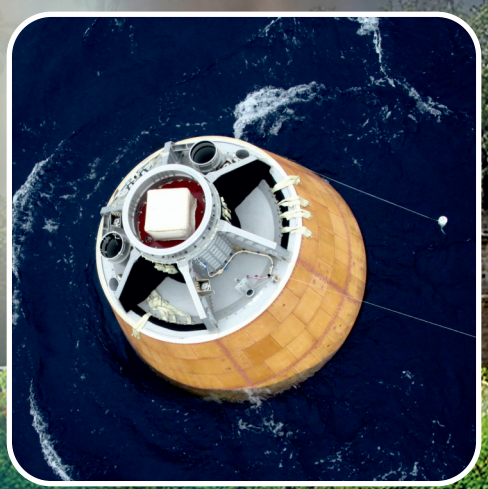
ISRO - SPPU Space Technology Cell
Savitribai Phule Pune University
(formerly University of Pune)



Annual Report 2017-18

Project Review by JPC Members

ISRO-SPPU
Space Technology Cell

Savitribai Phule Pune University
(Formerly University of Pune)

ANNUAL REPORT
2017-18

SUMMARY

This document presents details of the activities of ISRO-SPPU Space Technology Cell (STC) at Savitribai Phule Pune University for the year 2017-18. Studies in respect of eleven projects have been completed this year and final technical reports received from the Investigators. Summary of findings of these projects is presented in the Report. Presently there are 27 ongoing projects including eleven projects initiated in December 2017. Progress of these projects is monitored through periodical progress reports and reviews by Preliminary Evaluation Committee (PEC) and Joint Policy Committee (JPC). Current status of these projects is given in the Report. In response to ISRO-SPPU STC's call for new research projects under Joint Research Programme, 87 study proposals were received from various Departments and affiliated colleges of the University. These proposals were evaluated by Preliminary Evaluation Committee (PEC) for making recommendation to Joint Policy Committee (JPC). JPC interacted with the prospective investigators and approved 11 proposals for funding in the financial year 2018-19. Technical summary of the approved proposals has been included in the Report. Major establishments of DOS and their areas of technical activities were highlighted in the Annual Report 2014-15. With a view to bring out the potential research areas for the benefit of prospective investigators from the University, salient features of technical activities of National Remote Sensing Centre (NRSC/ISRO), Hyderabad were added in the Annual Report 2015-16 and on Satellite Application Center (SAC/ISRO) Ahmedabad in the Annual Report 2016-17. To continue, brief history and technical activities (extracted from ISRO websites) of two other important ISRO/DOS establishments, namely U R Rao Satellite Centre - URSC (formerly ISAC) and Laboratory for Electro-Optics Systems (LEOS), both located in Bengaluru are given in Chapter 7 of the present Annual Report.

ISRO Proposal Format and thrust areas in the suggested research topics have been also included for the guidance of prospective Investigators.

Contents

1. Introduction

Primary objective of Indian Space programme is to harness the advanced research areas of space science and technology and to derive the maximum benefit for the people of India. To meet this goal, focus has been on applications in space communications, long distance education, earth resources mapping/survey, meteorology and geodesy. In addition, equal stress is given on indigenous design and development of orbiting satellites for scientific research and space applications, sounding rockets and satellite launch vehicles to become self-reliant. With a view to encourage academia in participating and contributing in space related activities, RESPOND (Sponsored Research) programme started in the 1970s. Under RESPOND, projects are taken up by universities/academic institutions in the areas of relevance to Space Programme. 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), Bengaluru and Joint Research Programme with Savitrybai Phule Pune University (SPPU) to carry out research activities in the areas of 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 STC and JRP, projects are taken up by faculty of the Institute.

Under this plan, a Memorandum of Understanding (MoU), initiating Joint Research Programme (JRP), was signed between ISRO and Savitribai Phule Pune University (SPPU) on 21 January 1998. Initially five broad disciplines were identified for carrying out research study under this JRP. Co-operation between the two organizations was found beneficial and as a result, while renewing the MoU on 24 February 2006, these areas were enlarged by identifying additional disciplines where more emphasis could be laid on. The areas currently recognized for development are:

- Origin of life
- Space Radiation
- Wind measurements and modeling
- Optical coatings and sensors
- Rural development and developmental communication
- Geo-informatics
- Remote sensing applications
- Material Sciences
- Biodiversity
- Instrumentation
- Image processing

With a view to strengthen the institutional interaction and thereby enhancing scope of the activities pursued under JRP commensurate with the programmatic goals of ISRO, Memorandum of Understanding was revisited and concluded afresh on 21 March 2017. It was agreed that Joint Research Programme should continue with special emphasis on advanced research in the areas of relevance to the future technological and programmatic needs of Indian Space Programme.

2. Management of Joint Research Programme

Under ISRO-SPPU Joint Research Programme, emphasis has been on pursuing advanced research in the areas of relevance to the future technological and programmatic needs of the Indian Space Programme. A Joint Policy Committee (JPC) chaired by Vice Chancellor, SPPU with members from both ISRO and SPPU has been constituted jointly by Vice Chancellor, SPPU and Chairman, ISRO to guide the JRP. JPC plans the research programmes of common interest and periodically reviews such research programmes and related activities. JPC is responsible for approving the budget of JRP. Honorary Director, ISRO-SPPU STC, is responsible for the administration, fund utilization and day-to-day functioning of the STC. Following were the JPC Members during the year 2017-18.

Joint Policy Committee (JPC)

Prof (Dr) Nitin Karmalkar, Vice Chancellor, SPPU	Chairman
Dr MBN Murthy, SDSC/ISRO	Member
Dr G Nagendra Rao, LEOS/ISRO	Member
Dr S Aravamuthan, VSSC/ISRO	Member
Dr Rajeev Jyoti, DECU/ISRO	Member
Dr P V N Rao, NRSC/ISRO	Member
Dr MS Anurup, ISRO HQs	Member
Dr K Ganesh Raj/Dr Paul M A, ISRO HQs	Member
Prof S Ananthakrishnan, SPPU	Member
Prof P P Kale, SPPU	Member
Prof V B Gaikwad, SPPU	Member
Prof Shridhar Geji, SPPU	Member
Prof P Pradeep Kumar, SPPU	Member
Prof Suresh Gosavi, SPPU	Member
Prof P B Ahuja, COEP/SPPU	Member
Dr (Smt) Vidya K Gargote, Finance & Accounts Officer, SPPU	Member
Shri M C Uttam, SPPU	Member Secretary

Preliminary Evaluation Committee (PEC)

Preliminary Evaluation Committee (PEC) is a local Committee constituted to co-ordinate and assist in implementation of Joint Research Programme in Savitribai Phule Pune University. This Committee carries out preliminary evaluation of new research proposals and interacts with 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 2017-18.

Prof S Ananthakrishnan	Chairman
Prof PP Kale	Member
Prof (Mrs) Deepti Deobagkar	Member
Prof V B Gaikwad	Member
Prof Suresh Gosavi	Member
Prof P Pradeep Kumar	Member
Prof Shridhar Geji	Member
Prof A D Shaligram	Member
Prof Veena Joshi	Member
Prof D C Meshram	Member
Prof Sanjeev Sonawane	Member
(Dr) Smt Vidya K Gargote, FAO	Member
Shri M C Uttam,	Member Secretary

3. Completed research projects

Beginning in 1998-99, a total of 177 research projects have been undertaken by the various departments of the University and its affiliated colleges under ISRO-SPPU Joint Research Programme and 142 of these projects are completed in the past years ending in March 2017. During the year 2017-18 studies in respect of eleven projects listed below, have been also completed and final technical reports received from the Investigators. 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. In addition, these details are put on the University's website for wider dissemination. Copies of full technical reports of the completed projects are also sent to concerned libraries of ISRO Centres.

List of Projects completed during the year 2017-18

1. Development of flexible and high temperature aerogels (Project No.144)
2. Occurrence and distribution of fluoride in groundwater of Terekhol river basin, Sindhudurg district, Maharashtra: A Remote Sensing and GIS based study (Project No.145)
3. Remote sensing application in coastal geomorphology, changes in morphology in parts of West coast of Maharashtra, India (Project No.146)
4. Study of precipitation characteristics using disdrometer and satellite datasets over Pune (Project No.147)
5. Optimization of low voltage DC micro-grid with intelligent solar PV utilization for a Computer laboratory (Project No.148)
6. Processing of natural biopolymers - wild and domestic silk varieties of Northern Western Ghats : Fabrication of biopolymer film based technological substrate for advanced optical structure (Project No.149)
7. Stabilization of zirconia for electronic applications, in tetragonal and cubic structure using various dopants (Project No.150)
8. Interaction of plasma with thermal protecting system (TPS) material during re-entry of space vehicle (Project No.151)
9. Design feasibility of PLL frequency synthesizer for Ku band (Project No.155)
10. Space radiation from the optically transparent planar microstrip antenna integrated with the solar panels of small satellites (Project No.156)
11. Studies on biodiversity of poly-extremophilic bacteria for their probable use as test organisms in space research (Project No.158)

Summary of findings and brief details of completed projects:

Project No.	144
Title	Development of flexible and high temperature aerogels
Investigators	Chaure N B (PI), Sulabha K Kulkarni & Shailaja Mahamuni (Co-PIs) Dept of Physics, SPPU
Contact Scientist	Sehkar V, VSSC, Thiruvananthapuram
Duration	Two years (Started on:August 2014)
Budget (₹ lakh)	15.99
Results & Findings	Silica aerogels are prepared using Tetraethyl orthosilicate (TEOS), ethanol, hydrochloric acid (HCl) and ammonium hydroxide (NH_4OH). Two different acid catalyst HCl and Oxalic acid were used with base catalyst NH_4OH. Aim was to find the appropriate acid catalyst to improve the transparency, thermal conductivity and reduced density and pore size. Transmittance, surface morphology, pore size and thermal conductivity were studied using Uv-Vis spectroscopy, FESEM, TEM and BET technique. For both catalysts the transmittance was found to increase upon increasing the base catalyst (NH_4OH). Reduced transmittance could be due to Rayleigh scattering effect. Density decreased systematically for both acid catalysts on increasing the contents of NH_4OH. Average pore radius was in the range 8 to 9 A^O. Thermal conductivity with Oxalic acid is low compared to with HCl. This decreased on increasing NH_4OH content. Change in surface morphology was clearly seen in FESEM. Carbon aerogels are prepared using Na_2CO_3 (NC) and Triethylamine (TEA) catalyst for different RC ratios. Both supercritical and subcritical drying was employed in the preparation. Surface morphology, pore size and structural properties were studied by FESEM, BET and X-ray diffraction. The electrochemical impedance spectroscopy was performed to measure the capacitance. Samples prepared with different RC ratio showed changes in surface morphology and pore size.

