman Spectrometer and carry out preliminary experiments related to standardization of SERS substrates have been finalised.
15.	Sensor-less XY planar flexural scanning mechanism for precision application (Project No.134) Dr Suhas Deshmukh Budget: ₹ 14.32 lakhs Duration:2 years (Started on:January 2013)	Literature Survey completed. Received all equipments and experiments are progressing.

16.	Digital elevation model (DEM) fusion (Project No.135) Dr Pratibha Shingare Budget: ₹ 11.54 lakhs Duration:2 years (Started on:January 2013)	DEM generated from Cartosat-1 Satellite data (Both Reverse Pitch mode & Normal Pitch Mode stereo Images of cartosat-1 data). Various parameters like slope, Aspect related to both DEMs have been evaluated. Reference DEM downloaded from NRSC Bhuvan Website. Analysis regarding topographic aspects carried out. Reference DEM is fused with Cartosat-1 DEM with the help of simple data merging algorithm. Plan to prepare various methods & strategies related to Fusion like Weighted sum of analysis for DEM Fusion, Co registration for Registering both DEMs with the help of Matlab.
17.	Naphthoquinone containing metal polypyridyl complexes for solar cells: computational and experimental study (Project No.136) Dr Sunita A Salunke and Dr. Subhash S Pingale Budget: ₹ 16.26 lakhs Duration:2 years (Started on:November 2013)	Aim is to study theoretically and experimentally effect of the substituents on properties of 2-hydroxy-1,4-naphthoquinone dye such as electronic structure, orbital composition and optical properties in focus with requirement of the dyes to act as good sensitizers in DSSCs. Theoretical study of Lawsone dye is progressing. Synthesis and characterization of polypyridyl ligands and their ruthenium complexes are planned.
18.	Feasibility study on indigenous development of electrochemical based gas sensors and transmitters (Project No.137) Prof A D Shaligram and Shri M B N Murthy Budget: ₹ 29.60 lakhs Duration:2 years (Started on:November 2013)	Survey of Electrolyte, Electrode material and membrane material has been completed. References on NO_2 Electrochemical sensors have been collected. Preliminary examination of the basic NO_2 sensor regarding its constituents (chemical) and structural/electrical aspects is completed. Sensor is based on amperomteric detection. Studies on the electrolyte revealed the presence of H_2SO_4 as major constituent electrolyte, exploration on identifying other additives is in progress. Physical and chemical characterization of electrode material is in progress. Membrane (filter) is being examined for identifying the porosity and selectivity properties.

19.	Development of microwave excess noise generator heads using gas discharge of reactive and non reactive gases (Project No.138) Dr (Ms) S A Gangal Budget: ₹ 13.50 lakhs Duration:2 years (Started on:November 2013)	Literature survey completed. Designing & fabrication of microwave wave guides for mounting gas discharge tube in progress. Fabrication of gas discharge tubes of various dimensions with reactive and non reactive gases planned.
20.	Development of graphite fiber reinforced Aluminium (7075) in the rolled sheet form (Project No.139) Prof Madhuri Deshpande Budget: ₹ 20.05 lakhs Duration:2 years (Started on: December 2013)	Literature survey completed. Contacted ISRO expert to decide course of action. Order is placed for Microscope. Stir casting method of composite production with uncoated chopped Carbon fibers (PAN based) is planned.
21.	Halophilic bacterial diversity of marine ecosystems from West Coast of India (Project No.140) Prof Rebecca S Thombre Budget: ₹ 16.04 lakhs Duration:2 years (Started on: January 2014)	Literature survey completed. Contacts with ISRO experts established. Order for equipment placed. Plans for sample collection, one in Malwan and other in Mumbai made.
22.	Studies on nano-porous metal oxides via anodization and their applications in super capacitors (Project No.141) Dr Arif V Shaikh Budget: ₹ 11.76 lakhs Duration:2 years (Started on:January 2014)	Literature survey completed. Details of equipment for purchase have been worked out.
23.	The development of the F.C. Observatory - an autonomous robotic telescope (Project No.142) Dr Ms Raka V Dabhade Budget: ₹ 11.00 lakhs Duration:2 years (Started on: January 2014)	Literature survey completed. Details of equipment for purchase have been worked out. Visit to Nanded Observatory planned.
24.	Multifunctional conducting polymer transition metal nano structure based sensor device for detection of NO_2, H_2S and NH_3 (Project No.143) Dr Vasant Vidyadhar Chabukswar Budget: ₹ 15.82 lakhs Duration:2 years (Started on:January 2014)	Literature survey completed. Details of equipment for purchase have been worked out. Plans to synthesize conducting polymers like Polyaniline PANI, Polyaniline-ZnO nanoparticles finalized.

