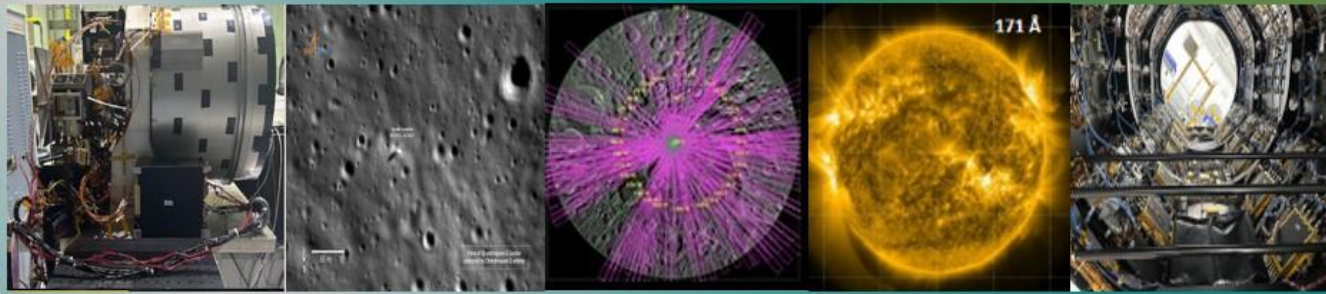
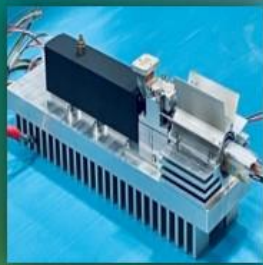
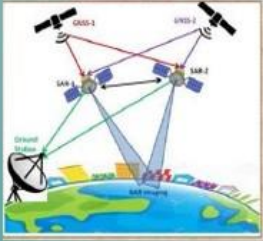


# रिसपांड बास्केट- 2024 RESPOND Basket 2024



## SAC Proposals

December 2024

रिसपांड एवं अनुसंधान प्रबंधन प्रभाग  
RESPOND and Research Management Division  
अंतरिक्ष उपयोग केंद्र, इसरो, अहमदाबाद  
Space Applications Centre, ISRO, Ahmedabad

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ISRO-SAC-TR-2024-056

# सैक रिसपांड बास्केट- शैक्षणिक संस्थानों हेतु अनुसंधान प्रस्तावों का गुलदस्ता

## SAC RESPOND BASKET 2024 *A Bouquet of Research proposals for Academia*

December 2024

रिसपांड एवं अनुसंधान प्रबंधन प्रभाग  
RESPOND and Research Management Division  
अनुसंधान, बाह्यसंपर्क एवं प्रशिक्षण प्रबंधन समूह  
Research, Outreach and Training Management Group  
प्रबंधन एवं सूचना प्रणाली क्षेत्र/ Management and Information Systems Area  
अंतरिक्ष उपयोग केंद्र, इसरो/ Space Applications Centre, ISRO

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एन एम देसाई / N M Desai  
विशिष्ट वैज्ञानिक / Distinguished Scientist  
निदेशक / Director



सत्यमेव जयते

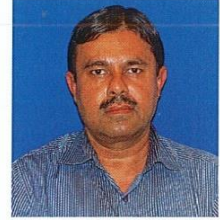
भारत सरकार GOVERNMENT OF INDIA  
अंतरिक्ष विभाग DEPARTMENT OF SPACE  
अंतरिक्ष उपयोग केंद्र  
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## Foreword

'Sponsored Research' 'RESPOND' Programme initiated in early 1970s has come a long way as one of the flagship programmes of ISRO with the primary objective of encouraging academia to participate and contribute in various space science and technology related research activities supporting the Indian Space Programme. 'RESPOND BASKET' is an initiative that underscores ISRO's unwavering commitment towards fostering innovation, collaboration and scientific advancements in Space Science, Technology and Applications with Academia participation.

Space Applications Centre (SAC) is one of the major Centres of ISRO with strong emphasis on R&D being pursued through intellect and experience of our Scientists/Engineers. It is with immense pride and joy that we present the 'RESPOND BASKET OF SAC-2024' comprising of 45 research topics curated by multidisciplinary technical teams at SAC. These brief proposals encompassing domains like Advanced Technologies including Quantum communications, small UAV for moving platform for QKD application, Antenna systems, Satellite Navigation, Electro-optical sensors, GNSS remote sensing, Earth Observation applications, Planetary Sciences, Image processing, Space grade material development, Social Research and Research management etc. as well as Human Space Programme related activities, being pursued at SAC. Each proposal includes a summary of proposed research, scope, programme linkage to SAC/ISRO activities and expected deliverables. The contact details of our SAC Focal Points are provided for discussion or any queries regarding proposal formulation and submission.

We believe "RESPOND BASKET OF SAC- 2024" is an intense and systematic attempt for soliciting research proposals from academia across the country. This bouquet of R&D topics reflects our ambitions and efforts towards inclusive R&D with academia participation. At SAC, we believe in pushing boundaries, overcoming challenges and continually expanding the horizons of Space Science, Technology and Applications.

We warmly invite academia intellect to enthusiastically participate and join hands with SAC to accelerate Nation's development through Indian Space Programme.



(एन एम देसाई) / (N M Desai)

निदेशक / Director

भारतीय अंतरिक्ष अनुसंधान संगठन



INDIAN SPACE RESEARCH ORGANISATION

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## General Instructions

1. RESPOND BASKET comprises of the most urgent and important research problems identified by Space Applications Centre (SAC) ISRO Ahmedabad on the basis of ISRO's upcoming programmatic R&D requirements. Each research problem comprises of a brief write-up about the topic for the faculty of the academic Institutions/R&D laboratories other than the Space Technology Cells (STCs) and Regional Academic Centre for Space (RAC-S) to select and prepare the proposals.
2. An individual or group(s) of scientists / faculty members affiliated to any academic institution/autonomous R&D institutions are eligible for **submitting the proposals through "I-GRASP" online portal (ISRO GRant in Aid for Space Research Programmes)** → Link <https://igrasp.isro.gov.in/>. Screenshot of "**I-GRASP**" online portal is given in the **Annexure -1**. The portal invites proposals from academia. The PIs from the academic institutions based on their area of interest and expertise select and submit the research proposals through this portal, where the entire process will be carried out through this portal.
3. The Principal Investigator(s) should be a full-time employee(s) of the concerned institution.
4. Principal Investigator shall be a domain expert in the area to which the proposal belongs and the list of publications to be uploaded in the portal at the time of submission of proposal. There may also be co-investigator(s) from the same/different institution(s) working on the project. But satisfactory completion of a project will be the responsibility of the Principal Investigator and the institution involved.
5. The age limit for the Principal Investigator is below 65 years (sixty-five) including the project period. Proposals from individuals not affiliated to any recognized institution/ R & D institutions will not be considered.
6. The signed "Declaration Form" shall be uploaded in the portal at the time of submission of proposal in the prescribed format. Format is given in the **Annexure -2**.
7. For other information regarding terms and conditions of ISRO Grants, details on research fellowships and Guidelines governing the allocation of funds etc., please visit ISRO website (<https://www.isro.gov.in/SponsoredResearch.html>).
8. The last date for submitting the proposals online under "RESPOND BASKET-2024' is **January 31, 2025**.
9. The submitted proposal will be subjected to critical evaluation by the ISRO/DOS Centre experts. The proposal will be evaluated on the basis of novelty, methodology, approach, experience of the PI in the subject area, duration of the project, budget etc.

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## Document Control Sheet

1.	Report No.	ISRO-SAC-TR-2024-056
2.	Title	सैक रिसपांड बास्केट- शैक्षणिक संस्थानों हेतु अनुसंधान विषयों का गुलदस्ता RESPOND BASKET OF SAC - <i>A Bouquet of Research Topics for Academia</i>
3.	Type of Report	Technical Report
4.	No. of Pages	100
5.	Authors	SAC / ISRO Team. Compiled by Smt. Ankita Patel and Dr. Abha Chhabra
6.	Originating Unit	RESPOND & Research Management Division (RRMD), Research, Outreach and Training Management Group (RTMG), Management and Information Systems Area (MISA), Space Applications Centre (ISRO), Ahmedabad.
7.	Abstract	This document is a bouquet of 45 project topics encompassing different facets of Advanced Technologies including Quantum Communications, small UAV for moving platform for QKD application, Antenna systems, Satellite Navigation, Electro-optical sensors, GNSS remote sensing, Earth Observation applications, Planetary Sciences, Image processing, Space grade material development, Social Research and Research management etc.
8.	Security Classification	Unrestricted
9.	Distribution	General

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## List of SAC RESPOND Basket 2024 Proposals