Project No.	145
Title	Occurrence and distribution of fluoride in groundwater of Terekhol river basin, Sindhudurg district, Maharashtra: A Remote Sensing and GIS based study
Investigators	Gaikwad S K (PI), Meshram D C (Co-PI) Dept of Geology, SPPU
Contact Scientist	Ganesh Raj K & Paul M A, ISRO HQs, Bengaluru
Duration	Two years (Started on:August 2014)
Budget (₹ lakh)	16.00
Results & Findings	Natural concentration of fluoride in groundwater depends on availability of fluoride in rock and minerals encountered by water as it moves along the flow path and solubility. As the study area namely Terekhol river basin, is

endowed with lithological variations and geology from Precambrian to recent deposits, concentration of fluoride in groundwater is found to vary with lithology. Morphometric study has been carried out using Survey of India's toposheets, satellite images (LISS-III) and SRTM data. The study area is classified as seventh order basin having rugged topography and presence of hard rock in the drainage basin. Evaluation of fluoride in groundwater was done using Ion Selective Electrode (ISE- Orien) from Indian Bureau of Mines (IBM), Nagpur. In most of the basin, low level of fluoride is found. Highest concentration of fluoride is detected, in a bore well during Pre-monsoon-2016 and it may be due to more weathering and leaching of fluoride rich mineral. Groundwater quality has been studied for drinking purposes and found that except pH, Electrical conductivity (EC) and Alkalinity (HCO_3) all elements showing optimum to high value prescribed by World Health Organization. Study also shows the SAR values less than 10 indicating quality of groundwater excellent for irrigation use. Less fluoride in Terekhol river's groundwater is attributed to high rainfall, rapid decrease in gradient accelerating runoff, low residence time and rock with low permeability. Thus degree of weathering and leachable fluoride in a terrain is more important in deciding the fluoride contents of water rather than the mere presence of fluoride-bearing minerals in the rocks.

Project No.	146
Title	Remote sensing application in coastal geomorphology, changes in morphology in parts of West coast of Maharashtra, India
Investigators	Milind A Herlekar (PI) Dept of Geology, SPPU
Contact Scientist	Rajawat A S, SAC / Ahmedabad
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	11.05
Results & Findings	In about 500 km long Maharashtra coastline, overall erosion length is 175 km, deposition length 224 km and length with no change is about 85 km. The erosion was seen to be more in the northern and deposition in the southern part of the coastal tract. The middle portion was seen to be stable, possibly due to presence of headlands and promontories. At some places sandpits are found to be growing or receding. Landform changes are related to shoreline geometry, wave energy conditions, precipitation, drainage, wind pattern and anthropogenic activity. The Maharashtra coast, part of tropical region, receives seasonal precipitation influencing the drainage pattern. Hence the seasonal studies of net balance of the beach sediments can be highly variable from year to year.

Project No.	147
Title	Study of precipitation characteristics using disdrometer and satellite datasets over Pune

Investigators	Rohini Lakshman Bhawar (PI), Pradeepkumar P (Co-PI) Dept of Atmospheric and Space Science, SPPU
Contact Scientist	Kiran Kumar N V P , NRSC, Hydearabad
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	8.50
Results & Findings	Rain intensity was studied over Pune using the data for two contrasting monsoon years 2012 and 2013. Frequency of occurrence of different rain intensities in 2012 was less than that of 2013 while the accumulated rain obtained from disdrometer and Indian Meteorological Department daily weather report were in good agreement. Z-R relationships for different rain events were also examined. Intensity parameter 'a' and slope parameter 'b' varies considerably depending on the type of the rain period. For convective period over Pune there is lower value of 'a' and higher value of 'b' as compared to transition and stratiform period respectively, which is different from the NARL, Gadanki dataset. Thus, suggesting a high temporal and spatial variability in the Z-R relationships over two tropical stations. Hence, one cannot use a signal Z-R relationship for parameterization of tropical rain in models. During convective period drop number density is large and drop diameter varies over wide range of values as compared to transition and stratiform periods, which can be attributed to higher rain intensity spell during convective period. In year 2013 there are more middle and high level clouds giving higher rain intensities as observed from disdrometer data. It means more cloud fraction observed from MODIS data in 2013 as compared to 2012 relates to presence of these higher clouds. While considering MODIS derived liquid water path and disdrometer rain intensity, lower cloud top temperature values are observed with high liquid water path; this suggest less vertical cloud development in 2012 and hence less rain intensity. In year 2013, less liquid water path is observed corresponding to high cloud top temperature with more rain intensity values. This indicates more vertical growth of clouds and giving more rain in 2013.

Project No.	148
Title	Optimization of low voltage DC micro-grid with intelligent solar PV utilization for a Computer laboratory
Investigators	Vivek M Aranake (PI), Mileend S Patil & Chandrashekhar S (Co-PIs) Vishwakarma Institute of Information Technology, Pune
Contact Scientist	Rao G N, LEOS, Bengaluru
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	30.54
Results & Findings	Many equipment which operate on AC supply have internal AC to DC conversion and DC power utilization at the end. Desktop computer is one typical example of such a load. While using Solar DC source for such applications, energy has to undergo multiple conversions which leads to energy losses. Solar energy availability is continuously variable and used as

supportive energy to either sharing with mains AC power or used by storing in batteries. Optimization of low voltage DC Micro Grid with Intelligent Solar PV utilization for computer laboratory is based on finding a solution to above mentioned problems. A typical Computer laboratory was considered and associated problems were studied and analyzed. Design was conceived overcoming the shortcomings of the existing system and improving the overall efficiency. This Computer laboratory is having 25 computers, 10 tube lights and 8 ceiling Fans as major load requiring power. Desktop computers were operating on AC input supply but having DC operation internally. Tube lights were conventional fluorescent tube lights with magnetic ballast and ceiling fan were single phase squirrel cage motor based fans. Total power consumption of the existing load was worked out and all the loads to operate on DC or directly on solar power, were converted. After conversion, the power consumption of the total load was measured and compared. Results confirm new power distribution method more efficient for utilizing solar power when used for local consumption with limited transmission. The total saving of power when used with new scheme is in the range of 30% for active power and 42% for apparent power.

Project No.	149
Title	Processing of natural biopolymers - wild and domestic silk varieties of Northern Western Ghats : Fabrication of biopolymer film based technological substrate for advanced optical structures
Investigators	Chaudhari R D (PI), Amalnerkar D P & Manish Shinde (CO-PIs) Shri Shiv Chhatrapati College, JUNNAR
Contact Scientist	Shri P P Kale
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	23.66
Results & Findings	Silk fibroin was extracted from *B. mori* silk variety. The fibroin was used for synthesis of nanoparticles, antimicrobial, larvicidal, algicidal activities as well as for making colorimetric biosensors for detection of various metals, pesticides, glucose etc. Synthesis of silver nanoparticles within the silk fibroin matrix has been successfully carried. The resultant non-cytotoxic and biodegradable nanocomposite dispersion was used as the colorimetric biosensor probe for the determination of various metallic, especially, heavy metals at very low concentrations. It has been observed that this probe can sensitively determine the colorimetric variations in aqueous mercury ions even at 1 ppb level. For other analytes such as chromium, copper and iron, the colorimetric sensor response was in the ppm level. Thus, it can be used for colorimetric probe for sensitive determination of mercury ions. Method of preparing the AgNP-SF nanocomposite dispersion is quite simple easy and can be used even by the rural and remote population. Colorimetric biosensor can detect pesticide in the food stuffs like fruits and vegetables surfaces. Iron oxide nanoparticles of fibroin are used for the detection of heavy metals such as mercury and lead. While,

zinc oxide nanoparticles of fibroin were used as a colorimetric biosensor for the detection of lead. This nanocomposite was also used as a colorimetric biosensor for the detection of glucose and urea.