5. New Research Projects

Invitation for new research proposals was sent in the month of September-October 2013 for submission of research proposals under ISRO-UoP Joint Research Programme. In response, 52 proposals were received from various Departments and affiliated colleges of the Pune University. For the purpose of preliminary evaluation, soft copy of the proposals was sent to PEC Members in advance. PEC in its meeting held on 6 February 2014 scrutinized the proposals and noted the area wise distribution as given below:

Research area	No.
❖ Atmospheric Sciences	3
❖ Biodiversity	5
❖ Image Processing	5
❖ Instrumentation	2
❖ Life Sciences	3
❖ Material Sciences	6
❖ Miscellaneous	7
❖ Optical Coatings & Sensors	11
❖ Remote sensing applications	5
❖ Rural development and Development communication	5
Total	**52**

Screening of the above proposals was undertaken based on the following criteria:

- Relevance of study with respect to overall goals as spelled out in ISRO-UoP Memorandum
- Relevance of study with respect to developing new science/technology – innovative idea
- Deliverable products as a result of the study
- Likely publications of research findings in refereed journals

After scrutiny of the above proposals, PEC shortlisted 22 proposals for technical presentation and further interaction. Investigators of the shortlisted proposals were invited to make a presentation to PEC on 24 and 25th February 2014. At the end of the presentation, Committee made an assessment and recommended 13 proposals for the consideration of Joint Policy Committee (JPC). Details of each of these proposals explaining objectives of the study, methodology, time period, funds requirement etc were then scheduled for presentation to JPC. After completion of the presentation and interaction with the prospective investigators, JPC approved 7 study proposals for funding under ISRO-UoP Joint Research Programme in the year 2014-15. Committee also desired that ISRO

scientists need to be identified as co-investigator/isro expert for each of the approved research projects.

In addition to above, JPC also considered following two proposals:

i. Research proposal titled **Development of flexible and high temperature aerogels** jointly proposed by Prof N B Chaure, Dept of Physics/UoP and Scientists from VSSC/ISRO. The proposal has been recommended by Director VSSC/ISRO because of its utility in developing material for Thermal Protection System for reentry space vehicles. The duration of the study period is 2 years and the projected cost ₹15.98 laks. JPC considered the proposal and approved PEC recommendation for its inclusion under ISRO-UoP Joint Research Programme.

ii. Research proposal on SEAPS titled **Development of Prequal engineering model of "SEAPS" (300 KHz to 30 MHz) RF front end electronics and data acquisition system for low frequency space science studies** submitted by Dr D C Gharpure, Dept of Electronic Sciences/UoP. Giving the background of the proposal, Prof S Ananthakrishnan explained the importance of the study to JPC Members and highlighted the role of Pune University in the joint venture with SAC/ISRO. The duration of the study period is 3 years and the projected cost ₹29.5 lakhs. JPC considered the PEC's recommendation and agreed to provide ₹10 lakhs as seed money which can be released after signing of the proposed MoU between UoP and SAC/ISRO.

Following is the list of the JPC approved research proposals along with the funds requirement.

Sr. No	Project Title/PI	Duration	Total funds requirement (₹ Lakhs)	Funds for year 2014-15 (₹ Lakhs)	Funds for subsequent years (₹ Lakhs)
1	**Study of precipitation characteristics using disdrometer and satellite datasets over pune** *Dr Rohini Bhawar Dept. of Atmospheric & Space Sciences, UoP*	2yrs	8.41	4.70	3.71
2	**Optimization of low voltage DC micro-grid with intelligent solar PV utilization for a computer laboratory** *Prof Vivek Aranake, VIIT College, Pune*	2yrs	21.39	11.63	9.76
3	**Processing of natural biopolymers-wild and domestic silk varieties of Northen Western Ghats: Fabrication of biopolymer film based technologyical substrate for advanced optical structures** *Dr R D Choudhari, Shri Shiv Chhatrapati college, Junnar*	2yrs	23.66	18.58	5.08