Sr. No.	SAC RB 2024 Proposal ID	Research Title	SAC Co-PI Name	Area of Research
1.	RES-SAC-2024-001	Development and Realization of GNSS Remote Sensing Signal Simulator	Shri. Pramod	Navigation, Remote Sensing, Signal Processing
2.	RES-SAC-2024-002	Feasibility of Polar CODEC for Satellite Navigation System	Shri Neeraj Mishra, Dr. Deepak Mishra	Navigation & Channel coding
3.	RES-SAC-2024-003	Advances in Numerical Weather Prediction (NWP) Modelling using AI/ML Techniques	Dr. Prashant Kumar	Weather forecasting, Data assimilation, Machine learning
4.	RES-SAC-2024-004	Investigation of microphysical processes within tropical cyclones using satellite data to predict TC rapid intensification	Dr. Neeru Jaiswal	Tropical cyclone analysis and forecasting
5.	RES-SAC-2024-005	Design, development and characterization of an autonomous ornithopter (Flapping wing UAV) technology demonstrator	Shri Pradeep Ananthanarayanan	Autonomous Powered flight on planets with atmosphere
6.	RES-SAC-2024-006	Design and Implementation of a cryptographically secure random number generator (CSPRNG)	Smt. Sugandh Mishra, Shri Deval Mehta	Navcom Technology, Satellite Navigation
7.	RES-SAC-2024-007	Thermal Analysis and lifetime estimation of AlGaIn-GaN HEMTs	Shri Prakhar Kumar Srivastava, Dr. Rakeshkumar K Kaneriya	High Frequency Semiconductors for Communication and Remote Sensing
8.	RES-SAC-2024-008	Design and Development of Algorithm for matching LiDAR intensity image with DEM and optical images	Shri K. Suresh, Shri Kannan V. Iyer, Shri Amitabh	Computer Vision
9.	RES-SAC-2024-009	Controlled Radiation Pattern Antennas for Anti-jamming GNSS Terminals	Shri Kaushik Kannan, Shri Rohit Kumar Nandwani, Dr. Ramesh Chandra Gupta	Microwave Antennas for Navigation
10.	RES-SAC-2024-010	Abnormalities detection in endpoint logs using AI	Shri Pravin K Choudhary, Shri Rohit Tyagi, Shri Yogesh Verma	Fine tuning of language models to detect log abnormalities
11.	RES-SAC-2024-011	Diffusion of GIS in Urban Planning and Development: A Sociological Perspective	Dr. Narayan Mohanty, Ms. Sini Susan Varghese, Dr. Abha Chhabra	Social Research & Management
12.	RES-SAC-2024-012	Design and development of reconfigurable photonic beam former for future scan-on-receive (SCORE) based synthetic aperture radar (SAR).	Shri. Nitesh Sharma Dr. Piyush Sinha	Photonic Integrated Circuit (PIC)

Sr. No.	SAC RB 2024 Proposal ID	Research Title	SAC Co-PI Name	Area of Research
13.	RES-SAC-2024-013	Self cleaning/dust repellant coatings on optical surfaces	Dr. B Narasiha Sharma, Shri Nitesh Thapa	Optical surface coating
14.	RES-SAC-2024-014	System design of Satellite Based Narrow-band Internet of Things	Shri Pawan Kumar Barnwal	Satellite communication/wireless communication, communication networks
15.	RES-SAC-2024-015	Development of nowcasting tool for extreme weather events (thunderstorms and cloud burst) using surface and satellite measurements over orographically complex region of India.	Dr. Neerja Sharma	Atmospheric Sciences
16.	RES-SAC-2024-016	Design and Development of high sensitivity InGaAs PIN-type in the SWIR range photodetector to provide fine pointing	Shri Nishant Kumar, Dr. Hari Shanker Gupta	Sensors
17.	RES-SAC-2024-017	Design and Implementation of algorithms for stand-alone onboard real-time orbit determination of LEO satellites with sub-meter accuracy	Smt. Saumi S., Shri Rohan Urdhwarshhe	Satellite Navigation
18.	RES-SAC-2024-018	Design and Development of Digital Coded Metasurface Antenna for Adaptive Beamforming Applications	Shri Kashish Grover, Shri Devendra Kumar Sharma	Unit Cell Design, Cost Effectiveness, Active Components Integration, Generating codes for digital coded met surface elements, FPGA implementation for dynamic reconfiguration of antenna, Machine Learning algorithms implementation for design optimization.
19.	RES-SAC-2024-019	Design and Development of vibration isolation system with hybrid D-struts for space payloads	Shri. Numan Ahmad, Shri. Naimesh R. Patel	Structures, Vibration Isolation
20.	RES-SAC-2024-020	Advanced Persistent Threats, Breach and Botnet Detection system using network traffic analysis	Shri Rohit Tyagi, Shri Pravin K Choudhary, Shri Chitraksh Vyas	Network Security
21.	RES-SAC-2024-021	Design and development of Comprehensive Research Evaluation Tool for enhancing Collaborative and Sponsored Research Management	Smt. Ankita Vishal Patel, Dr. Abha Chhabra	Research Management
22.	RES-SAC-2024-022	RFCMOS based Wideband Voltage Controlled Oscillators @ L,S,C,X and Ku-Band	Shri. K. S. Arjun Ms. Srishti Srivastava	RF and Microwave

Sr. No.	SAC RB 2024 Proposal ID	Research Title	SAC Co-PI Name	Area of Research
23.	RES-SAC-2024-023	On-chip nano wire grid fabrication for polarization sensing	Shri Ashwani Kumar	Electro-Optical Sensor Technology
24.	RES-SAC-2024-024	High Data rate Channel codec architecture for free space classical RF and optical communication	Dr. Deepak Mishra	Communication and optical communication
25.	RES-SAC-2024-025	Study of the Earth-Atmosphere radiation budget and its linkage to atmospheric feedback processes	Dr. Manoj Kumar Mishra	Earth's Climate
26.	RES-SAC-2024-026	Reconstruction of high resolution historical sea-level data using coarse resolution altimeter and high resolution observations from Surface Water and Ocean Topography (SWOT) mission.	Shri Aditya Chaudhary, Dr. Neeraj Agarwal	Satellite Oceanography
27.	RES-SAC-2024-027	Integrated Pseudolite & Satellite Based system for Lunar Navigation	Dr. Ashish K Shukla	Navigation
28.	RES-SAC-2024-028	Development of Superconducting Magnet for Space-borne sub-Kelvin Cooler (ADR)	Shri Vivek Kumar Singh, Shri Sandip R Somani, Shri Rakesh R Bhavsar	Cryogenics
29.	RES-SAC-2024-029	Development of a MATLAB Tool for antenna diagnostics using amplitude only field measurement and source reconstruction method	Shri Yogesh Tyagi, Shri Akula Ramu, Shri Sanjeev Kulshreshta	Source reconstruction method, Antenna Diagnostics, Phaseless antenna radiation pattern measurement, Phase retrieval algorithms
30.	RES-SAC-2024-030	Development of Space Grade Carbon Allotropes Materials by 3D Print Manufacturing Technology	Shri Ravi Kumar Varma	Materials
31.	RES-SAC-2024-031	Development of process for realization of seamless ultra-thin wall round tubes	Shri Rajat Patel, Shri Jigar Patel	Manufacturing
32.	RES-SAC-2024-032	Specialized language models deployable on end points with low compute resources	Shri Gulshan Gupta	AI/ML Technologies (Transformers, Language Models)
33.	RES-SAC-2024-033	Advanced Compression Techniques for SAR raw data.	Dr. Ameya Anil Kesarkar, Shri Vetel Akshay Pandit, Shri.Yogendra Sahu	Scalar & Vector Compression of SAR data
34.	RES-SAC-2024-034	Design and development of Distributed feedback laser (DFB)	Shri Nitesh Thapa, Shri K Ajay Kumar	High energy LASERS for LIDAR applications
35.	RES-SAC-2024-035	Design, Development & Dynamic Characterization of Multi-rotor Small UAV for Moving platform QKD application	Shri Pradeep Ananthanarayanan	Drones

Sr. No.	SAC RB 2024 Proposal ID	Research Title	SAC Co-PI Name	Area of Research
36.	RES-SAC-2024-036	Air bearing based platform to mimic microgravity experiments on earth for a propulsion module.	Shri Arvind Singh	Propulsion, navigation, structures Mechatronics
37.	RES-SAC-2024-037	Design and development of RF ASIC for SFCW ground penetrating radar	Shri. Ravi Khatri Dr. Piyush Sinha	Radio frequency integrated circuit (RFIC)
38.	RES-SAC-2024-038	Wide band wide beam circularly polarized antenna for Spectrum Monitoring Applications	Shri Mohit Anand, Shri Shibasish Prusty, Shri Alok Kumar Singhal	Microwave & Antenna Engineering
39.	RES-SAC-2024-039	Optical Beam Steering Photonic Chip for Lidar	Shri. Neeraj Keshav Dubey	Photonic Lidar Optical Beam Steering
40.	RES-SAC-2024-040	Development of metallized Graphite electrodes	Shri Ramagiri Santhosh Kumar, Smt. Shilpi Soni	Metallization on graphite for braze ability
41.	RES-SAC-2024-041	Acoustic Monitoring System	Shri Anurag S Verma, Shri Savit Anantharm	Sensors and processing
42.	RES-SAC-2024-042	Characterization of Polymeric Materials for Human Space Missions from Human Rating Aspects	Shri Prateek Bansal, Shri Divyanshu Singh, Shri Ravi Kumar Varma, Shri Amit Kumar Gupta	Polymeric Materials
43.	RES-SAC-2024-043	Custom Voice Command Identification	Shri Saket Chawla, Shri Ansuman Palo	Artificial Intelligence
44.	RES-SAC-2024-044	AI/ML based airborne LiDAR full waveform data processing for noise, feature extraction and annotation	Shri Sandip Paul Shri Jimit j Gadhia	Optics: Active remote sensing, airborne LiDAR
45.	RES-SAC-2024-045	Water quality monitoring System for microgravity environment	Shri Anurag S Verma, Mr. Priyesh Kumar Jain	Sensors



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## RES-SAC-2024-001: Development and Realization of GNSS Remote Sensing Signal Simulator

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development and Realization of GNSS Remote Sensing Signal Simulator</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Pramod
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail: <a href="mailto:pramodkm123@sac.isro.gov.in">pramodkm123@sac.isro.gov.in</a> Phone: 079-2691 5240
5.	Area of Research	Navigation, Remote Sensing, Signal Processing
6.	<b>Summary of the proposed research</b>	<p>Earth Observation (EO) techniques using Global Navigation Satellite System (GNSS) signals of opportunity such as GNSS-Reflectometry (GNSS-R) are gaining popularity in the recent years. It is a relatively new passive remote sensing technique that measures GNSS signals reflected over the earth's surface to measure key parameters of ocean, land, and ice surfaces.</p> <p>In order to test GNSS RS signal reception with configurable scenarios, a GNSS (direct signal) and GNSS-RS(reflected signal) signal generator is required with the capability to simulate navigation messages to allow positioning, as well as simulating any user-defined, direct and reflected path with satellite handovers. This capability to simulate specular and scattered reflections is required to test the delay-Doppler map (DDM) calculations in the GNSS RS Receiver.</p> <p>The proposed work involves modeling of the direct navigation signal &amp; and the corresponding reflected signal, received at LEO satellite in the operational scenario of a GNSS Remote Sensing spacecraft.</p> <p>The developed simulator should have the following capabilities :</p> <ol style="list-style-type: none"> <li>1. GPS L1 C/A and IRNSS SPS signal generation with proper Ephemerides and Almanac information</li> <li>2. GNSS transmitting and receiving LEO satellites orbit simulation;</li> <li>3. Any user-defined path should be able to be uploaded, either on the Earth or in orbit, with as much temporal resolution as necessary</li> </ol>