Project No.	150
Title	Stabilization of zirconia for electronic applications, in tetragonal and cubic structure using various dopants
Investigators	Khaladkar M Y College of Engineering, Pune
Contact Scientist	Surinder Singh, SAC, Ahmedabad
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	15.02
Results & Findings	Pure zirconia is an important constituent of ceramic materials used in high temperature applications and can be used as an additive to enhance the properties of other oxide refractories. Zirconia (ZrO2) has one of the lowest thermal conductivities in a ceramic, and is, therefore, widely used as thermal insulator at elevated temperatures. Pure zirconia is monoclinic at room temperature and changes to the denser tetragonal form at about 1000° C, which involves a volume change i.e. expansion of about 3-5 % and creates cracks within its structure. Due to the inversion of tetragonal to monoclinic phases, pure zirconia has low thermal shock resistivity. During heating process, zirconia undergoes a phase transformation process. The change in volume associated with this transformation makes the usage of pure zirconia in many applications impossible. Due to addition of some oxides of metals like Calcium, Magnesium and Yttrium, into the zirconia structure in a certain degree (about 1 to 18 mol %) results in a solid solution, which stabilizes in cubic form and has no phase transformation during heating and cooling. This solid solution is termed as stabilized zirconia, a valuable refractory. Stabilized zirconia is used as a grinding media and engineering ceramics due to its increased hardness and high thermal shock resistivity. Stabilized zirconia is also used in applications such as oxygen sensors and solid oxide fuel cells due to its high oxygen ion conductivity. Highly transparent stabilized zirconia can be obtained by sintering the stabilized zirconia at high temperature. Methods of synthesis: YSZ can be synthesized by various methods like solid state, co-precipitation, hydrothermal, sol-gel, mechanical mixing, etc. In the present work, synthesis methods used are co-precipitation by oxalate and hydroxide precursors as well as mechanical mixing of oxalates.

Project No.	151
Title	Interaction of plasma with thermal protecting system (TPS) material during re-entry of space vehicle
Investigators	Mathe V L (PI), Bhoraskar S V (Co-PI) Dept of Physics, SPPU

Contact Scientist	Ajith M R,VSSC, Thiruvananthapuram
Duration	Two years (Started on: August 2014)
Budget (₹ lakh)	12.56 lakhs
Results & Findings	To simulate the re-entry conditions, namely the presence of plasma species having density of 10^{10}-10^{12} /cm^3 at elevated temperatures, experimental set up consisting of Electron Cyclotron Resonance (ECR) plasma reactor was conceived and built. The system is capable of producing atomic oxygen of requisite density. Plasma having specific characteristics impinged on the surface of tile material and in-situ investigation of the interaction was carried out using actinometric technique. The density of plasma species generated in ECR was equivalent to that present in the surrounding atmosphere of space vehicle during its reentry. As the temperature inside the ECR plasma is close to room temperature, external source of heating was employed for tile surface to reach a temperature close to 1200 K. Catalytic activity of the TPS surface plays an important role in dissipating the heat. Plasma emission spectroscopy was used to investigate the effect of catalytic reactions at different temperatures. This technique is known as actinometry. Changes on the tile surface were studied using different analytical tools.

Project No.	155
Title	Design feasibility of PLL frequency synthesizer for Ku band
Investigators	Shobha Sachin Nikam, (PI) Pradeep B Mane & Sandeep Mishra (Co-PIs) AISSMS's Institute of Information Technology, Pune
Contact Scientist	Das D K, SAC, Ahemdabad
Duration	One and half years (Started on: June 2015)
Budget (₹ lakh)	8.60
Results & Findings	ISRO is using PLL synthesizer ICs from Peregrine semiconductor, in which VCO is out of chip and frequency is up to 3 GHz. Taking into the consideration the limitations of the existing PLL synthesizer in Ku band with low spur disturbance & Phase noise the design feasibility is carried out to develop a PLL frequency synthesizer in Ku band. Scope of integrating all blocks of PLL frequency synthesizer on a single IC chip to produce all frequencies of Ku band is there, as ISRO has already started application in this band. The design feasibility was carried out using simulations on Cadence tool with 65 nm TSMC technology for CMOS process. The approach of mixed signal circuit was considered as the PLL frequency synthesizer has both analog and digital blocks. The integer N architecture with phase frequency detector, charge pump, loop filter, LCVCO and programmable divider in a loop were considered. The design is feasible at reference frequency of 50 MHz, PLL frequency synthesizer frequency range from 12.57 to 21.09 GHz, phase noise range from -103.70 to -110.34 dBc/Hz @ 1 MHz offset frequency, fine tuning from 230 to 820 MHz and switching time less than 10 microsecond.

Project No.	156
Title	Stabilization of zirconia for electronic applications, in tetragonal and cubic structure using various dopants
Investigators	Jayashree Pratap Shinde (PI), Pratap Nivrutti Shinde (Co-PI) Sinhgade Academy of Engineering, Pune
Contact Scientist	Sri Rama Subrahmanyam R, URSC, Bengaluru Viswanathan M / LEOS, Bengaluru
Duration	One year (Started on: June 2015)
Budget (₹ lakh)	11.75
Results & Findings	For small satellite application mounting of an antenna is the main issue. For such application, an antenna of non-transparent material is typically mounted above the solar cell, which decreases the efficiency of solar cell. So, to integrate antennas with the solar cells by keeping efficiency constant, transparent antennas are used. ITO antennas are generally used which have optical transparency about 90%. As, the ITO material do not have 100% transparency the main aim is to decrease the conducting area of the antennas by removing some part of the conducting ITO material from patch and from the ground plane to increase the total optical transparency. A rectangular slit is cut from the top of the circular resonating element to increases the optical transparency of the patch. The optical transparency of patch has less effect on its radiation efficiency. The Antenna design is further modified by inserting the rectangular slit from the top of the circular resonating patch, which decreases the area of the resonating element and helps to increase the total optical transparency of patch. The rectangular slit has dimension of 27 mm x 8.6 mm. This is the modified circular shaped transparent antenna which is named as Antenna-G.

Project No.	158
Title	Studies on biodiversity of poly-extremophilic bacteria for their probable use as test organisms in space research
Investigators	Neelima M Deshpande (PI) Niranjan P Patil (Co-PI), Abasaheb Garware College, Pune
Contact Scientist	Manjunath K R, SAC Ahmedabad
Duration	Two years (Started on: July 2015)
Budget (₹ lakh)	9.00
Results & Findings	The extremophiles that could tolerate more than one factor of harsh conditions are called poly-extremophiles. There are unicellular and even multicellular organisms that are classified as hyperthermophiles (heat lovers), psychrophiles (cold lovers), halophiles (salt lovers), barophiles (living under high pressures), acidophiles (living in media of the lower scale of pH). At the other end of the pH scale they are called alkaliphiles (namely, microbes that live at the higher range of the pH scale). Thermo-acidophilic microbes thrive in elevated thermo-environments with acidic levels that exist ubiquitously in hot acidic springs. Focus of the study has been on salt loving organisms which can be ultraviolet or gamma radiation resistant.

Two main sources, hot water spring and sea shore were chosen for sampling purpose. Water, soil and sediments were collected and out of 49 bacterial isolates, 12 were halophiles, 27 thermotolerant, thermophiles, or Hyperthermophiles and 10 uv/ gamma radiation resistant. Among 12Poly-extremophily isolates, 3 grew in medium containing 11% NaCl at pH 8.5 and 50^{o}C and 1 isolate grew at NaCl-20% at pH 9 and 55^{o}C. In all, 12 robust organisms were isolated and identified which can be used as test organisms in space research. To name a few polyextremophiles, Bacillus aryabhattai and Geobacillus thermoglucosidasius as radiation resistant, sp. of Anoxybacillus and Geobacillus as hyperthermophiles and Salimicrobium halophilum as halophiles are the organisms with highest potential for multiple functionality under stress.

4. Ongoing research projects

Presently there are 24 ongoing projects (listed below) including eleven projects initiated in November 2017. 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 achieved in their studies. Midcourse correction is suggested by PEC wherever necessary. PEC meeting chaired by Prof S Ananthakrishnan, was held on 31st October 2017 to assess the progress of the ongoing projects and to make midcourse correction. JPC in its meeting held on 26 & 27 March 2018, reviewed the progress of ongoing projects and had detailed interaction with the investigators.

List of Ongoing projects

1. Feasibility study on indigenous development of electrochemical based gas sensors and transmitters (Project No.137)

2. Development of nuclear batteries using radioactive sources (Project No.152)

3. Design, fabrication and testing of a compact and robust monochromator (Project No.153)

4. Fabrication of magnetoelectric energy harvesters by utilizing piezoelectric-macro fiber composite (MFC) and magnetostrictive-nickel/metglas/magnetic oxide materials (Project No.154)

5. Development of coating/manufacturing technology for friction stir coating/welding tool for welding of 3 mm thick stainless steel sheets (Project No.157)

6. Development of Pre qual engineering model of “SEAPS” (300 KHz to 30 MHz) RF front-end electronics and data acquisition system for low frequency space science studies (Project No.159)

7. Converting energy derivable from low energy sources into electrical power for autonomous sensors applications (Project No.160)

8. Development of high current density thermal-field (T-f) cathodes (Project No.161)

9. Fabrication of a small satellite for monitoring radiations in different orbits of outer atmosphere where orbit maneuvering will be controlled by solar sail (Project No.162)

10. Studies on glare reduction techniques for indoor illumination systems (Project No.163)

11. Valve-less linear compressor driven stirling cycle cryocooler for space applications (Project No.164)

12. Drilling techniques/technology for drilling of miniature size holes of diameter less than 10 microns in super alloys for a depth of 1.0 mm (Project No.165)