4	**Interaction of plasma with thermal protecting system (TPS) material during re-entry of Space Vehicle** *Dr V L Mathe, Dept.of Physics, UoP*	2yrs	12.56	9.28	3.28
5	**Stabilization of zirconia in tetragonal and cubic structure using various dopants for electronic applications** *Dr M Y Khaladkar, College of Engineering, Pune*	2yrs	15.02	10.51	4.51
6	**Remote sensing application in costal geomorphology, changes in morphology in parts of West coast of Maharashtra, India** *Dr Milind Herlekar, Dept. of Geology, UoP*	2yrs	11.05	7.16	3.89
7	**Occurrence and distribution of fluoride in groundwater of terekhol river basin, Sindhudurg district, Maharashtra: A remote sensing and GIS based study** *Dr S K Gaikwad, Dept. of Geology, UoP*	2yrs	16.00	9.80	6.20
8	**Deveopment of Aerogel based high performance TPS for Launch vehicles** *Dr N B Chaure, Dept of Physics, UoP & Dr V Sekkar, VSSC/ISRO*	2 yrs	15.98	7.00	8.98
9	**Development of Prequal engineering model of "SEAPS" (300 KHz to 30 MHz) RF Front-End Electronics and data acquisition system for low frequency space science studies** *Dr D C Gharpue, Dept. of Electronic Science, UoP*	3yrs	29.50	10.00	19.50
	Total		**153.57**	**88.66**	**64.91**

6. Major events in the STC calendar

PEC meetings

The Preliminary Evaluation Committee (PEC) carries out preliminary evaluation of new research proposals and interacts with the Investigators to modify the proposals wherever needed. The proposals recommended by the Committee are examined by the Joint Policy Committee for final approval. PEC also has the responsibility to periodically review the progress of the ongoing projects and take corrective measures. First review meeting of the year took place on 13 September 2013. Investigators were invited to make technical presentation on the progress of their projects, highlighting the achievements and the difficulties, if any. While reviewing the progress of the projects, Committee stressed on the following points:

  i.   Progress of the study with respect to overall goals as spelled out in the original proposal
 ii.   Relevance of study with respect to developing new science/technology
iii.   Deliverable products as a result of the study
 iv.   Publications of research findings in refereed journals
  v.   Timely completion of the projects and submission of final technical reports

PEC held its next two meetings on 6th February and 24th February 2014 to review the progress of ongoing projects and also to carry out preliminary evaluation of new research proposals.

JPC meetings

Joint Policy Committee (JPC) supervises the overall management of the ISRO-UoP Interaction Programme, recommends the funds requirement to ISRO HQs and suggests new areas of activities as and when necessary. JPC held its first meeting on 16&17 July 2013 to take a stock of the ongoing projects and consider new research proposals for the year 2013-14. JPC approved 8 new research proposals and recommended a total budget of Rs.143.11 lakhs for the year 2013-14.
Next meeting of JPC was held on 11&12 march 2014. After reviewing the progress of ongoing projects, Committee considered the new proposals and approved nine projects for the year 2014-15. JPC also approved a total budget of Rs 172.26 lakhs for the year 2014-15.

Commencement of new projects

After the receipt of Grants-in-aid from DOS, for the year 2013-14, eight research projects, which were approved in the JPC meeting held on 16/17 July 2013, made a beginning during November 2013-January 2014 with the release of first installment of funds.

7. ISRO Proposal Format

Faculty Members of University of Pune and its affiliated colleges are required to follow the ISRO format as given in http://www.isro.gov.in/scripts/srrespond.aspx and reproduced below for making research proposals and seeking financial grant from ISRO. Requirement is that Principal Investigator(s) should be full-time employee(s) of the concerned institution and proposal is to be forwarded through Head of the academic institution. Research proposals from individuals not affiliated to any recognized institution of the University are not considered. Institutions proposing a project for support are expected to commit the use of the existing infrastructure available with them. ISRO provides financial grants to support fellowship, materials, consumables, internal travel, testing charges, data etc. Funds for purchase of essential minor equipments which are not available in the institution and would be useful for future projects are also provided. There is no provision for any kind of payment to the Principal Investigator (or other staff) belonging to the Institution. The allocated funds cannot be used for travel abroad for any reasons.

Generally invitation for making research proposals is sent in the month of September-October and processing of the proposals is completed in 4-5 months time. For any information/clarification, Faculty Members may contact the ISRO-UoP Space Technology Cell or visit our website www.unipune.ac.in/isro to get the required information.