		<ol style="list-style-type: none"> <li>4. Estimation of location of the specular reflection point and glistening zone (area where scattered power is collected);</li> <li>5. reflected surface scattering coefficient generation based on geophysical parameters</li> <li>6. It shall be able to model and generate both direct and reflected signals, on rough or smooth surfaces incorporating tropospheric and ionospheric effects on both direct and reflected signal.</li> <li>7. Graphical input/output user interface (GUI).</li> <li>8. Generation of IF/RF direct and reflected navigation signals</li> </ol>
7.	<b>Scope of the proposed research</b>	<p>Modeling of the Navigation signal with ionospheric effects</p> <p>Modeling of the reflected signal with surface properties, spacecraft dynamics, tropospheric and ionospheric effects.</p> <p>Porting of the models on suitable Hardware to generate physical direct and reflected signal with defined parameters</p>
8.	<b>Linkages to Space Programme</b>	GNSS Remote Sensing
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Signal Generation models</li> <li>• Software Signal Simulator</li> <li>• Hardware Signal Simulator</li> <li>• Documentation</li> </ul>



## RES-SAC-2024-002: Feasibility of Polar CODEC for Satellite Navigation System

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Feasibility of Polar CODEC for Satellite Navigation System</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Neeraj Mishra Dr. Deepak Mishra
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:neerajsci@sac.isro.gov.in">neerajsci@sac.isro.gov.in</a> Phone: 079- 2691 8233/8232  E-mail : <a href="mailto:deepakmishra@sac.isro.gov.in">deepakmishra@sac.isro.gov.in</a> Phone: 079- 2691 8790/8233/8234
5.	Area of Research	Navigation & Channel coding
6.	<b>Summary of the proposed research</b>	<p>The Global Navigation Satellite System (GNSS) relies on Forward Error Correction (FEC) to ensure reliable data transmission, especially in challenging low Signal-to-Noise Ratio (SNR) conditions. Recently, NAVIC has adopted Low-Density Parity-Check (LDPC) codes. The reliability of these systems heavily depends on the performance of the chosen channel codes.</p> <p>Among the emerging FEC alternatives is the Polar code, introduced by Erdal Arikan in 2008. Polar codes are a class of error-correcting codes known for their capacity-achieving characteristics and systematic construction, which allow them to approach the Shannon limit for reliable communication. Notably, Polar codes overcome the error floor problem commonly associated with short-length block codes, often used in navigation systems. Their recent implementation in the control channels of 5G systems further demonstrates their potential.</p> <p>This research aims to assess the feasibility of utilizing Polar codes in navigation systems, specifically evaluating their performance compared to existing channel codes employed in NAVIC. The study will focus on developing Polar codes tailored for GNSS applications and conducting a thorough performance evaluation to compare their effectiveness against currently used LDPC codes.</p>

		By investigating these aspects, this research intends to provide valuable insights into enhancing the reliability and efficiency of GNSS communications, which could lead to improved positioning accuracy and overall system performance. The goal is to establish Polar codes as viable candidates for future GNSS systems.
<b>7.</b>	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Feasibility analysis of Polar codes for short frame length.</li> <li>• Arriving at suitable constituent codes for applications and hence design an encoder.</li> <li>• Developing an efficient decoding algorithm to improve the coding gain</li> <li>• Hardware realization of a low complex encoder and reliability-based decoder.</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	Next Generation NavIC Program
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Optimum Polar codes with hardware implementation of encoder and decoder</li> </ul>

## RES-SAC-2024-003: Advances in Numerical Weather Prediction (NWP) Modelling using AI/ML Techniques

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Advances in Numerical Weather Prediction (NWP) Modelling using AI/ML Techniques</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Prashant Kumar
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:prashant22@sac.isro.gov.in">prashant22@sac.isro.gov.in</a> Phone: 079-2691 6050
5.	Area of Research	Weather forecasting, Data assimilation, Machine learning
6.	<b>Summary of the proposed research</b>	<p>The accuracy of short-range weather forecasts from high-resolution NWP models can be affected by factors such as surface heterogeneity, data assimilation techniques, and uncertainties in model physics.</p> <p>To address these issues, the proposed research aims to utilize machine learning (ML) techniques alongside modern atmospheric modeling advancements. By integrating ML, we can improve the predictive capabilities of traditional NWP models, enabling more accurate and reliable forecasts. Machine learning algorithms can identify complex patterns in large datasets, helping to tackle surface heterogeneity and enhance data assimilation.</p> <p>Additionally, ML models can continuously adapt and learn from new data, refining predictions and minimizing errors. This integration not only aims to boost forecast accuracy but also facilitates real-time updates during rapidly changing weather conditions.</p> <p>Overall, this research seeks to advance short-range weather forecasting, enhancing our understanding of weather dynamics and improving forecast reliability for various applications.</p>
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>The proposed research aims to enhance NWP model predictions using AI/ML techniques. These methods can be employed to develop observation operators for assimilating new (e.g. visible radiance assimilation) data, correcting model biases, improving assimilation techniques, refining post-processing, etc.</li> </ul>

		<ul style="list-style-type: none"> <li>By integrating AI/ML approaches, the research seeks to increase the accuracy and reliability of weather forecasts, ultimately contributing to better decision-making in various applications.</li> </ul>
8.	<b>Linkages to Space Programme</b>	<p>This research aims to enhance short-range weather forecasts by integrating ML techniques with high-resolution NWP models and ISRO satellite data from INSAT-3DS, TRISHNA, etc.</p> <p>By leveraging ML, we can improve data assimilation, address surface heterogeneity, and provide more accurate and timely weather predictions for various applications.</p>
9.	<b>Expected deliverables</b>	<p>The deliverable include enhanced short-range weather forecasts, improved data assimilation techniques, insights from satellite observations, and a comprehensive evaluation of model accuracy and reliability.</p>

## **RES-SAC-2024-004: Investigation of microphysical processes within tropical cyclones using satellite data to predict TC rapid intensification**

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Investigation of microphysical processes within tropical cyclones using satellite data to predict TC rapid intensification</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Neeru Jaiswal
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5.	Area of Research	Tropical cyclone analysis and forecasting
6.	<b>Summary of the proposed research</b>	Tropical cyclone (TC) rapid intensification (RI) is the most challenging problem at present, which lead to uncertainty in the TC intensity prediction. Thus to improve the TC intensity forecast, it is highly important to understand the various dynamical and microphysical processes modulating the intensity of TCs. Satellite data is a primary input for deriving the TC intensity and structural parameters. The geostationary satellite generated thermal IR, water vapor and visible channel images provides the signatures of TC characteristics and are being used for TC intensity estimation world-wide. The cloud top characteristics of north Indian ocean (NIO) cyclones are observed by every half an hour image from INSAT-3D/3DR/3DS. These images can be labelled with the cyclone geolocation and intensity values archived in the cyclone best track data and trained in a deep learning based models to detect the TC-RI. Other advanced microwave satellite data can also be explored to investigate the processes within the cloud system responsible for TC-RI. The developed trained neural network can be used to predict TC-RI in the real-time using satellite imageries.
7.	<b>Scope of the proposed research</b>	Real-time satellite based indicators to predict TC rapid intensification.
8.	<b>Linkages to Space Programme</b>	Disaster Management Support Programme (DMSP)
9.	<b>Expected deliverables</b>	ANN based model to be used during real-time TC intensity analysis and prediction.

## RES-SAC-2024-005: Design, development and characterization of an autonomous ornithopter (Flapping wing UAV) technology demonstrator

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design, development and characterization of an autonomous ornithopter (Flapping wing UAV) technology demonstrator</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Pradeep Ananthanarayanan
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:pradeepa@sac.isro.gov.in">pradeepa@sac.isro.gov.in</a> Phone: 079-2691 2231/2233/2249
5.	Area of Research	Autonomous Powered flight on planets with atmosphere
6.	<b>Summary of the proposed research</b>	<ul style="list-style-type: none"> <li>• Configuration and Design of a powered ornithopter UAV that is capable of housing small video camera capable of streaming live video.</li> <li>• Software/firmware development as required to meet the requirements.</li> <li>• Integration of NAVIC for accurate positioning.</li> <li>• Manufacturing assembly, integration and initial operation of the UAV.</li> <li>• Dynamic Characterization (vibrations, drift, landing shocks etc.) of the UAV using variety of sensors like accelerometers, gyros inclinometers etc.</li> </ul>
7.	<b>Scope of the proposed research</b>	Configuration and Design of a powered ornithopter UAV that is capable of housing small video camera capable of streaming live video. Failure mode effect and criticality analysis of the UAV design. The UAV shall have in-built failure tolerant and fail safe safety features. It shall adhere to ingress rating of at least IP65 while IP67 is desirable.
8.	<b>Linkages to Space Programme</b>	UAV Research & Navigation
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Ornithopter UAV with payload capacity to carry small video camera.</li> <li>• Accessories of UAV like remote controller, master computer (laptop) with required software/firmware, charging cables, spare batteries, antenna etc.</li> <li>• Raw Data acquired during dynamic characterization of UAV.</li> <li>• Anything else that is necessary to satisfactorily operate and maintain the UAV.</li> </ul>



## RES-SAC-2024-006: Design and Implementation of a cryptographically secure random number generator (CSPRNG)

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Implementation of a cryptographically secure random number generator</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Smt. Sugandh Mishra Shri Deval Mehta
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5.	Area of Research	Navcom Technology, Satellite Navigation
6.	<b>Summary of the proposed research</b>	<p>This project aims at design of an algorithm for a cryptographically secure random number generator, its performance analysis and its software and hardware implementation.</p> <p>CSPRNG are different from a PRNG in a way that CSPRNG are designed to be more resilient to attacks and their outputs are unpredictable in nature making them suitable to cryptographic applications.</p>
7.	<b>Scope of the proposed research</b>	<p>CSPRNG are usually designed using cryptographic primitive. Scope of project includes design and implementation of a CSPRNG algorithm with following desired characteristics-</p> <ul style="list-style-type: none"><li>• Forward security</li><li>• Backward security</li><li>• Uniform distribution of output numbers</li><li>• Resistance to state compromise</li><li>• Efficient re-seeding mechanism</li><li>• Statistically robust – must pass suite of randomness such as NIST, diehard Tests etc.</li><li>• Input Entropy assessment</li><li>• Implementation and demonstration of Algorithm in software as well as in hardware such as in an FPGA while performance consideration such as power and resource consumption is to be taken into account</li></ul>
8.	<b>Linkages to Space Programme</b>	CSPRNG are utilized in various security protocol such as encryption, encryption key generation, digital signature and authentication.