13. Bioleaching of electronics wastes (E – wastes) (Project No.166)

14. Study of cloud parameters observed by ceilometer with the satellite retrieved and Mesoscale Model generated, cloud parameters (Project No.167)

15. Astrobiology experiments on effect of impact and space related stress on micro-organisms isolated from rocks: Implications for origin of life and lithopanspermia (Project No.168)

16. Wear, corrosion and impact toughness of the high nitrogen martensitic stainless steel (XD15NW) (Project No.169)

17. Miniaturized microstrip antenna designs for 3U cubeSat covering UHF, L- and S- band frequency spectrum and their interference study for earth observations (Project No.170)

18. Design and development of work function measurement set up and its use to measure work function of thrusters (Project No.171)

19. Development of solders for use in cryogenic applications (Project No.172)

20. Selective capture and conversion of CO_2 to methanol from direct air using MOFs supported polyamines (Project No.173)

21. Conducting polymer supported bimetallic nanostructures for fuel cell and hydrogen storage applications (Project No.174)

22. Investigations on ZnSe:Te quantum dot scintillators for charge particle detection in space radiation environment (Project No.175)

23. Development of AlN based ceramics for high temperature electrical insulation (Project No.176)

24. QPSK demodulator based on wideband acquisition technique (Project No.177)

Current status of ongoing Projects:

Sr No.	Project title, Name of Investigator, Budget, Duration & Contact Scientist	Current status and observations
1.	Feasibility study on indigenous development of electrochemical based gas sensors and transmitters (Project No.137) PIs: Shaligram A D / Haram S K Budget: ₹ 29.60 lakhs Duration:Two years (Started on: November 2013) Contact Scientist: Murthy M B N /Senthilkumar R, SDSC/SHAR	Feasibility study has been completed. Final Report to be submitted.
2.	Development of nuclear batteries using radioactive sources (Project No. 152) PI: Sanjay D Dhole Budget: ₹ 19.98 lakhs Duration: Two years (Started on:June 2015) Contact Scientist: Ilangovan S A, VSSC	Permission for procurement of Tritium radioactive source from AERB, BARC is awaited.
3.	Design, fabrication and testing of a compact and robust Monochromato (Project No. 153) PI: Chandrashekhar S Garde Budget: ₹ 19.44 lakhs Duration: Two years (Started on:June 2015) Contact Scientist: Saji Kuriokose, SAC	Interaction with SAC engineers needed for translating the research work to practical applications.
4.	Fabrication of magnetoelectric energy harvesters by utilizing piezoelectric-macro fiber composite (MFC) and magnetostrictive Nickel/Metglas/Magnetic oxide materials (Project No. 154) PI: Kambale R C Budget: ₹ 10.00 lakhs Duration: Two years (Started on:June 2015) Contact Scientist: Bhanu Pant, VSSC Sreemulanadhan H, VSSC	Effect of environment changes such as temperature on power density of designed energy harvesters needs to be assessed. Focus should be on Vibration Harvesting Testing of MFC P1/ Ni(thickness - 0.1 mm. Limitations of the structures and Cost to be projected. Presentation to VSSC engineers may be done from application point of view. Limitations of the system also to be listed.

5.	Development of coating/manufacturing technology for friction stir welding tool for welding of 3 mm thick stainless steel sheets (Project No. 157) PI: Rajesh Chaudhari Budget: ₹ 23.02 lakhs Duration: Two years (Started on:June 2015) Contact Scientist: Sivakumar D, VSSC	Regular interaction with VSSC engineers to be kept up.
6.	Development of Pre qual engineering model of "SEAPS" (300 KHz to 30 MHz) RF Front-End Electronics and Data Acquisition System for low frequency space science studies (Project No. 159) PI: Gharpure D C Budget: ₹ 28.22 lakhs Duration: Two years (started on: June 2016) Contact Scientist: Rajeev Jyoti, SAC	As PI has gone to Ahmedabad to make a technical presentation to SAC engineers, she could not be present for this review. She is to submit a report on her interaction with SAC engineers.
7.	Converting energy derivable from low energy sources into electrical power for autonomous sensors applications (Project No. 160) PI: Shaligram A D /Subhash V Ghaisas Budget: ₹ 8.08 lakhs Duration: Two years (started on: June 2016) Contact Scientist:Kale Pramod P/Uttam M C	Progress status was presented by Amit, Research Scholar. Progress is satisfactory.
8.	Development of high current density thermal-field (T-f) cathodes (Project No. 161) PI: More M A Budget: ₹ 13.31 lakhs Duration: Two years (started on: June 2016) Contact Scientist:Kale Pramod P/Uttam M C	PI presented the annual report of the work. ISRO Scientist needs to be identified so that the work finds applications of interest to ISRO.
9.	Fabrication of a small satellite for monitoring radiations in different orbits of outer atmosphere where orbit maneuvering will be controlled by solar sail (Project No. 162) PI: Rohini Mudhalwadkar P Budget: ₹ 20.60 lakhs Duration:Two years (started on: June 2016) Contact Scientist: Kale Pramod P/ Uttam M C	Magnetic field of the magnetorquers to be determined. Battery capacity is high, needs recheck. FMEA –failure mode and effect analysis of the mission to be done. For assistance in orbit determination from GPS data, Sandip Aghav may be contacted (sandip.aqua@gmail.com).

10. Studies on glare reduction techniques for indoor illumination systems (Project No. 163) PI: Jayashri Bangali A Budget: ₹ 19.18 lakhs Duration: Two years (started on: June 2016) Contact Scientist: Nagendra Rao, LEOS	DIA Lux readings are to be relooked and further verification to be carried out.
11. Valve-less linear compressor driven stirling cycle cryocooler for space applications (Project No. 164) PI: Virendra K Bhojwani Budget: ₹ 22.10 lakhs Duration: Tree years (started on: July 2016) Contact Scientist: Alok Shrivastava, SAC	Graphite fiber should be used instead of perpex material. Update presentation to ISRO engineer and get his comments on progress.
12. Drilling techniques/technology for drilling of miniature size holes of diameter less than 10 microns in super alloys for a depth of 1.0 mm (Project No. 165) PI: Ganesh G Dongre Budget: ₹ 38.20 lakhs Duration: Three years (started on: July 2016) Contact Scientist: Jacob Philip,VSSC	Micro drilling experiments using coated EDM tool should also be tried. There is a need to identify and explore the gas assisted laser drilling using Argon to get quality holes.
13. Bioleaching of electronics wastes (E – wastes) (Project No. 166) PI: Ameeta Ravikumar Budget: ₹ 20.93 lakhs Duration: Two years (started on: June 2016) Contact Scientist: Saboo T, VSSC	Dr W N Gade who was a Co-PI of the project, has informed vide his letter dated 28 July 2017, about his superannuation and his non-availability in the University, suggesting the name of Dr Rajendra Patil as Co-PI of the Project. This is agreed to. PI and Co-PI presented the details of work carried out and the potential of its application. It was suggested that they should interact with identified ISRO Scientist so that the results could be put to practical application.
14. Study of cloud parameters observed by ceilometer with the satellite retrieved and mesoscale model generated, cloud parameters (Project No.167) PI: Pradeep Kumar P Budget: ₹ 9.30 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Amit Kesarkar,	Progress will be assessed after completion of six months.

NARL/Gadanki	
15. Astrobiology experiments on effect of impact and space related stress on micro-organisms isolated from rocks: Implications for origin of life and Lithopanspermia (Project No.168) PI: Rebecca S Thombre Budget: ₹ 14.50 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Bhalamurugan Sivaram, PRL	Progress will be assessed after completion of six months.
16. Wear, corrosion and impact toughness of the high nitrogen martensitic stainless steel (XD15NW) (Project No.169) PI: Dhokhe N B Budget: ₹ 15.00 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Thomas Tharian K, LPSC	Progress will be assessed after completion of six months.
17. Miniaturized microstrip antenna designs for 3U CubeSat covering UHF, L- and S- band frequency spectrum and their interference study for earth observations (Project No.170) PI: Pratap N Shinde Budget: ₹ 16.66 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: V Senthilkumar, URSC	Progress will be assessed after completion of six months.
18. Design and development of work function measurement set up and its use to measure work function of thrusters (Project No.171) PI: Mathe V L Budget: ₹ 18.70 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Ajit M R, VSSC	Progress will be assessed after completion of six months.
19. Development of solders for use in cryogenic applications (Project No.172) PI: Madhuri C Deshpande Budget: ₹ 20.06 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Ramesh Narayanan P, VSSC	Progress will be assessed after completion of six months.

20. Selective capture and conversion of CO_2 to methanol from direct air using MOFs supported polyamines (Project No.173) PI: Waghmode Shobha Ajeet Budget: ₹ 15.00 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Benny K George, VSSC	Progress will be assessed after completion of six months.
21. Conducting polymer supported bimetallic nanostructures for fuel cell and hydrogen storage applications (Project No.174) PI: Wankhede V A Budget: ₹ 17.00 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Benny K George, VSSC	Progress will be assessed after completion of six months.
22. Investigations on ZnSe:Te quantum dot scintillators for charge particle detection in space radiation environment (Project No.175) PI: Shweta Dilip Jagtap Budget: ₹ 16.50 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Srikar P Tadepalli, ISAC	Progress will be assessed after completion of six months.
23. Development of AlN based ceramics for high temperature electrical insulation (Project No.176) PI: Kaustubh R Kambale Budget: ₹ 9.48 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Shanbhogue K M, LPSC	Progress will be assessed after completion of six months.
24. QPSK Demodulator based on wideband acquisition technique (Project No.177) PI: Wankhede V A Budget: ₹ 3.78 lakhs Duration: Two years (started on: Nov 2017) Contact Scientist: Chandrasekharam K, SAC	Progress will be assessed after completion of six months.