Application for grant of funds

1. Application Institution
2. Title of the Research Proposal
3. Name of the Principal Investigator
4. Name(s) of other investigator(s) with the name(s) of their Institution
5. Proposed duration of Research Project
6. Amount of grant requested (in ₹)

	1st Year	2nd Year	Total
Staff			
Equipment and Supplies			
Others			

Total

7.   a) Bio-data of all the Investigators (Format-A).
        b) Brief description of the Research Proposal with details of budget (Format-B).
        c) Declaration (Format-C).

8. I/We have carefully read the terms and conditions for ISRO Research Grants and agree to abide by them. It is certified that if the research proposal is approved for financial support by ISRO, all basic facilities including administrative support available at our Institution and needed to execute the project will be extended to the Principal Investigator and other Investigators.

	Name	Institution	Designation
Principal Investigator			
Co-Investigator(s)			
Head of the Department/Area			
Head of the Institution			

Format A

Bio-data of the Investigator(s)*

1.	Name
2.	Date of Birth (dd/mm/yyyy)
3.	Designation
4.	Degrees conferred (begin with Bachelor's degree)

Degree	Institution conferring the degree	Field(s)	Year

5.	Research/training experience (in chronological order)

Duration	Institution	Name of work done

6.	Major scientific fields of Interest:
7.	List of publications:
8.	Email id and Telephone number of PI :
9.	Email id of the Head of the academic institution:

* Bio-data for all the investigators should be given, each on a separate sheet.

Format B

<div align="center">

Proposal Preparation Format

</div>

1. *Title of the research proposal*

2. *Summary of the proposed research*
   A simple concise statement about investigation, its conduct and anticipated results
in no more than 200 words

3. *Objectives*
   A brief definition of the objectives and their scientific, technical and techno- economic importance

4. *Major scientific fields of interest*
   A brief history and basis for the proposal and a demonstration of the need for such an investigation preferably with reference to the possible application of the results to ISRO's activities. A reference should also be made to the latest work being carried out in the field and the present state-of-art of the subject.

5. *Approach*
   A clear description of the concepts to be used in the investigation should be given. Details of the method and procedures for carrying out the investigation with necessary instrumentation and expected time schedules should be included. All supporting studies necessary for the investigation should be identified. Necessary information of any collaborative arrangement, if existing with other investigators for such studies, should be furnished. The Principal Investigator is expected to have worked out his collaborative arrangement himself. For the development of balloon, rocket and satellite-borne payloads it will be necessary to provide relevant details of their design. ISRO should also be informed whether the Institution has adequate facilities for such payload development or will be dependent on ISRO or some other Institution for this purpose.

6. *Data reduction and analysis*
   A brief description of the data reduction and analysis plan should be included. If any assistance is required from ISRO for data reduction purposes, it should be indicated   clearly.

7. *Available Institutional facilities*
   Facilities such as equipments, test instruments etc available at the parent Institution for the proposed investigation should be listed.

8. *Fund Requirement*
   Detailed year wise break-up for the Project budget should be given as follows

	1st Year	2nd Year	Total

8.1 Salaries:
8.1.1 Research Fellows/
   Project Assistant
8.1.2 Supporting Technical Staff
8.1.3 Other staff, if any

   Total:

   (Note: please specify designation and rate of salary per month for each category)

8.2 Equipment

	1st Year	2nd Year	Total

   Total:

   (Note: Please specify various individual items of equipment and indicate foreign exchange requirement, if any)

8.3 Consumables and Supplies

	1st Year	2nd Year	Total

   Total:

   (Note: Please specify the items and indicate foreign exchange requirement, if any.)

8.4 Travel

	1st Year	2nd Year	Total

   Total:

8.5 Other project costs, if any (give details)

	1st Year	2nd Year	Total

  a.   **Grand Total**

9. Whether the same or similar proposal has been submitted to other funding agencies of Government of India. If yes, please provide details of the Institution & status of the proposal.

Format C

Declaration

I/We hereby agree to abide by the rules and regulations of ISRO research grants and accept to be governed by all the terms and conditions laid down for this purpose.

I/We certify that I/We have not received any grant-in-aid for the same purpose from any other department of the central government/state government/public sector enterprise during the period to which the grant relates.