		Designed CSPRNG can be utilized in different ISRO projects including navigation signal authentication ,encryption key generation for secure communication , signal encryption etc.
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Designed CSPRNG algorithm, its mathematical modelling and technical details</li> <li>• Functionally Tested software: source code and executables in C / python or MATLAB</li> <li>• FPGA implementation: Functionally tested HDL source code of the design</li> <li>• Installable controller software on any supported Windows PC along with manual.</li> </ul>

## RES-SAC-2024-007: Thermal Analysis and lifetime estimation of AlGaIn-GaN HEMTs

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Thermal Analysis and lifetime estimation of AlGaIn-GaN HEMTs</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Prakhar Kumar Srivastava Dr. Rakeshkumar K Kaneriya
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5.	Area of Research	High Frequency Semiconductors for Communication and Remote Sensing
6.	<b>Summary of the proposed research</b>	<p>AlGaIn/GaN based HEMTs offer exceptional high power density at high frequencies. However, this comes at the cost of increased power dissipation in a very small area and associated self-heating effects. Elevated temperatures can lead to increased degradation and failure rates, and a reduction in output power performance.</p> <p>Therefore, an accurate method of estimating the device temperature, through modeling and analysis is essential. This typically, shall be done, in a phased manner. In the first phase, a baseline electrical model of the device, shall be developed, to predict device temperature. The device shall then be fabricated and measurements (IR and MicroRaman) shall be carried out on the fabricated device to derive empirical data. Using empirical data, an FEA model shall be developed. This FEA model shall then be used to accurately predict device temperature for different device geometries.</p> <p>This model shall also be used to predict the lifetime of the devices by simulating the thermal performance at specified elevated temperatures.</p> <p>The heterostructure details, device geometry and ambient conditions, for the above work, shall be provided by SAC.</p>

<b>7.</b>	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Thermal Analysis of AlGa<sub>N</sub>/Ga<sub>N</sub> on SiC HEMTs</li> <li>• Development of model for channel temperature prediction in AlGa<sub>N</sub>/Ga<sub>N</sub> on SiC HEMTs</li> <li>• Lifetime estimation of AlGa<sub>N</sub>/Ga<sub>N</sub> on SiC HEMTs</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	Communication, Navigation and Microwave Remote Sensing payloads of SAC/ISRO
<b>9.</b>	<b>Expected deliverables</b>	Model for channel temperature prediction in and lifetime estimation in AlGa <sub>N</sub> /Ga <sub>N</sub> on SiC HEMTs

## RES-SAC-2024-008: Design and Development of Algorithm for matching LiDAR intensity image with DEM and optical images

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Development of Algorithm for matching LiDAR intensity image with DEM and optical images</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri K. Suresh, Shri Kannan V. Iyer, Shri Amitabh
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5.	Area of Research	Computer Vision
6.	<b>Summary of the proposed research</b>	Design and Development of an Algorithm for matching LiDAR intensity image (depth map) of an area acquired in real-time with the reference Digital Elevation Model (DEM) and/or optical image of that area acquired beforehand.  The reference DEM and optical image generally will be of a bigger area of coverage and the LiDAR depth map will be a subset of that. It should be noted that the acquired LiDAR depth map will have scale difference, translation, and rotation with respect to reference DEM and optical images. The reference DEM and the optical image will be of a certain fixed scale, north-oriented, and associated geo-coordinates.
7.	<b>Scope of the proposed research</b>	Development of an algorithm and required software modules to be implemented in commercial FPGA hardware. Scope restricts to the development of an algorithm for correspondence between LiDAR depth map with reference DEM and/or optical images. For testing the approach, the existing LiDAR data and optical images of the Earth/Lunar/Mars planet surface can be used.

<b>8.</b>	<b>Linkages to Space Programme</b>	Interplanetary Landing Missions, like Lunar and Mars landing missions
<b>9.</b>	<b>Expected deliverables</b>	Commercial FPGA hardware, on-board software, ATBD document and documents covering design and implementation details of algorithms in FPGA hardware.



## RES-SAC-2024-009: Controlled Radiation Pattern Antennas for Anti-jamming GNSS Terminals

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Controlled Radiation Pattern Antennas for Anti-jamming GNSS Terminals</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Kaushik Kannan Shri Rohit Kumar Nandwani Dr. Ramesh Chandra Gupta
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5.	Area of Research	Microwave Antennas for Navigation
6.	<b>Summary of the proposed research</b>	<p>Jamming and interference can drastically degrade the GNSS position, navigation and time availability even to the extent of complete cease in service. The low power GNSS signals from space are overpowered by the excessive noise generated by the jammers, which consequently saturates the user GNSS receiver front-end.</p> <p>The anti-jamming terminals have the capability to find the direction of interference and have the ability to mitigate this interference by creating nulls in the antenna pattern in the direction of the interference. Generally, these terminals are capable of mitigating interference from multiple jammers. The number of simultaneous nulling direction depends on the number of radiating elements used in the terminal. This generally creates a compromise between the size of the terminal and the number of simultaneous nulling possible.</p> <p>In addition of anti-jamming function, these terminals must also provide consistent RF performance across the band and good GNSS tracking performance. The terminal should have the capability of tracking satellites even at low elevation.</p>

		Since majority of the GNSS providers operate in L5 band and L1 band, these terminals should cater to these frequencies.
<b>7.</b>	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Antenna array design</li> <li>• Development of algorithm for generating optimum excitation for generating nulls in the direction of multiple simultaneous interference</li> <li>• Development of algorithm for automatic detection of interference direction</li> <li>• Development of control system for automatic detection and adaptive nulling based on interference directions</li> <li>• Design of active circuit integrated with the array antenna</li> <li>• Demonstration of anti-jamming capability</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	Anti-jamming GNSS Terminals for Strategic Users
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Antenna array integrated with active circuit</li> <li>• Control system for automatic detection and adaptive nulling of multiple simultaneous interference sources</li> </ul>

## RES-SAC-2024-010: Abnormalities detection in endpoint logs using AI

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Abnormalities detection in endpoint logs using AI</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Pravin K Choudhary Shri Rohit Tyagi Shri Yogesh Verma
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5.	Area of Research	Fine tuning of language models to detect log abnormalities
6.	<b>Summary of the proposed research</b>	<p>The proposed project aims to explore the use of Artificial Intelligence (AI), specifically Large Language Models (LLM) or Small Language Models (SLM), for proactive monitoring and detection of abnormalities in endpoint logs. With the increasing complexity of IT infrastructures, endpoint logs (such as system, application, and security logs) are crucial for identifying operational anomalies, security threats, and performance issues. Traditional methods of log analysis rely on manual inspection or rule-based systems, which can be time-consuming, error-prone, and ineffective at scaling with the volume and complexity of modern log data. This research intends to leverage LLMs or SLMs, which have demonstrated advanced capabilities in natural language understanding and pattern recognition, to automatically process and analyze vast amounts of endpoint log data in real-time. The AI models will be trained to identify deviations from normal behavior by recognizing patterns, correlating log events, and detecting anomalies such as unusual login attempts, system misconfigurations, or suspicious network activity. The primary objective is to develop a proactive monitoring system that can trigger alerts or initiate corrective actions before an issue escalates, improving both security and system reliability. By using AI-driven approaches, the project seeks to enhance the</p>

		<p>speed and accuracy of anomaly detection while reducing the need for manual intervention. Ultimately, this research could revolutionize endpoint monitoring, offering more efficient and scalable solutions for enterprises in an era of increasing cyber threats and complex IT ecosystems.</p>
7.	Scope of the proposed research	<p>AI-Powered Log Analysis and Anomaly Detection</p> <ol style="list-style-type: none"> <li><b>1. Data Collection &amp; Preprocessing:</b> <ul style="list-style-type: none"> <li>Collect log data from system, application, network, and security endpoints.</li> <li>Clean and preprocess data: parse, normalize timestamps, and filter redundant information.</li> <li>Convert logs into structured formats (e.g., JSON, CSV) for AI analysis.</li> </ul> </li> <li><b>2. Exploratory Data Analysis (EDA):</b> <ul style="list-style-type: none"> <li>Identify patterns, trends, and anomalies in the log data.</li> <li>Categorize logs by severity, source, and event type to establish baseline behavior.</li> </ul> </li> <li><b>3. Model Selection &amp; Development:</b> <ul style="list-style-type: none"> <li>Evaluate and select suitable AI models (LLMs/SLMs) for log data processing.</li> <li>Train models on historical log data to detect typical patterns and anomalies.</li> </ul> </li> <li><b>4. Anomaly Detection Framework:</b> <ul style="list-style-type: none"> <li>Develop an AI-based anomaly detection system to identify deviations in real-time logs.</li> <li>Implement supervised/unsupervised learning for anomaly detection.</li> </ul> </li> <li><b>5. Real-time Log Analysis &amp; Monitoring:</b> <ul style="list-style-type: none"> <li>Build a real-time log processing pipeline for continuous log analysis.</li> <li>Integrate alerting systems to notify admins of abnormal activities.</li> </ul> </li> <li><b>6. Evaluation &amp; Performance Testing:</b> <ul style="list-style-type: none"> <li>Assess accuracy, precision, and recall of the anomaly detection system.</li> <li>Test scalability to handle high volumes of log data.</li> </ul> </li> <li><b>7. Proactive Remediation &amp; Automation:</b> <ul style="list-style-type: none"> <li>Integrate with automated remediation systems for predefined actions based on detected anomalies.</li> </ul> </li> <li><b>8. Provide recommendations for future improvements of the monitoring system</b></li> </ol>
8.	Linkages to Space Programme	<p>On successful completion of project, ISRO can utilize it for log analysis of all forms of logs and detect APT</p>

		attacks proactively and thereby protect ISRO assets from very sophisticated state sponsored attacks.
9.	<b>Expected deliverables</b>	A trained model to which log files can be given as input and the model investigates the logs to detect any potential abnormalities/threats/attacks.