5. New research proposals for the year 2018-19

In response to ISRO-SPPU STC's call for new projects, 87 study proposals were received from various Departments and affiliated colleges of the University. These proposals were evaluated by the Preliminary Evaluation Committee (PEC) for making recommendation to Joint Policy Committee (JPC). PEC examined the new proposals and noted that some of the proposed studies were very similar to the projects already completed under ISRO-SPPU Joint Research Programme and such studies need not be repeated. PEC scrutinized the new proposals and short listed 37 for further technical evaluation. Investigators of these proposals were invited to make a technical presentation to PEC on 7 and 8 March 2018. At the end of the exercise, Committee made an assessment and recommended 19 proposals for the consideration of JPC. Investigators of these proposals were then invited to highlight the merits of the proposed study to JPC on 26 March 2018. JPC interacted with the prospective investigators and approved 11 proposals for funding in the financial year 2018-19. Technical summary of each of the approved proposals is given below:

Proposal No.	2017/016
Title	Development of an NDT technique for through thickness measurement of non-uniform residual stresses in metallic materials
Investigators	Vikas Pralhad Dive (PI), Sanjay Shridhar Lakade, (Co-PI) DYPIEMR Pune
Contact Scientist	Krishnakumar R, LPSC, Thiruvananthapuram
Duration	Two years
Budget (₹ lakh)	10.48
Objective of the proposed study	Devise NDT method to measure and determine non uniform residual stresses @ 5 to 6 mm depth. Study effect of change of welding method of friction stir welding over TIG on weld pool and residual stresses in weld. finite element welding simulation and ultrasonic stress measurement using the LCR Wave.

Proposal No.	2017/019
Title	An investigation of tropical mesospheric echoes: causative mechanisms and application to study mesospheric turbulence
Investigators	Kishor Kumar G (PI) Dept of Atm & Space Sciences, SPPU
Contact Scientist	Venkat Ratnam M, NARL, Gadanki
Duration	Two years
Budget (₹ lakh)	7.80
Objective of the proposed study	To determine properties of low latitude mesospheric echoes and to reveal their causative mechanisms. To identify diurnal variations of mesospheric echoes to address their source mechanism. To identify long term variations of low latitude mesospheric dynamics and to classify/quantify the turbulence structure at mesospheric heights

Proposal No.	2017/022
Title	Development of image processing algorithms for blur reduction and noise

	elimination in satellite imagery
Investigators	Ashwini M Deshpande Cummins College of Engineering for Women, Pune
Contact Scientist	To be identified
Duration	Two years
Budget (₹ lakh)	9.60
Objective of the proposed study	To develop new image processing algorithms for estimating point spread function from observed images and to obtain deblurred and denoised images. An experimental set-up employing a programmable camera will demonstrate acquisition of ground truth PSF models of motion and atmospheric turbulence. Effectiveness of proposed algorithms will be verified through the image quality metrics.

Proposal No.	2017/028
Title	Development of optical disdrometer
Investigators	Aditee Joshi Dept of Electronic Science, SPPU
Contact Scientist	To be identified
Duration	Two years
Budget (₹ lakh)	10.00
Objective of the proposed study	Design a lab scale experimental model for optical disdrometer and a graphic user interface for displaying disdrometer parameters.

Proposal No.	2017/043
Title	Effects of simulated microgravity on expression profile of microrna in human cardiomyocyte
Investigators	Varsha W Wankhade (PI), Indranil Banerjee (Co-PI) Dept of Zoology, SPPU
Contact Scientist	Parul Patel, SAC/Ahmedabad
Duration	Two years
Budget (₹ lakh)	20.00
Objective of the proposed study	To explore the changes in expression of microRNA under simulated microgravity condition in 2D cell culture model. To study the expression of important genes related to heart physiology in 2D cardiomyocyte. To understand the status of cellular stress in cardiomyocytes under the influence of micro-gravity.

Proposal No.	2017/046
Title	Applications of plasmonic nanoshapes in hybrid flexible solar cells
Investigators	Chaure N B Dept of Physics, SPPU
Contact Scientist	To be identified

Duration	Two years
Budget (₹ lakh)	16.00
Objective of the proposed study	Synthesis of metal (plamonic) Au, Ag and Al nanoparticles of different sizes as well as shapes by wet chemical processable techniques and their incorporation (cross linking/blending) into the conducting polymer matrix to form polymer nanocomposites (PNCs). These PNCs will be used at targeted areas in solar cell.

Proposal No.	2017/053
Title	Feasibility study on: Development of sequestration and biotransformation strategies for the treatment of ammonium perchlorate
Investigators	Kisan M Kodam (PI), Suresh B Waghmode (Co-PI) Dept of Chemistry, SPPU
Contact Scientist	Benny K George, VSSC/Thiruvananthapuram
Duration	One year
Budget (₹ lakh)	5.00
Objective of the proposed study	Some species of bacteria are known for their biochelation ability to sequester ammonia and phosphate in the form of struvite ($NH_4M_gPO_4$, $6H_2O$). This type of bacteria can be used for sequestration of ammonia from the ammonium perchlorate and remaining perchlorate will be reduced with Co/Ni-doped titanium dioxide and/or Co/Ni-dopedzinc oxide based photocatalysis or with the help of bacterial granules in a bioreactor.

Proposal No.	2017/054
Title	Development of nano - material smart coating for anti - reflection and thermal control of space structures
Investigators	Kunal U Shinde (PI), Rosilda Selvin (Co-PI), Sandip Institute of Engineering and Management, Nashik
Contact Scientist	To be identified
Duration	One year
Budget (₹ lakh)	16.50
Objective of the proposed study	Fully-dispersible dispersible zeolite MFI/Beta nano crystals will be synthesized and mixed with zeolite seeds and non-ionic surfactants for preparing AR coating. For thermal control applications, VO_2 nano particles and vanadium silicalite-1 zeolite nano precursors will be synthesized using hydrothermal method.

Proposal No.	2017/058
Title	Characterization of AISI 321 stainless steel at low temperatures
Investigators	Rajesh Chaudhari Vishwakarma Institute of Technology, Pune
Contact Scientist	To be identified
Duration	Two years

Budget (₹ lakh)	15.00
Objective of the proposed study	Characterization of microstructures and mechanical properties of AISI 321stainless steel at low temperatures and different strain rates

Proposal No.	2017/089
Title	Ontology enabled disaster management web service using data integration
Investigators	Shilpa Pimpalkar AISSMSIOIT, Pune
Contact Scientist	To be identified
Duration	Two years
Budget (₹ lakh)	0.60
Objective of the proposed study	Design of web application addressing the information needs covering all the phases of disaster management such as, preparedness, early warning.

Proposal No.	2017/040
Title	Studies on microbial diversity and bioburden estimation of ISRO spacecraft assembly clean rooms
Investigators	Neelima M Deshpande (PI), Tejaswini A Pachpor (Co-PI) Abasaheb Garware College, Pune
Contact Scientist	Parul Patel, SAC/Ahmedabad
Duration	Two years
Budget (₹ lakh)	13.57
Objective of the proposed study	To study biodiversity of air flora from clean room and surface flora from satellite assembly line. To analyse bacterial load at different stages of assembly line. Culture dependent studies. Metagenomic studies: Next generation sequencing. To suggest methods to reduce bioburden based on diversity. Checking each isolate's extremophily with respect to temperature tolerance, radiation and salt tolerance.

6. Major events in the STC calendar

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 (JPC) for final approval. PEC also has the responsibility to periodically review the progress of the ongoing projects and take corrective measures. There were three PEC meetings held during the year 2017-18. JPC had its two-day's meeting on 26th and 27th March 2018. Highlights of these events are given below.

1. 32nd PEC meeting held on 31 October 2017

Member Secretary informed the Committee that out of 166 projects, 142 were completed earlier (by 31 March 2017) and final completion reports received. Studies in respect of twelve projects have been completed and Investigators have either submitted or are in the process of preparing the Final Report. PIs of the remaining 12 projects were invited to make technical presentation to PEC in regard to the status of their projects. Dr T V C Sarma, Scientist from NARL Gadanki and ex-ISRO Scientists Shri Suresh Naik (SAC) and Shri V B Lal (VSSC) also participated as invitees in the assessment of the progress of ongoing projects. Investigators made a detailed technical presentation highlighting the progress of their work.

2. 33rd PEC meeting held on 15 February 2018

Meeting was held for initial evaluation of new research proposals. Against our invitation, 87 research proposals were received from various Departments and affiliated colleges of the University. Summary along with the soft copy of the study proposals was sent to all PEC Members for their advanced study. Existing guide lines in evaluation of the new proposals are:

- 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
- Publications of research findings in refereed journals

Committee examined the new proposals and categorized area wise into ten groups, as shown below. After a detailed scrutiny of the new proposals, Committee short listed 37 proposals and decided to invite the prospective investigators for clarifications and technical presentation. No further action on the remaining proposals is to be taken as these are not much meaningful from ISRO's programme point of view and also lacking in technical novelty.