	Name	**Designation**	**Signature**
Principal Investigator			
Head of the Department/Area			
Head of the Institution			

Seal of the Head of the Institution

8. Suggested topics for research proposals

Keeping ISRO's space programme in mind, following list of research topics has been prepared for the consideration of prospective Investigators from Pune University while making research proposals under the above scheme:

Atmospheric / Oceanic science area

1. Study projects to establish observation network and create remote sensing based spatial databases for modeling and periodic assessment of net carbon balance in India
2. Dynamic modeling for real time weather forecast
3. Assimilation of satellite data in numerical weather and ocean prediction models
4. Global and regional numerical dynamic models for ocean state forecast
5. Diagnostic study using satellite data to understand atmospheric and oceanic process near ocean surface
6. Empirical and dynamic modeling and assimilation techniques for predicting movement and intensity of a cyclone
7. Aerosols and their impact on climate, algorithms for atmospheric aerosols using satellite information over land and oceans
8. Aerosol transportation and climatic studies
9. Estimating aerosols over land and ocean using multiangular and polarization measurements
10. Algorithms/models for generating 5-daily and 10-daily snow cover products, snow melt run-off, features of glaciers to understand Himalayan cryosphere
11. Atmospheric dynamics – winds, waves and structure
12. Atmospheric modeling for radiometric correction
13. Wind vectors from satellite observations
14. Cloud studies using satellite data
15. Physics and dynamics of atmospheric boundary layer (0-1 km)
16. Ionospheric (100-1000 km) modeling characteristics, features, dynamics, electron content
17. Propagation studies for ionospheric correction making use of satcom technology
18. Temperature and humidity profile from atmospheric sounders
19. Application of atmospheric parameters in monsoon related activities
20. Rainfall estimates from infrared and microwave radiometers
21. Retrieval of ocean surface wind vector from first principle
22. Retrieval of ocean wave spectra and ocean winds from Synthetic Aperture Radar
23. Simulation of altimeter signals from ocean surface and retrieval of basic ocean parameters
24. Simulation of coastal wave and circulation through Numerical Model
25. Merging open ocean and coastal models for waves and circulations
26. Sensitivity studies on forecast winds, waves, mixed layer depth for their application in physical and biological oceanography
27. Studies related to:
    - ARFI : Aerosol radiative forcing over India (National Network with 40 Universities and Institutions)
    - IGBP : ISRO Geosphere biosphere programme
    - GAGAN – Aircraft navigation

Optical coatings and sensors
1. Piezoelectric films on Zn-cut Al2O3, NCD substrates for Surface Acoustic Wave (SAW) devices with low propagation loss, high performance and high frequency characteristics
2. Langasite single crystal (LGS) for high performance, low loss narrow band SAW filters
3. Nanostructured magnetostrictive thin films for SAW device applications
4. Ferroelectric thin films for electronically tunable filters used in wireless communication system
5. Investigating compaction, focusing, alignment techniques and swath improvement in Hyper spectral system
6. Mathematical modeling and optical domain processing in multipurpose large area array detectors
7. Life/failure mechanism in photo detectors using InGaAs, InSb and Si-PIN technologies and modeling to estimate life of such detectors

Rural development & developmental communication
1. Harnessing space technology for social benefits such as distance education, rural development, tele-medicine, satellite navigation and communication support for disaster management
2. Mapping information and communication practices in the tribal areas, special focus to Rajasthan, Madhya Pradesh, Gujarat and Maharashtra
3. A comparative study on media habits between rural and urban India
4. Community's felt and perceived information needs in the agriculture sector
5. Community's felt and perceived information needs in the health sector of rural India
6. Impact assessment of Edusat Network as supportive role in the field of formal education and teacher's training
7. Socio-economic research/evaluation of satellite-based societal applications
8. Demonstration projects for new applications of space and related technologies for end-users of socio-technical system
9. Study of social, economic and cultural impact of new technologies and production of software as models/examples
10. Content generation in terms of multi-media programs and evaluation study at national and regional levels for Edusat utilization
11. Interactive programs for applications like Training, Education, e-Governance, Disaster Management, Tele-conferencing, Urban/Rural Development under Gramsat programme
12. ISRO's Village Resource Centres into multi-service centres and integration with existing VRCs
13. Innovative applications for Education, Health and rural welfare using satcom technology