## RES-SAC-2024-011: Diffusion of GIS in Urban Planning and Development: A Sociological Perspective

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Diffusion of GIS in Urban Planning and Development: A Sociological Perspective</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Narayan Mohanty Ms. Sini Susan Varghese Dr. Abha Chhabra
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5.	Area of Research	Social Research & Management
6.	<b>Summary of the proposed research</b>	India being at the forefront of geospatial governance initiatives, promotes GIS as a decision support tool for planning and monitoring the projects initiated by its urban local bodies. Urban planning requires a teamwork of practitioners from several related fields such as engineering, economy, architecture, archeology/humanities, ICT etc. Application of GIS plays an important role as a support system in the work carried out by these multiple practitioners towards urban planning & development.  The study focus on to map out the diffusion of geospatial technology in urban planning and development, its use and impact from sociological perspectives under the theme of SDG 11.
7.	<b>Scope of the proposed research</b>	The study will highlight the sociological aspects of geospatial technology in urban planning such as role of remote sensing technology and sustainable infrastructure development, urban sprawl, social mobility etc. It will showcase the use and adoption of GIS among its users (Municipality, Govt. organization, academia etc.).

<b>8.</b>	<b>Linkages to Space Programme</b>	ISRO is pioneered in GIS technology development and diffusion. The study will understand the adoption of GIS technology among users as well as Sustainable Development Goals 11 (sustainable cities and communities)
<b>9.</b>	<b>Expected deliverables</b>	Policy relevant recommendation, Report, publications

## **RES-SAC-2024-012: Design and development of reconfigurable photonic beam former for future scan-on-receive (SCORE) based synthetic aperture radar (SAR)**

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and development of reconfigurable photonic beam former for future scan-on-receive (SCORE) based synthetic aperture radar (SAR)</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Nitesh Sharma Dr. Piyush Sinha
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5.	Area of Research	Photonic Integrated Circuit (PIC)
6.	<b>Summary of the proposed research</b>	<p>This proposal aims to design and develop a photonic integrated beamforming receiver for Scan-on-Receive Synthetic Aperture Radar (SCORE-SAR), addressing the limitations of conventional digital beamforming methods that rely on FPGA technology. Digital beamforming is power-hungry and suffers from bandwidth limitations, making it less suitable for spaceborne SAR systems where Size, Weight, Power, and Cost (SWaP-C) considerations are critical.</p> <p>The proposed solution leverages photonic technology to deliver intermediate frequency (IF) output, offering a smaller, more power-efficient, and wider bandwidth alternative to traditional digital beamforming systems. The photonic integrated receiver will process signals from 12 input channels and synthesize up to 3 beams simultaneously, significantly improving the system's real-time imaging capabilities and spatial resolution.</p> <p>The hybrid design will integrate passive photonic components (fabricated using SiN on insulator waveguide technology) for optical signal processing and a Blass matrix for beamforming. Active components, such as InP-based semiconductor optical amplifiers (SOAs) and Mach-Zehnder modulators, will handle signal amplification, modulation, and downconversion. The Blass matrix beamforming will ensure precise</p>



		<p>control with amplitude error kept below 5% and phase error constrained to less than 10% to minimize pointing error and reduce the impact on SNR.</p> <p>This hybrid integration of passive and active photonic components will enable compact, lightweight, and high-performance radar systems suitable for next-generation SAR platforms. The final system will be packaged with space-grade reliability, ensuring robust operation in challenging environments. This photonic solution offers significant SWaP-C advantages over digital FPGA-based systems, making it ideal for spaceborne SAR missions.</p>
7.	<b>Scope of the proposed research</b>	<p>The research will focus on the design, simulation, fabrication, and testing of a photonic integrated beamforming receiver capable of processing signals from 12 input channels and synthesizing up to 3 beams. The system will achieve beamforming through a Blass matrix architecture, which dynamically controls the phase and amplitude of incoming signals to enable real-time, multi-beam scanning.</p> <p>The hybrid photonic integrated circuit (PIC) will use SiN on insulator technology for low-loss passive components, including optical delay lines and tunable couplers, and InP-based components for signal amplification, modulation, and downconversion. The receiver will downconvert X-band signals to intermediate frequency (IF) using an optical heterodyne detection technique, providing a wideband, low-power alternative to digital solutions.</p> <p>This research will also explore packaging solutions to ensure the system is compliant with space-grade requirements, including radiation hardness, thermal stability, and mechanical robustness. The integration of photonic and electronic components into a single, compact assembly will be a key focus, delivering a high-performance, low-power solution for SAR missions.</p>
8.	<b>Linkages to Space Programme</b>	Future Scan-on-Receive (SCORE) based high resolution wide swath X-Band Synthetic Aperture Radar
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>A photonic integrated beamforming receiver with IF output and capable of synthesizing up to 3 beams from 12 input channels, using a Blass matrix for real-time beamforming.</li> </ul>

		<ul style="list-style-type: none"> <li>• Hybrid PIC design with SiN on insulator based passive components and InP-based active devices for amplification, modulation, and downconversion.</li> <li>• Packaging solution compliant with space-grade standards, ensuring thermal and radiation robustness.</li> <li>• Performance evaluation of the photonic integrated beamforming receiver over required environmental condition.</li> </ul>
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## RES-SAC-2024-013: Self-cleaning/dust repellant coatings on optical surfaces

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Self-cleaning/dust repellant coatings on optical surfaces</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. B Narasiha Sharma Shri Nitesh Thapa
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:bns@sac.isro.gov.in">bns@sac.isro.gov.in</a> Phone: 079-2691 3803  E-mail : <a href="mailto:niteshthapa@sac.isro.gov.in">niteshthapa@sac.isro.gov.in</a> Phone: 079-2691 3812
5.	Area of Research	Optical surface coating
6.	<b>Summary of the proposed research</b>	Optical imaging systems on planetary missions for in-situ exploration are exposed to multiple hazards including dust/regoliths etc. For efficient and long term operations of optical imaging systems, self-cleaning/dust repellant coatings are essential. Coatings shall meet the optical performance requirements over large spectral range from visible (350nm) to thermal IR range (20um).
7.	<b>Scope of the proposed research</b>	Development of coating process for self-cleaning optical surfaces. Testing and characterization of samples.
8.	<b>Linkages to Space Programme</b>	Future planetary missions.
9.	<b>Expected deliverables</b>	Coating process and evaluation samples

## RES-SAC-2024-014: System design of Satellite Based Narrow-band Internet of Things

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>System design of Satellite Based Narrow-band Internet of Things</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Pawan Kumar Barnwal
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:pawanbarnwal@sac.isro.gov.in">pawanbarnwal@sac.isro.gov.in</a> Phone: 079-2691 8315/8317
5.	Area of Research	Satellite communication/wireless communication, communication networks
6.	<b>Summary of the proposed research</b>	<p>As per 3GPP rel.18 standard regarding Non-Terrestrial Network (NTN), direct-to-satellite based IoT (SIoT) in sub-6 GHz frequency band has become the mandate. Satellite based IoT will increase the utilities of IOT across various applications such as smart grid, smart cities, agriculture, transportation. There are many problems associated with SIoT:</p> <ul style="list-style-type: none"> <li>• Design of energy efficient waveform for IoT.</li> <li>• Design of system architecture of integrated satellite-terrestrial based IoT.</li> <li>• Multiple access technology required to support thousands of sensors present in FoV of satellite.</li> <li>• Compensation of delay and Doppler spread.</li> <li>• Maximum throughput over targeted service area</li> </ul>
7.	<b>Scope of the proposed research</b>	<p>In the present research for SIoT, it is expected to work on :</p> <ul style="list-style-type: none"> <li>• Energy efficient waveform Design</li> <li>• Multiple access technology Design</li> <li>• System architecture design, throughput analysis and compatibility with NB-IoT LTE standards</li> </ul>
8.	<b>Linkages to Space Programme</b>	Development of future LEO satellites for IoT applications such as smart cities
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Detailed technical report, algorithm and simulation model for waveform design, and multiple access design.</li> <li>• Demonstration of developed algorithm computability with existing NB-IOT standards and commercial IOT applications.</li> </ul>

**RES-SAC-2024-015: Development of nowcasting tool for extreme weather events (thunderstorms and cloud burst) using surface and satellite measurements over orographically complex region of India.**

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development of nowcasting tool for extreme weather events (thunderstorms and cloud burst) using surface and satellite measurements over orographically complex region of India.</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Neerja Sharma
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:neerjasharma@sac.isro.gov.in">neerjasharma@sac.isro.gov.in</a> Phone: 079-2691 6115
5.	Area of Research	Atmospheric Sciences
6.	<b>Summary of the proposed research</b>	Recent decays show a remarkable increase in extreme rainfall events allied with thunderstorms and cloud burst over India. Such events are more prone, complex and destructive over hilly regions. Although, accurate and timely nowcast procedure for thunderstorms and cloud burst over orographically complex region is very demanding, challenging too. The synergy of satellite and ground based observations can play a prominent role to understand the physical processes of such events in turn developing the nowcast procedure.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• The synergistic observations from ground and satellite would provide a deep insight on the physical processes allied with the thunderstorms and cloud burst events over hilly region.</li> <li>• The developed tool would be useful for nowcasting thunderstorms and cloud burst events over complex orographic region, which is in great demand.</li> </ul>
8.	<b>Linkages to Space Programme</b>	INSAT-3R/3S and future INSAT-4 Generation
9.	<b>Expected deliverables</b>	Nowcasting tool for thunderstorms and cloud burst over orographically complex regions of India.