3. 34th PEC meeting held on 7 & 8 March 2018

The prospective investigators of the shortlisted 37 new proposals were invited to make technical presentation to the Committee and provide necessary clarifications. Prof C S Garde, PI of Proposal titled *Compact and Robust Raman Spectrometer* communicated his request to withdraw his proposal and this was agreed to. Shri A V Patki, Shri V B Lal and Shri A K Sinha (Ex-ISRO Scientists) participated as invitees, in evaluation of the new proposals. After detailed interaction with the investigators, Committee recommended a list of 19 projects for consideration of Joint Policy Committee (JPC).

4. 20th JPC meetings held on 26 and 27 March 2018

Joint Policy Committee (JPC) supervises the overall management of the ISRO-SPPU Interaction Programme, recommends the funds requirement to ISRO HQs and suggests new areas of activities as and when necessary. JPC meeting was held on 26 & 27 March 2017 to take a stock of the ongoing projects and consider new research proposals for the year 2018-19. JPC meeting was chaired by Hon'ble Vice Chancellor Prof Nitin Karmalkar and attended by the following Members/invitees. JPC approved 11 new research proposals and recommended a total budget of Rs 220.14 lakhs for the year 2018-19.

Shri P P Kale (SPPU)
Prof S Ananthakrishnan (SPPU)
Prof Suresh Gosavi (SPPU)
Prof Pradeep Kumar (SPPU)
Prof A D Shaligram (SPPU)
Smt (Dr) Vidya K Gargote (SPPU)
Dr M V Ramana, NRSC, Hyderabad
Dr M A Paul, ISRO Hq, Bengaluru
Dr Benny George VSSC, Thiruvananthapuram
Dr M V Hanumanta Rao LEOS, Bengaluru
Dr (Mrs) Parul Patel SAC, Ahmedabad
Dr S Sreedharan VSSC, Thiruvananthapuram
Shri A V Patki (ex-ISRO)
Shri A K Sinha (ex-ISRO)
Shri V B Lal (ex-ISRO)
Dr M M Ali (ex-ISRO)
Shri M C Uttam (Member Secretary)

5. Commencement of new projects

After the receipt of Grants-in-aid from DOS, for the year 2017-18, eleven research projects, which were approved in the JPC meeting held on 20 & 21st March 2017, made a beginning in the month of December 2017 with the release of first installment of funds.

List of research proposals

A. Aero Space

1. Prediction model for vibration in turbopumps considering the effects of unbalance, fluid forces, seals, internal clearances
2. Machining parametric optimization of Aluminum and Nickel alloy using desirable approach for WEDM
3. Acoustic source localization using microphone array technique by employing beam forming algorithm and finding the major jet noise sources during lift off from launch pad
4. Design and development of performance model for digital image correlation based strain and displacement measurement system
5. Aerodynamic design and prediction methodology of the grid fins of different cross-section in supersonic flight regime
6. Experimental and Numerical Analysis of pulsating jet nozzle Impingement on heat sinks for electronic cooling
7. High precision relative navigation and attitude reference system for space docking experiment (IISU)
8. Parametric analysis and modeling of flow separation in various nozzle
9. Hybrid solution methodology with a combination of cartesian grid and meshless method for high speed turbulent viscous flow solution from cartesian mesh
10. Structural health monitoring through classification of strain patterns using artificial neural network
11. Mathematical modeling and performance simulation of a closed die forged component of various composite materials
12. Measurement and characterization of plasma plume of a modified stationary plasma thruster for space propulsion
13. Surface fabrication by rapid prototyping for aerodynamic high temperature applications
14. Experimental studies on thermal hydraulics of spiral plate heat exchanger
15. Strain gauge based structural health monitoring (SHM) of large structures like Launch Pedestal, Umblical Tower, VAB etc using WSN
16. Development of an NDT technique for through thickness measurement of non-uniform residual stresses in metallic materials

B. Atm Science

17. Understanding the relationship between sea surface temperature (SST) variations over north Indian Ocean and cloud parameters during Indian summer monsoon period
18. SDR Cloud RADAR
19. An investigation of tropical mesospheric echoes: causative mechanisms and application to study mesospheric turbulence
20. Modeling studies of aerosol-cloud-climate interactions in different environments using coupled chemistry-meteorology model WRF-Chem

C. Image Processing

21. Development of image processing algorithms for blur reduction and noise elimination in satellite imagery (B 2.6- NRSC/ B 6.8 SAC)
22. No reference image quality analysis framework
23. Image classification and intelligence
24. Target detection using synthetic aperture radar imagery for surveillance
25. Vision aided inertial navigation system

D. Instrumentation

26. Development of Optical Disdrometer
27. Charge pump PLL frequency synthesizer design
28. Design, development and modeling of 25kW quadruplex BLDC motor with quadruplex hall sensor sets and development of predictive controller based drive for linear electromechanical actuator
29. Compact and robust Raman Spectrometer
30. Design and optimum utilization of electrical energy for space satellite
31. Development of Control algorithms for autonomous mobile robotic manipulator
32. Design of area and power efficient real time hybrid floating point/logarithmic number system arithmetic (HNS) unit
33. Testing, benchmarking and power quality evaluation of the Li-ion batteries used in transportation application
34. Robust control for 5 DOF robot
35. Piezoelectric actuators for position control applications – development and demonstration of closed loop control algorithm for precise position control

E. Life Science

36. A preliminary study on novel biomaterial for proposal protection of astronaut from solar radiations and microgravity – A necessity for manned space mission of indian space research organization (isro)
37. Studies on microbial diversity and bioburden estimation of ISRO spacecraft assembly clean rooms
38. Development of UV-resistant re-engineered silk based biomaterial
39. Microbial degradation of ammonium perchlorate
40. Effects of simulated microgravity on expression profile of microrna in human cardiomyocytes

F. Material Science

41. Synthesis, characterization and fabrication of ($Cu_2Z_nS_nS_4$) CZTS thin film solar cell prepared by chemical spray pyrolysis
42. Development of portable, flexible and highly sensitive sensor device based on Graphene conducting polymer nanocomposites for detection of CO_2 and O_2 gas
43. Applications of plasmonic nanoshapes in hybrid flexible solar cells
44. Process development and optimization of novel electro discharge machining variants for machining of super alloys (Titanium Ti6Al4V, Inconel 600/718, Haynes 25, Molybdenum, Columbium 103)
45. Development of nano- polishing technology for metal mirrors
46. Design and fabrication of metamaterials useful for space applications
47. Polyol assisted solvothermal fabrication of transition metal (Fe, Co, Cu) doped ZnO as catalysts for enhanced thermal decomposition properties of ammonium perchlorate
48. Development of grapheme oxide based gas sensors
49. Enrichment of H_2O_2 by distillation process and safe storage
50. Development of sequestration and biotransformation strategies for the treatment of ammonium perchlorate
51. Development of scratch-resistant nanozeolite anti-reflective coating
52. Hybrid Architectures of metal oxide nanoparticle grafted doped graphene as CO_2 and O_2 gas sensor
53. Fabrication of efficient lead halide perovskite solar cell

54. Development of Vanadium Oxide smart coatings for thermal control of space structures
55. Characterization of AISI 321 stainless steel at low temperatures
56. Development of high efficiency CdS/CdTe thin film solar cells by low cost techniques
57. Nanostructured metal oxide/hydroxide synthesis by using mechanochemical method and characterization for supercapcitor application

G. Miscellaneous

58. Development of temperature dependent models of PHEMTs, MHEMTs and InP HEMTs for wide temperature range including cryogenic temperature
59. Robust feature extraction for speaker recognition
60. Knowledge extraction from large dataset efficiently using parallel data mining algorithm
61. Optimization of machining parameters for machining of super alloys Co-operative spectrum sensing and allocation in cognitive radio network using game theory
62. Co-operative spectrum sensing and allocation in cognitive radio network using game theory
63. Collisional transions in cyclopropenone (c-c3h2o) and their applications in astronomy and astrophysics
64. Hidden markov model based heart sound segmentation

H. Remote Sensing

65. Mapping, change detection and integrated management of mangrove habitat along the coast of Maharashtra using satellite imageries
66. Drought risk assessment using remote sensing and geo-informatics approach: A case study of Solapur District, Maharashtra
67. Applications of multispectral and hyperspectral remote sensing techniques in the identification of olivine rich picrite rocks from the Deccan trap flood basaltic province of western India and their economic and petrogenetic singnificance
68. Remote sensing - GIS based studies for groundwater prospects mapping in the Kundalika river basin, west coast of Maharashtra, India
69. River morphology monitoring and analysis using temporal SAR images
70. RS-GIS based inventorization and monitoring of coastal wetlands of Raigad District of Maharashtra State
71. Urban sprawl analysis using geospatial technology: a case study of Ahmednagar city
72. Pre-disaster management and technique to avoid land sliding in prone areas

I. Rural Development

73. IoT (Internet Of Things) based techniques for agro-ecosystem characterization
74. An empirical study on skill gap analysis and challenges faced by skilling post graduate students in rural area
75. Design of network and message structure for disaster warning broadcast through satellite during Tsunami

J. Satellite Communication

76. Parallel processing approaches for real time data processing and reprocessing in HPC environment and using GPGPU platforms as well as accelerators like Intel-Phi
77. The study and performance estimation of a MC-CDMA system under multipath fading channel
78. Algorithms for knowledge extraction from big data
79. Design, simulation and analysis of microwave photonics terminals for free space optical link

80. Design & implementation of monopulse tracking antenna using substrate integrated waveguide (siw) technology for ku band
81. Parallel processing approaches for real time data processing and reprocessing in HPC environment and using GPGPU computing platform with CUDA
82. Design & implementation of software defined radio for small satellites
83. Target detection using synthetic aperture radar imagery for surveillance
84. Development of strategies for dynamic resource allocation in multi beam mobile and broadband satellites
85. Ontology enabled disaster management web service using data integration
86. Performance analysis of big data platforms and intensive workflow execution in cloud
87. Laser based gigabyte communication framework for image and audio transmission

7. R/D activities in DOS/ISRO establishments

With a view to bring out the potential research areas to the notice of prospective investigators, brief description of major establishments of DOS and their areas of technical activities were highlighted earlier in ISRO-SPPU STC's Annual Report 2014-15. This was followed by adding salient features of technical activities of National Remote Sensing Centre (NRSC/ISRO), Hyderabad in the Annual Report 2015-16 and Satellite Application Centre (SAC/ISRO) Ahmedabad in the Annual Report 2016-17. To continue, brief history and technical activities (extracted from ISRO websites) of two other important ISRO/DOS establishment, namely U R Rao Satellite Centre - URSC (formerly ISAC) and Laboratory for Electro-Optics Systems (LEOS), both located in Bengaluru are included here.