Geo-informatics
1. Algorithms and techniques for processing terrestrial imagery acquired in stereo/mono
2. Study of planetary geodesy for optimization in calculating surface measurements (coordinates, distances, areas) on spheres or spheroids
3. Methods to analyze multisensor satellite data and to detect guides for mineral exploration
4. Three dimensional models of urban area using GIS techniques
5. Continuous simulation model using high resolution satellite data embedded with GIS technique to represent the entire hydrological system on computer
6. Multi facet model for assessing the impact of a geo-hazard on human settlement and simulating the damage scenario
7. Spatial decision support system (SDSS) for flood management, using Geoinformatics (mathematical and statistical modeling techniques)

Remote sensing applications

1. Investigation in geo-correction models namely (a) Model based on ephemeris platform and sensor information (b) Model relating ground control points or features and (c) Hybrid model
2. Sensor calibration on ground based test sites
3. Signal processing and tracker algorithms for altimeter sensor, correlation algorithm for synthetic aperture radiometer and performance analysis, feature extraction algorithm for microwave data
4. Partitioning land surface temperature into components using angular thermal remote sensing
5. Quantifying variability of green-house gases (GHG) using space borne sensors
6. Agro-ecosystem models to study long term sustainability
7. Developing land data assimilation system to optimally merge remote sensing observations with hydrological model
8. Earthquake precursors using satellite data such as land surface temperature and gravity anomalies
9. Modeling the dynamics of change of land use cover for future projection
10. Modeling hydrological cycle of natural wetlands in relation to change in land use/cover
11. Differential SAR interferometry and its applications for geohazards monitoring
12. Differences in spectral reflectance between healthy and stressed vegetation and fluorescence signal emanating for different crops
13. Hydrological analysis using temporal water level data and field data of irrigation water for different crops especially in arid and semi-arid regions
14. Satellite based mapping and modeling photosynthesis to quantify the biophysical characteristics of mangrove and to predict the effect of climate change on it
15. Developing hyperspectral remote sensing techniques for coral reef mapping and modeling
16. Wetland mapping involving microwave and optical data and modeling Methane emission from Wetlands
17. Integrated approach (including remote sensing inputs) for multi-crop assessment in sparse cropped regions
18. Remote sensing techniques for crop assessment in hilly terrain/high altitudes
19. Remote sensing based indices/techniques for agro-ecosystems characterization
20. Ingestion of remote sensing inputs/products in climate change analysis/modeling of agro-ecosystems
21. Algorithm development for agro-ecosystems product generation from geostationary platform
22. Newer tools and techniques for quick assessment of temporal dynamics of crops/vegetations using Indian multi temporal satellite data
23. Mathematical/matching algorithm in spectral library development using hyperspectral data
24. Modeling soil carbon sequestration in relation to cropping systems and climate change
25. Farming systems model with remote sensing inputs/products
26. Classification of hyperspectral remote sensing data to discriminate between crop condition, variety and stage
27. Inversion of radiative transfer model for estimation of crop parameters from hyperspectral data
28. Marine resources related studies:
    - Calibration and validation
    - Mixed layer physics
    - Algal-bloom specific algorithm for chlorophyll retrieval from ocean colour data
    - Identification of phytoplankton functional type (PFT) and time series measurements on inherent optical properties to develop bio optical algorithm

- Assessment of fate of carbon during algal bloom
- Impact of climate change on ocean productivity

29. Environment related studies:
   - Eco-casting of environmental parameters
   - Quantitative modeling of wind erosion
   - Decertification vulnerability analysis
   - Quantitative estimation of gas emission from biomass burning
   - Urban hazard model
   - Microwave scattering and emissivity models from natural surfaces
   - Retrieval and modeling of atmospheric pollutants
   - Hyper spectral data evaluation for forest condition assessment
   - Early warning/forecasting models for land slides
   - Forewarning and damage assessment for natural disasters
   - Development of indices for urban transportation geometry
   - Development of semi automated procedures for urban structural planning
   - Evaluating impact of watershed treatment
   - Web based solution for multi resolution image fusion
   - Methodology to derive digital terrain model
   - Development of web based services
   - Development of data mining tools
30. Disaster management related studies:
   - Early warning for cyclone prediction of track and probable landfall point
   - Areas likely to be inundated and estimation of population affected in case of floods
   - Short range and medium range forecast for local severe weather conditions
   - Earth-quake precursors with satellite based observations and ground experiments
   - System study on services for rural centers, fishing community etc
31. Marine biology
   - Techniques to retrieve gravity/geoid using satellite altimetry over oceans
   - Modeling marine lithosphere using gravity and other geophysical data
   - Subsurface tectonics and associated processes
   - Tsunami modeling
   - Hydrocarbon exploration in offshore regions
   - GIS based marine living resource management system, species specific fisheries forecast, conservation for engendered marine organism
32. Coastal Processes
   - Holocene and Quaternary coastal evolution
   - Coastal erosion and predicting shoreline changes
   - Sediment budgeting with reference to sediment cells
   - Coastal vulnerability models and risk assessment
   - Models for integrated coastal zone management plans
   - Algorithms for Indian coastal waters, atmospheric correction models for turbid water and Bathymetry estimation in optically shallow waters
   - Bio-geo-chemistry of the coastal, components of carbon cycle, nitrogen cycle and phytoplankton blooms, fish stock assessment, primary and new production modeling
33. Geo-Hazards
   - Earthquake precursors
   - Modeling geodynamics