## RES-SAC-2024-016: Design and Development of high sensitivity InGaAs PIN-type in the SWIR range photodetector to provide fine pointing

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Development of high sensitivity InGaAs PIN-type in the SWIR range photodetector to provide fine pointing</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Nishant Kumar Dr. Hari Shanker Gupta
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:nishantsingh@sac.isro.gov.in">nishantsingh@sac.isro.gov.in</a> Phone: 079-2691 2250/2274/2258  E-mail : <a href="mailto:hari@sac.isro.gov.in">hari@sac.isro.gov.in</a> Phone: 079-2691 2272/2250/2274
5.	Area of Research	Sensors
6.	<b>Summary of the proposed research</b>	<p>The Quantum Technology Demonstration in Space is India's pioneering quantum payload being develop by ISRO to explore quantum communication and entanglement in a space environment. To achieve precise optical alignment between the satellite and the ground station, the payload relies on a Pointing-Acquisition-Tracking (PAT) detector, essential for maintaining the narrow, directive communication link required in space-based quantum communication. The Pointing-Acquisition-Tracking (PAT) detector is an essential system used in optical communication to maintain precise alignment between a satellite and a ground station. In space-based optical communication, especially at optical frequencies, the communication beam is highly directive and narrow, requiring accurate line-of-sight alignment. The PAT detector utilizes both Quad detector for fine alignment, ensuring precise pointing between the satellite and the ground station. The Quad detector is a InGaAs PIN-type photodetector designed to provide fine pointing in laser beam experiments, enabling precise alignment needed to initiate further activities. Constructed as a 4-quadrant photodetector, it measures the relative incident optical intensity across its four segments, allowing accurate determination of alignment with the optical ground station. By detecting intensity variations between quadrants, the NFOV detector fine-tunes the systems positioning, ensuring stable and accurate alignment essential for high-precision optical communication.</p>

7.	Scope of the proposed research	<ul style="list-style-type: none"> <li>• To select suitable material, design steps and identification of fabrication house</li> <li>• A common composition is around 53% InAs and 47% GaAs, which yields a lattice structure closely matching that of Indium Phosphide (InP), enabling the material to be grown on InP substrates with minimal lattice mismatch. This balance also helps stabilize the material's band gap, maintaining effective absorption in the desired SWIR range. Optimization of quantum efficiency and Dark noise from 1.4 <math>\mu\text{m}</math> to 1.6 <math>\mu\text{m}</math> range.</li> <li>• Perform TCAD simulation using foundry parameters.</li> <li>• Fabrication and characterization of the single pixel and Quad high sensitivity InGaAs PIN-type photodetector.</li> <li>• InGaAs (Indium Gallium Arsenide) sensors, dark current plays a critical role in limiting the sensor's performance, especially in precision measurements. Simulation for achieved quantum efficiency.</li> </ul>
8.	Linkages to Space Programme	Future Quantum and Optical Communication Programme and Bhartiya Antriksh Station
9.	Expected deliverables	TCAD simulation file, Single photodiode, Quad photodiode and Quad-Photodiode sensor

## RES-SAC-2024-017: Design and Implementation of algorithms for stand-alone onboard real-time orbit determination of LEO satellites with sub-meter accuracy

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Implementation of algorithms for stand-alone onboard real-time orbit determination of LEO satellites with sub-meter accuracy</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Smt. Saumi S. Shri Rohan Urdhwareshe
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:de_saumi@sac.isro.gov.in">de_saumi@sac.isro.gov.in</a> Phone: 079-2691 5159  E-mail : <a href="mailto:rohansu@sac.isro.gov.in">rohansu@sac.isro.gov.in</a> Phone: 079-2691 5143/5142
5.	Area of Research	Satellite Navigation
6.	<b>Summary of the proposed research</b>	Today for scientific explorations, it's required to derive sub-meter level position accuracy in on-board GNSS receivers at LEO platform.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>Theoretical study for different possibilities for Precise On-board orbit Determination (P2OD) solution</li> <li>Algorithm development in MATLAB and C, ultimately portable to embedded platform.</li> <li>Testing with simulator data keeping receiver on LEO orbit and adding all necessary perturbations</li> </ul>
8.	<b>Linkages to Space Programme</b>	It will be useful for GNSS radio occultation payloads where sub meter level on-board POD is required for atmospheric characterization.
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>Designed algorithm, its mathematical modelling and technical details</li> <li>Functionally Tested software: source code and executables in C / python or MATLAB</li> <li>Installable controller software on any supported Windows PC along with manual.</li> <li>Technical Report containing performance analysis of all possible algorithms</li> <li>Demonstration of the designed algorithm</li> </ul>



## RES-SAC-2024-018: Design and Development of Digital Coded Metasurface Antenna for Adaptive Beamforming Applications

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Development of Digital Coded Metasurface Antenna for Adaptive Beamforming Applications</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Kashish Grover Shri Devendra Kumar Sharma
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:kashish_asg@sac.isro.gov.in">kashish_asg@sac.isro.gov.in</a> Phone : 079-2691 2119  E-mail : <a href="mailto:devendrasharma@sac.isro.gov.in">devendrasharma@sac.isro.gov.in</a> Phone : 79-2691 2110
5.	Area of Research	Unit Cell Design, Cost Effectiveness, Active Components Integration, Generating codes for digital coded met surface elements, FPGA implementation for dynamic reconfiguration of antenna, Machine Learning algorithms implementation for design optimization.
6.	<b>Summary of the proposed research</b>  (A Simple concise statement about the investigation/theme in around 250 words)	A digital coded metasurface antenna is a type of antenna that employs a digital coded metasurface to manipulate electromagnetic waves. This technology uses an array of engineered unit cells, each programmed with specific digital patterns, to control wave properties such as <b>phase, amplitude, and polarization</b> . Field-Programmable Gate Arrays (FPGAs) play a crucial role in the implementation of digital coded metasurfaces, especially in applications requiring dynamic reconfiguration and real-time processing. FPGAs allow for flexible coding of the metasurface, enabling real-time adjustments to phase shifts, amplitude, and polarization states. Custom algorithms for wave manipulation (e.g., beamforming, focusing) can be programmed into the FPGA, allowing for adaptive control of the metasurface's response. Incorporating active components (like varactors or RF switches) into the unit cells allows for dynamic reconfiguration of the metasurface. Advanced design methodologies, including machine learning algorithms, are increasingly used to optimize the coding patterns for desired performance metrics, reducing the design time and enhancing functionality.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>Antenna design and development: Development of a digital coded metasurface antenna at X-Band.</li> </ul>

		<ul style="list-style-type: none"> <li>• MATLAB Tool Development: Machine learning algorithms implementation for the unit cell efficiency optimization.</li> <li>• FPGA Implementation: Developing Algorithms for adaptive beam forming.</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	<ul style="list-style-type: none"> <li>• X-band space born SAR Antenna</li> </ul>
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Development of a digital coded metasurface antenna being implemented using discrete elements (diodes etc.).</li> <li>• FPGA Implementation for adaptive beam forming antenna (direction) demonstration in developed antenna.</li> </ul>

## RES-SAC-2024-019: Design and Development of vibration isolation system with hybrid D-struts for space payloads

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and Development of vibration isolation system with hybrid D-struts for space payloads</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri. Numan Ahmad Shri. Naimesh R. Patel
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:naahmad@sac.isro.gov.in">naahmad@sac.isro.gov.in</a> Phone: 079-2691 4321  E-mail : <a href="mailto:naimesh@sac.isro.gov.in">naimesh@sac.isro.gov.in</a> Phone: 079-2691 4325
5.	Area of Research	Structures, Vibration Isolation
6.	<b>Summary of the proposed research</b>	<p>Proposed research work will focus on the design and development of actively controlled D-struts (three parameter vibration isolators) for space payload of mass up to 100 Kgs.</p> <p>The three parameter vibration isolators, which are also called D-struts (dual struts), are low frequency vibration isolators which are better absorbers as well as better isolators as compared to conventional spring-mass-damper (two parameter) vibration isolators. In the D-strut isolator the damper is elastically connected, due to which it offers 40 dB/decade roll-off in the isolation region as compared to 20 dB/decade roll-off of two parameter isolator; while maintain the absorbing capacity in the transmissibility region. Hybrid D-struts consist of an active actuation element to control and suppress the vibration loads. The design of a single D-strut is independent of the payload mass as opposed to the conventional isolator which are designed for a particular payload mass.</p>
7.	<b>Scope of the proposed research</b>	The scope of this project is to design and develop an actively controlled vibration isolation system with Hybrid D-struts for a payload of mass 50Kg to 100 Kg. The control bandwidth should be 0 to 200 Hz. The natural frequency of the vibration isolation system should be less than 20 Hz.
8.	<b>Linkages to Space Programme</b>	This technology can be used for vibration suppression of delicate optical payload, where there is a requirement of good shock absorbing as well as good vibration isolation. This technology can be used in

		deployable space telescope, where the optical telescope can be isolated from the spacecraft bus.
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Vibration isolation system with D-struts (for payload mass of 50 Kg to 100 Kg)</li> <li>• Design details (including CAD model, design calculations, mathematical model, control system details)</li> <li>• Testing and characterization methodology for D-struts (impedance measurement of single D-strut)</li> </ul>