U R Rao Satellite Centre - URSC (formerly ISAC)

Activities relating to satellite technology started at Satellite Systems Division in Space Science & Technology Centre, Trivandrum in the late sixties. Later in 1972 to build the first Indian Satellite Aryabhata, the scene shifted to Bangalore with the formulation of Indian Scientific Satellite Project (ISSP). The Indian Institute of Science campus initially housed the project activities until it moved to the industrial sheds at Peenya, Bangalore where the first Indian satellite Aryabhata was developed and thus was born the Isro Satellite Centre (ISAC) in 1976. In 1984 the Centre moved to the present campus at Old Airport Road, Vimanapura in Bangalore. Since early 90's, contemporary and advanced satellites were built and tested in this campus. These satellites continued to serve the key sectors like communication, agriculture, water resources, urban planning, Land use, Fisheries, Oceanography, Weather forecasting, Disaster management, Search and Rescue and Navigation. URSC today is engaged in research and development in various facets of science and engineering related to spacecraft technology like astronomy, electronics, thermal, mechanical, material science, computer science etc.To cater to the growing need of satellite for various applications, ISRO Satellite Integration & Testing Establishment (ISITE) was established in 2006 in a campus located about 8 km away from the present campus. This has a large clean room and state-of-the-art electronics fabrication and test facilities for the assembly, integration and testing of communication satellites. URSC also has collaborative research and development programs with academic institutions/universities through ISRO-cells.

Major missions of the Centre:

Space science missions like Chandrayaan-1, Mars Orbiter Mission and Astrosat have put India in the global map. Space Astronomy Team along with Space Science Instrumentation Facility (SSIF) at URSC is involved in scientific research and instrumentation, in the areas of astronomy and astrophysics, solar physics, planetary science and space weather. SSIF also assists academic institutions/universities in the design, development and realization of space-worthy science payloads. The primary responsibility is to analyse scientific and technological requirements of identified proposals, converting the requirement into instrumentation, help them developing laboratory model of the payload, and oversee realisation of associated Qualification and Flight payloads. Through these activities, URSC provides domain expertise support for developing new scientific payload from laboratory model to qualification and flight model.

Communication
Communication Satellite provides the essential satellite based services comprising of Telecommunication,Television and Radio broadcasting, Meterorological imaging and weather forecasting, weather data collection and data dissemination, Disaster warning etc. For providing these services the space system has two segments viz. the space segment and the user ground segment. The space segment consists of the spacecraft at different orbital slots.

Deep Space Missions
A Deep Space / Interplanetary mission involves a trip to the planet/s of our solar system outside the earth utilizing Satellites, Lander Crafts and Rovers. Primary objective is to demonstrate technologies relating to communication, survival in deep space environments and on the planets, exploration of planets physical, chemical and atmosphere systems. Results from such explorations will help in understanding the planet's atmosphere, plan for inhabitation / colonization and advance detection of catastrophical aspects arising in the solar system such as sun storms, comets and meteorite strikes.

Science Missions
Scientific satellite missions focus on a detailed understanding of our universe. Astrosat, India's first dedicated multi wavelength space observatory, will observe universe in optical, ultraviolet, low and high energy X-ray regions of electromagnetic spectrum. Scientific objectives include understanding high energy process in binary star systems, estimating magnetic fields of neutron stars, studying star birth regions and high energy processes in star systems lying beyond our galaxy.

Earth observation
Main objective of earth observation satellites is to gather information about earth - physical, chemical and biological systems. Application of Earth observation satellites are primarily in the areas of cartography, oceanography, meterology, natural resource management & space science.

Experimental Satellites
Experimental satellites are designed for technology demonstration with smaller payloads. Examples are APPLE (Ariane Passenger PayLoad Experiment), RS-1 (Rohini Satellite) and Aryabhata.

Navigation
Satellite-based Navigation System provides positioning, navigation and timing (PNT) services to users across the world. India has entered into the arena of satellite navigation with its two major projects viz. GAGAN (GPS Aided Geo Augmented Navigation), & IRNSS (Indian Regional Navigation Satellite System). GAGAN is a space-based augmentation for GPS developed jointly by ISRO and Airports Authority of India (AAI) to meet the Civil Aviation Requirements. The functional performance and operational requirements of GAGAN shall be governed by the specifications as mentioned in the international standards. IRNSS is India's indigenous regional navigation system providing PNT services to users in the Indian region. The project envisages establishment of a regional navigational satellite system using a combination of GEO and GSO spacecrafts and state-of-the-art ground systems. The IRNSS System provides navigation solution all time with position accuracy better than 20 m during all weather conditions, anywhere within India and a region extending about 1500 km around India.

Students Satellites

Over the past few decades, several universities/academic institutions have participated in ISRO's space related programme. As part of this, several institutions were interested in introducing education in the space technology and subsequently space sciences have taken initiative and designed student satellites as well as developed payloads. In order to coordinate all the activities related to space technology projects by students in the academic institutions/universities, especially student satellites, ISRO/URSC has established a mechanism to streamline these activities in the form of small satellites. URSC has built and launched several small satellites in collaboration with academia and universities within/outside countries. ISRO has been encouraging student community to participate in ISRO missions and learn space technology as capacity building effort to prepare the future space scientists and technologists as well as to develop future vendors in this area, who can design develop, fabricate, test, space technology sub-systems and units for consumption within the country as well as to become competitors in the world market.

Laboratory for Electro-Optics Systems (LEOS)

Laboratory for Electro-Optics Systems (LEOS) situated at Peenya Industrial Estate, Bangalore was established in 1993. It is actively engaged in design, development and production of electro-optic sensors and camera optics for satellites and launch vehicles. Sensors include star trackers, earth sensors, sun sensors & processing electronics. Electro-optic sensors are used for attitude determination and navigation of Low Earth Orbit (LEO), Geosynchronous Earth Orbit (GEO) and inter planetary spacecrafts, landers and rovers. Optics both refractive and reflective of various dimensions is used for imaging and meteorological applications. Attitude sensors are star tracker, earth sensors, sun sensors, magnetometers and fiber optics gyroscope. Star trackers are highly accurate attitude sensors using charge coupled devices and active pixel sensors. Advanced version of this sensor with accuracy of 1 arc second is under development. In addition, micro star tracker and nano star tracker are under development for small satellites and nano satellites. Multi-spectral refractive optical systems with moderate and wide field-of-view lens assemblies such as linear imaging self-scanning sensor, advanced wide field sensor, hyper spectral imager, field corrector optics and terrain mapping camera have been developed and flown. Refractive optical elements for different versions of star tracker, navigation sensors and payloads have been designed and realized. Medium/high-resolution large-area light-weight telescope mirrors ranging from 200 mm to 705 mm have been developed which has given sub-meter resolution earth observation pictures. LEOS is also engaged in developing laser based payloads for scientific/interplanetary missions, thin film coatings for optics, detectors and micro electro-mechanical systems. Various optical coatings such as anti-reflection coating, reflection enhancement coating, filter coatings etc have been developed. Black absorber coating for star sensor baffle vanes, photo masks for different sun sensors and encoders are other contributions. In this laboratory, indigenous development of silicon photo-detector, micro coarse analogue sun sensor, immersed bolometer for earth sensor and MEMS inclinometer is also taking place.

8. 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

Proposal Preparation Format

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

9. Supported areas of research

Research proposals are supported by ISRO in any area of relevance to the space programme of which the following are few examples:

Space Science : Physics of the ionosphere and magnetosphere; meteorology, dynamics of the atmosphere; geophysics, geology; astronomy; cosmology; astrophysics; planetary and interplanetary space physics and climatology.

Space Technology : Rocket and satellite technology; propulsion systems design and optimization; aerodynamics and heat transfer problems related to space vehicles; guidance and control systems for launch vehicles and spacecraft; polymer chemistry, propellant technology; ultra-light-weight structure; satellite energy systems; space electronics, space communication systems; orbital mechanics, computer sciences and new material development.

Space Application : Remote sensing of earth's resources: space communication; satellite geodesy image processing, satellite meteorology including weather forecasting, Space Education and Ecology.

Keeping ISRO's space programme in mind, following thrust areas are suggested for research topics.