- Modeling geohazards in particular to urban areas
- Early warning of landslides
- Risk modeling due to storm surges/tsunami

34. Geo-Archaeology
    - Multisensor satellite data for identifying hitherto unknown surface/buried archaeological site
    - Validation using geophysical techniques such as GPR, pitting and trenching
35. Mineral exploration
    - Multisensory satellite data for mineral exploration
    - GIS based models to identify mineral prognostics zones by integrating geological, geophysical and geochemical data
36. Planetary Sciences
    - Lunar surface composition, morphology, hyperspectral data analysis, thermal remote sensing, spectral characterization, surface dating and volcanism
    - Lunar gravity and crustal thicknesses studies
    - Martian surface and polar ice
    - Characterization of martian analogues rocks in India
    - Hyperspectral analysis of Mars data, thermal remote sensing of martian atmosphere
    - Studies related to planetary atmosphere and inner and outer planets

Material Sciences - Chemistry/Chemical technology areas

1. H_2O_2 of 98% purity, stabilizers for its safe storage and catalyst for its decomposition
2. Synthesizing cubane and substituted cubanes
3. Making aqueous solution of Hydroxylammonium nitrate (HAN) of 60% concentration and developing catalyst to initiate its decomposition
4. Development of silicone polymers for thermal paints
5. Studies related to fuel cells such as simulation & analysis of humidification methods in microgravity environment

Material Sciences - Mechanical area

1. Modeling guided wave propagation in (i) circumferential direction of tubes and (ii) sheets with defects, to select mode for cross sectional defect detection
2. Modeling eddy current flow in Al sheets for mathematical correlation between eddy current flow and the material property
3. Experimental analysis and evaluation of formability limit diagram for Inconel-718 sheets of different thicknesses (0.5 mm to 1.8 mm)
4. Thermal analysis of resistance spot welds
5. Analysis of weld bead instability in the overlap zone of keyhole electron beam welds
6. Thermal analysis of partial penetration and full penetration seam welds by laser
7. Testing/screening of metallic materials at high temperatures and in high oxygen environment
8. Miniature specimen test techniques
9. Thermal analysis of seam welds by laser
10. Diffusion bonded ceramic-ceramic/metal joints
11. Piezoelectric actuators for position control applications

Material Sciences - Structures area

1. Acoustic Emission technique to detect generation and growth of active defect during flight of launch vehicles
2. AE monitoring with Neural Network for real time integrity evaluation of the hardware
3. Filtering out noise from genuine AE signature
4. Real time monitoring of Electron Beam welding process using AE technique
5. Automated/semi-automated method for strain measurement
6. Measurement of non-uniform residual stresses
7. Digital holographic microscope for MEMS characterization
8. Experimental investigation of delamination fracture toughness
9. Interlaminar shear stress between the skin and honeycomb core
10. PUF Embedded sandwich panels
11. Sandwich structures with negative Poisson's ratio
12. Applicable eccentricity and failure strength of single and multi row lap joint
13. Finite element software for inflatable structures
14. 3-D contact element with friction
15. Microgravity slosh analysis
16. Health monitoring of structures using vibration data
17. Shock and vibration isolation system
18. Structural analysis of solid propellant grains in presence of voids
19. Constitutive equations for nano composites
20. Structural health monitoring through classification of strain patterns
21. Structural health monitoring of composite structures using optical fibres with Bragg Grating sensors

Material Sciences - Aeronautics/aerodynamics/aerothermal areas

1. Estimation of gaseous radiation for interplanetary missions when entry velocity is greater than 15 km/s. Both equilibrium and non-equilibrium air radiation need to be modeled for the estimation of radiative heating.
2. Thermal response of sandwich honeycomb panels under transient heating conditions. Aim is to develop an analytical model to evaluate effective thermal conductivity considering all the modes of heat transfer and to validate the model using controlled experiments.
3. Heat flux distribution in the vicinity of protrusions on the cone cylinder body under varying mach number and Reynolds number. Aim is to develop the methodology and substantiate it by carrying out experiments to get confidence in using the model for configurations with protrusions on cone cylinder body.