## RES-SAC-2024-020: Advanced Persistent Threats, Breach and Botnet Detection system using network traffic analysis

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Advanced Persistent Threats, Breach and Botnet Detection system using network traffic analysis</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Rohit Tyagi Shri Pravin K Choudhary Shri Chitraksh Vyas
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:rohittyagi@sac.isro.gov.in">rohittyagi@sac.isro.gov.in</a> Phone: 079-2691 5122  E-mail : <a href="mailto:pravin.choudhary@sac.isro.gov.in">pravin.choudhary@sac.isro.gov.in</a> Phone: 079-2691 5125  E-mail : <a href="mailto:chitraksh@sac.isro.gov.in">chitraksh@sac.isro.gov.in</a> Phone: 079-2691 5121
5.	Area of Research	Network Security
6.	<b>Summary of the proposed research</b>	<p>The aim of the project is to detect Advanced Persistent Threat, Breach and Botnets from network traffic analysis.</p> <p>The research should focus on developing a network traffic analysis system capable of identifying following malicious behavior:</p> <ol style="list-style-type: none"> <li>1. Command and Control (C&amp;C) Traffic: Detecting communication between compromised machine and an attacker's server.</li> <li>2. Lateral Movement: Identifying spread of attack laterally across a network.</li> <li>3. Data Exfiltration: Identifying unusual outbound traffic indicating potential data leakage.</li> <li>4. Botnet behavior: Detecting patterns characteristics of botnet activities. The botnets can be Fast-Flux based, DGA based, HTTP based etc.</li> <li>5. Intrusion detection: Detection anomalous network traffic associated with intrusion attempts.</li> </ol> <p>The solution can leverage machine learning, anomaly detection and traffic flow analysis for detecting</p>

		malicious network activities. The solution should be able to work on encrypted traffic.
<b>7.</b>	<b>Scope of the proposed research</b>	<p>The scope of the proposed research is following:</p> <ul style="list-style-type: none"> <li>• Network Security monitoring platform that shall work passively on network data/ flows to identify threats/breach in the network.</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	Aid in providing cyber security services to ISRO/DOS projects.
<b>9.</b>	<b>Expected deliverables</b>	Software and related algorithms.

## RES-SAC-2024-021: Design and development of Comprehensive Research Evaluation Tool for enhancing Collaborative and Sponsored Research Management

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and development of Comprehensive Research Evaluation Tool for enhancing Collaborative and Sponsored Research Management</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Smt. Ankita Vishal Patel Dr. Abha Chhabra
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:research_sac@sac.isro.gov.in">research_sac@sac.isro.gov.in</a> Phone: 079-2691 3333
5.	Area of Research	Research Management
6.	<b>Summary of the proposed research</b>	<p>Sponsored Research with Academia is a major activity under Capacity Building Programme of ISRO. RESPOND (Sponsored Research) Programme which started in 1970s has gradually evolved with various new avenues and opportunities for Academic collaborations.</p> <p>SAC is major R&amp;D Centre of ISRO and actively participate in Sponsored Research with Academia.</p> <p>The Evaluation of outcome of Completed R&amp;D activities is an integral part of Research Management. Currently, SAC has developed a methodology for evaluation of outcome of completed R&amp;D activities. However, in evolving scenario with focused Advanced R&amp;D with Technology Readiness for absorption of R&amp;D outcome in SAC/ ISRO missions &amp; projects, there is an urgent need to design and develop a Comprehensive Research Evaluation Tool for enhancing Collaborative and Sponsored Research Management at SAC.</p>
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Study of existing methods across R&amp;D organizations for evaluating collaborative and Sponsored Research.</li> <li>• Design of Comprehensive Research Evaluation Framework based on ISRO's Sponsored and Collaborative Research.</li> <li>• Development of web based tool using open source AI/ML and NLP techniques.</li> <li>• Testing and Evaluation of developed tool.</li> <li>• Demonstration and deployment of Comprehensive Research Evaluation Tool for enhancing Collaborative and Sponsored Research Management</li> </ul>

8.	<b>Linkages to Space Programme</b>	<p>The proposed study has strong linkage for Research Management activities at SAC.</p> <p>The developed tool would serve useful for evaluating R&amp;D with academia across all ISRO centers and CBPO, ISRO HQ.</p>
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Research Evaluation Framework</li> <li>• Web based tool with user manual</li> <li>• Detailed Report and Publications</li> </ul>



## RES-SAC-2024-022: RFCMOS based Wideband Voltage Controlled Oscillators @ L, S, C, X and Ku-Band

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>RFCMOS based Wideband Voltage Controlled Oscillators @ L,S,C,X and Ku-Band</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri K. S. Arjun Ms. Srishti Srivastava
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:arjun.ks@sac.isro.gov.in">arjun.ks@sac.isro.gov.in</a> Phone: 079-2691 5219  E-mail : <a href="mailto:srishti@sac.isro.gov.in">srishti@sac.isro.gov.in</a> Phone: 079-2691 5219 / 5218 / 5319
5.	Area of Research	RF and Microwave
6.	<b>Summary of the proposed research</b>	Wideband Voltage Controlled Oscillators are very much required for the development of broadband Frequency Synthesizers. Design of wideband VCO's with low phase noise is a challenge.  This Proposal is for designing wideband VCO's with relatively low phase noise at different Frequency Bands using RFCMOS technology.  The project aims to design and develop a wideband Voltage Controlled Oscillator at different Frequency Bands Viz. L, S, C, X, Ku-Band with octave bandwidth.
7.	<b>Scope of the proposed research</b>	Development of indigenous design for wideband VCO's required for tunable frequency synthesizers at different bands
8.	<b>Linkages to Space Programme</b>	Future Earth Observation Microwave Payloads
9.	<b>Expected deliverables</b>	Deliverables include technology transfer and design database sharing.

## RES-SAC-2024-023: On-chip nano wire grid fabrication for polarization sensing

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>On-chip nano wire grid fabrication for polarization sensing</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Ashwani Kumar
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : ashwani507@sac.isro.gov.in Phone: 079-2691 5423/5418
5.	Area of Research	Electro-Optical Sensor Technology
6.	<b>Summary of the proposed research</b>	<p>Traditional imaging systems have focused on capturing and replicating the imaged environment in terms of colour and intensity. One important property of light, which the human eye is blind to and it is ignored by traditional imaging systems, is polarization. Polarization of light caused by reflection from materials contains information about the surface roughness, geometry and other properties of the imaged environment. Polarization-contrast imaging has proven to be very useful in gaining additional visual information in optically scattering environments, such as target contrast enhancement in hazy/foggy conditions, depth map of the scene in underwater imaging, presence of ice in clouds or non-spherically shaped dust particles and in normal environmental conditions, such as classifications of chemical isomers, classifications of pollutants in the atmosphere, and non-contact fingerprint detection among others. In addition, polarization of light has found a niche in many biomedical applications, such as imaging for early skin cancer detection, cell classification and retinal surgery.</p> <p>Wire grid polarizer is compatible with complementary metal-oxide-semiconductor (CMOS) technology, and it can be fabricated monolithically by using metal layers for wiring. Using deep-submicron CMOS technologies, which allow the design of metal patterns finer than 100 nm. The angle (0, 45, 90 and 135 degree) of the polarizer on each pixel can be designed.</p>
7.	<b>Scope of the proposed research</b>	Process details, design and fabrication
8.	<b>Linkages to Space Programme</b>	Earth observation and on-orbit polarimetry

9.	Expected deliverables	Test chips

## RES-SAC-2024-024: High Data rate Channel codec architecture for free space classical RF and optical communication

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>High Data rate Channel codec architecture for free space classical RF and optical communication</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Deepak Mishra
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:deepakmishra@sac.isro.gov.in">deepakmishra@sac.isro.gov.in</a> Phone: 079- 2691 8790/8233/8234
5.	Area of Research	Communication and optical communication
6.	<b>Summary of the proposed research</b>	Forward Error Correction (FEC) is an integral part of satellite communication system since it ensures reliable data transmission in the presence of high noise in satellite links. Proper selection of FEC code is a key factor in transmitting and receiving data reliably. The choice of a FEC code for different specifications of satellite systems depends on various factors such as encoding/decoding complexity, decoding delay, error floor issues, high coding gain for low transmitter power and spectral/bandwidth efficiency. Looking back at the various space missions till date, different codes have been used for different missions. Considering the data rate requirement of 1 Gbps and more for classical RF channel as well as Optical channel, FEC architecture will play a important role for implementation in hardware. Based upon current available hardware resources achieving a high throughput of 1 GBPS and beyond is the need of current high throughput satellite.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Arriving at optimum hardware architecture of channel codes for high data rate communication with minimum throughput 1Gbps or beyond.</li> <li>• Implementation strategies for the channel codes in the hardware</li> <li>• Hardware realization of a low complex encoder and decoder.</li> <li>• Validation and Verification of coding gain for high data rate optical communication.</li> <li>• Hardware demonstration of the proposed architecture.</li> </ul>
8.	<b>Linkages to Space Programme</b>	Currently ISRO is working on high throughput satellite and direct free space optical communication satellite,

		<p>where there is a need of high data rate 1 Gbps and more. In order to work these satellites at lower SNR condition or dynamic SNR condition, high data rate compatible architecture of channel codec is required. The developed channel codec architecture will be directly used in these programs.</p>
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Optimum High data architecture for channel codes</li> <li>• Implementation demonstration of channel code beyond 1 Gbps for classical and optical communication.</li> <li>• Integration strategies of channel codec with higher order modulation and optical modulation.</li> </ul>