Aerospace

- Propellant formulation with ingredients of Nano size
- Droplet modelling in cryogenic injectors
- Mathematical modelling of liquid migration under Zero 'g' condition
- Modelling of plasma and its dynamics inside hollow cathode in Electric Thruster
- Electronics and signal processing of Ultrasonics used for spacecraft propellant gauging using Ultrasonic Flow meter
- Hydrazine dissociation model and thermal model for the monopropellant thruster
- Development of green propellants Amonium Di Nitramide (ADN), Hydroxyl Ammonium Nitride (HAN)
- Heat transfer characterization of kerosene with Aluminium Nano particles
- Characterization of Heat transfer parameters in Gel Propellant Engines
- Estimation of gaseous radiation for interplanetary missions
- Wing body reentry vehicle optimization studies
- Development of analytical tool for low thrust interplanetary mission trajectories
- Space Debris- setting up experimental set ups in ground lab level simulating space conditions
- Automated acoustic emission data analysis through ANN
- Micro machining of metals to provide low mass flow rates (>0.1 SCM) of Xenon gas for EPS application
- Metallurgical studies on Copper - Nickel dissimilar metals EB weld interface
- Development of vacuum brazing technique for joining carbon fiber reinforced Silicon Carbide (C-SiC) to Columbium and C-SiC to Titanium
- Development of ceramic material with higher electrical insulation at high temperature
- Development of materials / alloys including coatings for high pressure oxygen environment
- Development of graphene based sensors
- Development and characterization of oxygen, moisture and nitrogen absorber (non heating type)

- Theoretical & experimental evaluation of 3D weld porosity effects on integrety of welded structures (pressure vessels & thrust chambers)
- Development of thermal barrier coating with Nano materials
- Development of ceramic coating to prevent metal burning in high temperature and oxygen rich environment
- Physical property measurement at low temperature up to 20K
- Characterization of SS 321 at low temperatures: Study of phase transition relating to Strain rate & temperature
- Development of coating materials used in high temperature environment
- Laser ultrasonic for online EBW evaluation of Ti alloys

Material Sciences

- Experimental evaluation of damping in fluid conveying pipelines immersed in fluid environment
- Crack growth studies in propellant tanks through experiments & theoretical modeling
- Monitoring and assessment of EB weld of titanium, spot welding of aluminium inter-stages through acoustic emission
- Through thickness measurement of non-uniform residual stresses in metallic components
- Development of an algorithm and codes for measurement of non-uniform residual stresses in composite components using the method of incremental hole drilling
- Development of digital holographic microscope for MEMS characterization, deflection and shape measurement
- Thermal characteristics of PUF core sandwich for a temperature range of 600K
- Inter laminar shear stress evaluation of bonded structures
- Evaluation of acoustic characteristics polyamide foam for sandwich application
- Development of finite element software for inflatable structures
- Microgravity slosh analysis
- Dynamic modelling and analysis of human body exposed to vibration environment during space flight
- Visco-elastic structural analysis of solid propellant grains in the presence of voids
- Development of constitutive equations for Nano composites
- Fracture studies on textile composites
- Defect formation in steel and aluminium welds
- Microstructure and micro texture evaluation in age hardenable aluminium alloys
- Submicrostructure characterisation of Al-Li alloys
- Analysis of weld bead instability in the overlap zone of keyhole electron beam welds
- Ceramics for electromagnetic applications
- Oxidation behaviour of advanced high temperature coatings for super alloys and Ti-based intermetallic alloys
- Development of nano composite coatings for corrosion protection of light alloys such as aluminium and magnesium
- Oxidation behavior of cast superalloys and stainless steel
- Development of cast components in Ti-Al intermetallic base alloys
- Influence of pitting corrosion on the fatigue and fracture toughness of high strength aluminum alloys
- Development of aluminium nitride ceramic tapes for space electronic packaging applications

- Development of BaxSr1-xTiO3 tunable dielectric thin films prepared by pulsed laser deposition
- Study of defects in composites
- Development of Hydrogen Peroxide based propellant systems
- Development of software for modeling/simulation of mechanical/ballistic properties of solid rocket propellants
- Development of cubane and substituted cubanes for high energy & high density propellant
- Synthesis and scale up of energetic nitrate binders for solid propellants
- Modelling of polymer derived nanoceramics
- Development of bio-based polyurethane coatings
- Development of metal organic frameworks for the selective adsorption of gases like H_2, CO_2 and CO

Avionics

- Direct approach of generation for three phase motor driver by multi-level inverter with reduced computational complexity
- Custom ASIC design of asynchronous RISC processor
- Mixed signal ASIC
- Design, fabrication, testing and realization of a MEMS acoustic sensor
- Design, fabrication, testing and realization of a capacitive, MEMS accelerometer
- Design, fabrication, testing and realization of a MEMS shock sensor
- Design, fabrication, testing and realization of programmable high voltage power supply
- Design and analysis (static & dynamic) of a planetary rollerscrew
- Modeling, simulation, analysis and design of a controller for a robotic manipulator having five degree of freedom for lunar mission
- Fibre optic sensors
- Development of nano technology based gas sensor (both presence & % quantity)

Image processing and pattern recognition

- Relative radiometric normalization techniques
- Advanced image registration models/frameworks/software/libraries
- Image classification and intelligence
- Kernel based Learning/Machine Learning for change detection analysis
- Super resolution approaches for Remote Sensing Images
- Resolution enhancement approaches for scatterometer and radiometer data
- Automatic feature extraction and labeling techniques
- Noise modeling, blur removal
- Image representation
- Image based modeling and 3D re-construction
- Techniques for classification of hyper spectral images
- Techniques for textural feature extraction from multi-spectral and hyper spectral images

Atmospheric sciences

- Measurements of height profiles of electron density, electric field and neutral wind in equatorial F region
- Linking thunderstorm related dynamical forcing on upper atmosphere
- Measurements of upper mesospheric temperature and winds

- Three dimensional simulation of Rayleigh Taylor instability
- Modeling of equatorial electrojet
- Study of low latitude ionosphere applied to satellite based communication and navigation systems
- Study of Electro-dynamical and thermospheric processes leading to positive and negative ionospheric storms in low latitudes
- Modeling of atmospheric tides
- Numerical simulations of stratospheric sudden warming and their global influence
- Use / development of remote sensing techniques for high resolution real time monitoring of convective systems (thunderstorms, cyclones etc)
- Development of advanced techniques for conventional and satellite based data assimilation in weather and climate models
- Satellite weather image processing
- Development of low cost nephelometer
- Development of OH analyzer
- Study of cloud-aerosol interaction in fog/cloud chamber
- Understanding dynamical characteristics of Mesoscale convective systems and their association with energetics of atmosphere
- Understanding the link among surface fluxes, atmospheric boundary layer and clouds
- Understanding the rain processes (both at macroscale and microscale) at a regional level
- Radar signal processing
- Radar Data processing
- Improvements in satellite rain retrievals using advanced statistical or physics based algorithms
- Time dependent attenuator for lidar signal
- Development of a Fiber optic based IF filter for lidar to solve the problem of temperature dependence of filters
- Dual-polarized patch antenna for radar applications
- Design and development of Solid state TR modules for radar applications
- Ocean and weather modeling and Forecasting

Remote Sensing and GIS

- Multi-spectral data compression
- Information fusion methods for multi-sensor data
- Automated cloud detection algorithms
- Automation in aerial/HR data processing and DEM/feature extraction
- Data compression and archival
- Spatial modelling for peri urban areas
- Cognitive techniques in remote sensing data analysis
- Development of automatic feature extraction algorithms (water spread, snow cover, crop and vegetation etc.
- Hyperspectral remote sensing for water quality
- Ground water withdrawals using space data
- Altimeter data processing for estimation of water levels in lakes and rivers
- Estimation of snow depth, snow water equivalent and snow pack characterization
- Multi resolution segmentation approaches for classification of land use / land cover
- Forewarning of disasters

- Forewarning of crop stress
- Polarimetric decomposition techniques for classification of crop / vegetation types
- Interferometric water cloud model for vegetation height assessment
- Assessment of climate variation / change and its impacts using EO data
- Modelling (landslide susceptibility modelling and forecasting, glacier lake outburst flood modelling & snow avalanche modeling
- Greenhouse gases estimation
- Hydrological modeling
- Forest meteorology and ecosystem modeling
- Mangrove ecosystem analysis and its role in climate change
- Coral reef mapping and modeling
- Wetland ecosystem
- Integrated approach (including remote sensing inputs) for multi-crop assessment in sparse cropped regions
- The remote sensing techniques of crop assessment in hilly terrains/ high altitudes
- RS based indices/techniques for agro-ecosystems characterization/evaluation
- Applications of RS/GIS in horticulture studies
- Development of farming systems models with RS inputs/products
- Modelling soil carbon sequestration in relation to cropping systems and climate change

Rural development & developmental communication

- Mapping information and communication practices in the tribal areas
- A comparative study on media habits between rural and urban India
- Community's felt and perceived information needs in the agriculture and health sector
- Impact assessment of Edusat Network as supportive role in the field of formal education and teacher's training
- Benefits and challenges for outsourcing space projects
- Impact analysis of ISRO's space programs in rural and urban India
- Space Technology – need and expectation of society and present scenario study
- Demand assessment for future earth observation requirements
- Demand assessment for future communication services

SPPUP—200-9-2018 (373) [3\ISRO]

Scrutiny of New Research Proposals During 33rd PEC Meeting

ISRO-SPPU Space Technology Cell
Savitribai Phule Pune University
(formerly University of Pune)

Technical Presentation in PEC Meeting

New Research proposals presentation during
34th PEC Meeting

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