Material Sciences - Human Space Flight Programme

1. System supporting LiOH particles on porous ceramic material to absorb carbon dioxide produced by human metabolism
2. Block copolymer based on polyethylene oxide (PEO) soft segment and polyether-ester block amide (PEBA) hard segment to make liquid cooling & ventilation garment (LCVG) for space suit
3. High pressure Oxygen compatible materials
4. Fluid circuit for thermal control system inside crew module
5. Dynamic modeling and analysis of human body exposed to vibration environment during space flight

Electronics/Instrumentation area

1. Low power circuit design techniques for ultra low power RF transeceiver
2. Temperature dependent models of basic devices for design circuits optimized for cryogenic temperatures
3. Nonlinear device modeling for RF and microwave power amplifiers for communication transmitters
4. Input filter with low mass and volume by inductor and capacitor values enhancement techniques
5. Input filter combining accuracy of EM solver and the speed of Equivalent
6. Microwave photonics terminals for free space optical link design, simulation and analysis
7. Low power S-band transceiver (all analog) with inbuilt synthesizer
8. Carrier cancellation techniques with focus on digital signal processing
9. Spectrum sensing techniques like Cognitive Radio (CR) for effective resource utilization
10. Compressive sensing techniques for broadband data communication
11. Doppler compensated modems with higher order coding
12. Fiber optic sensor system for simultaneous measurement of strain, temperature, pressure, and displacement
13. Non-contact whole field strain mapping using principles of stereovision and Digital Image Correlation (DIC)
14. Sensor system and data acquisition for strain measurement at temperatures 800 ^{o}C & above
15. Characterizing micro and nano electro mechanical systems under static and dynamic conditions
16. Extending exact synthesis method to non-linear microwave circuit designs
17. Non-linear stability analysis for MMIC design
18. Automated AE monitoring with Neural Network for real time integrity evaluation
19. Differentiating genuine AE signals from external noise in real time AE monitoring
20. Piezoelectric material in precision position control of mirrors in optical structures of satellites
21. Piezo stack actuators and Macro Fiber Composite
22. MEMS based transducers and sensors
23. Cryo temperature sensors

Image processing

1. A generic model based on Rational Polynomial Coefficient (RPC) is a common approach in satellite data processing in encapsulating the interior and exterior orientation of image acquisition, geometric correction and derivation of digital elevation models (DEM). Investigation related to various orders of polynomials, functional representations, bundle adjustment of s block of images using such representations, DEM generation for a block of imagery and extension of this methodology to planetary data processing to be carried out.
2. Currently satellite images have resolution ranging from 25 m to 0.8 m and likely to improve to 0.25 m. Study to be carried out to generate images with better than 0.25 m resolution using available multi-resolution images. This involves development of concepts like super resolution, image registration, sub-pixel processing and multi-resolution.
3. With the availability of high resolution stereo imagery, there is a need to develop new techniques for a dense set of match point pairs from such data to derive the DEM. In view of large volume of data involved, optimization aspect is to be investigated. New algorithms should remove the short comings of cross-correlation techniques using FFTs.

4. Urban DEM poses a different challenge due to singular nature of the underlying DEM surface which is to be detected. It should cater to identification of buildings and steep landscapes and determination of their heights through space intersection by other means. Special techniques based on morphological features and AI paradigms to be developed for solving this problem. Generation of relative DEM also to be investigated.

5. Developing robust techniques using image cues for interpolation from DEMs and considering constraints such as break points, break lines and exclusion masks

6. Combining DEMs from various sources into a single DEM considering slope, aspect and other terrain properties for better DEMs.

Project status review in 18th PEC Meeting

ISRO - UoP Space Technology Cell
University of Pune

Scrutiny of New Research Proposals by PEC

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