## RES-SAC-2024-025: Study of the Earth-Atmosphere radiation budget and its linkage to atmospheric feedback processes

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Study of the Earth-Atmosphere radiation budget and its linkage to atmospheric feedback processes</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Manoj Kumar Mishra
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:manoj_mishra@sac.isro.gov.in">manoj_mishra@sac.isro.gov.in</a> Phone: 079-2691 6109
5.	Area of Research	Earth's Climate
6.	<b>Summary of the proposed research</b>	<p>Currently all the component of the Earth-Atmosphere system is undergoing rapid changes due to influence exerted by human beings. This is resulting in unprecedented changes in the atmospheric properties and processes, including the interaction of the atmosphere with other components of the Earth system, as well as their roles in climate variability and change.</p> <p>In order to advance and improve the understanding of these changes it is required to observe and model these components both at local as well as global scale at much larger scale. At the same time large amount of data which was gathered in the last two decades already exist need to be analyzed. This requires collaboration between different institutions who can work together toward this common goal. The contribution can include theoretical studies, proposal of new observation/instrument, setting up of network, development of new models etc.</p> <p>Large amount of data has been gathered by Indian as well as global satellites. A comprehensive analysis is required to make the assessment of radiative and dynamic feedback processes.</p>
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Earth's climate</li> <li>• Earth's feedback processes</li> <li>• Distribution of clouds and aerosols</li> <li>• Insitu measurement of Earth-atmosphere parameters.</li> <li>• Generation of local/global dataset of atmospheric variables.</li> </ul>

		<ul style="list-style-type: none"> <li>• Atmospheric boundary layer dynamics</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	<p>Research on the Earth atmosphere and climate is one of the broad theme of the SAC-ISRO. The atmospheric and Oceanic sciences group is involved in the study and observation of its different components. This research project will enhance the collaboration with the universities and institutions carrying out similar research.</p>
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Setting of observation network for Earth-atmosphere system studies.</li> <li>• Data collection</li> <li>• Development of theoretical models for Assessment of Earth-Atmosphere system feedback processes.</li> </ul>

## **RES-SAC-2024-026: Reconstruction of high resolution historical sea-level data using coarse resolution altimeter and high resolution observations from Surface Water and Ocean Topography (SWOT) mission.**

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Reconstruction of high resolution historical sea-level data using coarse resolution altimeter and high resolution observations from Surface Water and Ocean Topography (SWOT) mission.</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Aditya Chaudhary Dr. Neeraj Agarwal
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:aditya.osd@sac.isro.gov.in">aditya.osd@sac.isro.gov.in</a> Phone: 079-2691 6116  E-mail : <a href="mailto:neeraj@sac.isro.gov.in">neeraj@sac.isro.gov.in</a> Phone: 079-2691 6045
5.	Area of Research	Satellite Oceanography
6.	<b>Summary of the proposed research</b>	High resolution sea level data is a gap area for understanding the small mesoscales and sub-mesoscale ocean dynamics. Our current understanding of these dynamics has been hampered by the limitations of traditional satellite altimetry, which struggles to resolve these fine-scale processes due to resolution and noise constraints. This observational gap is particularly evident in dynamically complex regions like the Arabian Sea, where monsoonal winds, intense stratification, and a productive ecosystem further complicate the picture. The current state of art i.e. AVISO analyzed gridded sea level data is available at 25km x 25 km resolution. With the availability of high resolution sea level observations from SWOT mission, we can possibly reconstruct the available analyzed sea levels fields (25km x 25km) at a better resolution. In this proposal we intend to use the high resolution sea level data from the SWOT that is available since April 2023 along with collocated coarse resolution AVISO sea level to develop a machine learning based technique for reconstructing the historical sea level data at higher spatial resolution. Several AI/ML techniques can be tried, for e.g. Convolutional neural network (CNN), Long Short Term Memory (LSTM) neural networks, generative adversarial networks (GANs) etc. High resolution satellite observations of Sea surface



		temperature and chlorophyll from INSAT and OCM series can also be used in the machine learning procedure.
<b>7.</b>	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>Generating a long timeseries of high resolution sea level database for fine scale process understanding</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	<p>SARAL AltiKa, EOS-06/Oceansat-3, Scatsat-1, Oceansat-2, SWOT, Jason, Sentinel series, INSAT series.</p> <p>MOP-4</p>
<b>9.</b>	<b>Expected deliverables</b>	30 years of high resolution (5 km X 5 km) sea surface height anomaly database

## RES-SAC-2024-027: Integrated Pseudolite & Satellite Based system for Lunar Navigation

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Integrated Pseudolite &amp; Satellite Based system for Lunar Navigation</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Ashish K Shukla
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:ashishs@sac.isro.gov.in">ashishs@sac.isro.gov.in</a> Phone: 079-2691 2474/2489/5145
5.	Area of Research	Navigation
6.	<b>Summary of the proposed research</b>	Integrated Pseudolite & Satellite based systems are required for more precise 3D lunar positioning. New Position algorithms and software needs to be developed for this purpose.
7.	<b>Scope of the proposed research</b>	Development of 3D positioning algorithm for standalone lunar navigation using Pseudolites & satellite in lunar orbit.
8.	<b>Linkages to Space Programme</b>	Navigation Program & Chandrayaan Mission
9.	<b>Expected deliverables</b>	Positioning Algorithm & software.

## RES-SAC-2024-028: Development of Superconducting Magnet for Space-borne sub-Kelvin Cooler (ADR)

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development of Superconducting Magnet for Space-borne sub-Kelvin Cooler (ADR)</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Vivek Kumar Singh Shri Sandip R Somani Shri Rakesh R Bhavsar
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:singhvivek@sac.isro.gov.in">singhvivek@sac.isro.gov.in</a> Phone: 079-2691 3995  E-mail : <a href="mailto:sandipsomani@sac.isro.gov.in">sandipsomani@sac.isro.gov.in</a> Phone: 079-2691 3931  E-mail : <a href="mailto:rbb@sac.isro.gov.in">rbb@sac.isro.gov.in</a> Phone: 079-2691 3942
5.	Area of Research	Cryogenics
6.	<b>Summary of the proposed research</b>	Superconducting (SC) Magnets are an important part of Adiabatic Demagnetization Refrigerator (ADR) under development at SAC to achieve sub-Kelvin Temperature. Magnetic Field need to be varied in controlled way in range of 0-4T to achieve temperature in order of 0.5K (Sink Temperature $\approx$ 4.2-6 K; Heat Load $\approx$ 10mW). SC Magnet design and development along with shielding and control electronics need to be developed under this project.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Design of SC Magnet</li> <li>• Realization and characterization of SC Magnet</li> <li>• Development of control electronics to operate SC Magnet</li> <li>• Development of appropriate magnetic shielding for SC Magnets</li> </ul>
8.	<b>Linkages to Space Programme</b>	Sub-Kelvin Cooler for THz Project, quantum communications and futuristic astronomical missions
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Design and development document</li> <li>• 03 sets of fully characterized SC Magnets along with its control electronics</li> </ul>

## **RES-SAC-2024-029: Development of a MATLAB Tool for antenna diagnostics using amplitude only field measurement and source reconstruction method**

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development of a MATLAB Tool for antenna diagnostics using amplitude only field measurement and source reconstruction method</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Yogesh Tyagi Shri Akula Ramu Shri Sanjeev Kulshreshta
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5.	Area of Research	Source reconstruction method, Antenna Diagnostics, Phaseless antenna radiation pattern measurement, Phase retrieval algorithms
6.	<b>Summary of the proposed research</b>	<p>Antenna diagnostics methods based on the acquisition of the radiated field are becoming a key issue due to their features: first, they are non-invasive methods, so they make possible the determination of antenna anomalies avoiding try-and-error procedures that require interacting with the antenna.</p> <p>Conventional equivalent source reconstruction methods (SRM) require both phase and amplitude information of the acquired field data. However, there are situations where the phase information is not available or impractical to obtain. Hence, the development of SRM using phaseless Fields is important. Diagnostics techniques are most based on far-field/near-field to nearfield (FF/NF-NF) transformation, in order to determine the extremely NF on a surface close to the antenna-under-test (AUT). Limitation of wave mode-based FF/NF-NF methods to canonical acquisition and diagnostics geometries is overcome by the introduction of the Sources reconstruction methods (SRM), an integral equation technique that characterizes the antenna under test</p>

		(AUT) through a set of equivalent electric and/or magnetic currents distribution.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• <b>Antenna Diagnostics:</b> Enhancing the ways in which antenna performance can be measured and potential issues detected through non-invasive methods</li> <li>• <b>Source Reconstruction Techniques:</b> Developing algorithms for reconstructing the source from amplitude-only measurements</li> <li>• <b>MATLAB Tool Development:</b> Leveraging MATLAB's computational capabilities to create a user-friendly tool for researchers and engineers in the field of antenna design and diagnostics.</li> </ul>
8.	<b>Linkages to Space Programme</b>	<ul style="list-style-type: none"> <li>• Large ground station antenna characterization and diagnostics.</li> </ul>
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Development of a MATLAB Tool for antenna diagnostics using amplitude only field measurement and source reconstruction method</li> </ul>

## RES-SAC-2024-030: Development of Space Grade Carbon Allotropes Materials by 3D Print Manufacturing Technology

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development of Space Grade Carbon Allotropes Materials by 3D Print Manufacturing Technology</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Ravi Kumar Varma
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5.	Area of Research	Materials
6.	<b>Summary of the proposed research</b>	<p>In terms of process ability and necessary product qualities, years have already elapsed in the development of materials for traditional manufacturing techniques. Since Additive Manufacturing (AM) is still a relatively new technique, there are still gaps in material qualification, standardization, and development.</p> <p>The space industry has long been a hub for novel ideas and ground-breaking technologies, but it is currently entering a new cycle that might have far-reaching effects on the industrial, sociological, and economic fronts. Despite many similarities, the prospects and difficulties for the space sector to adopt Additive Manufacturing (AM) are probably significantly greater than those related to the aviation sector. In addition to having mechanical performance on par with space structures made traditionally, those 3D-printed parts can be functionalized during the additive manufacturing process to provide radiation and heat-shielding properties.</p>
7.	<b>Scope of the proposed research</b>	<p>The global aerospace &amp; space sector is currently using 3D printing to produce parts for commercial aircraft with the same level of reliability as traditional methods. It is more crucial to uphold the core and consistent requirements of low mass, high dependability, and low manufacturing volumes.</p> <p>Because of the many advantages that the layer wise production paradigm offers, the Additive Manufacturing has the ability to enable all of these features. With the use of carbon allotropes like carbon, carbon nanotubes (CNT), graphene, and metal particles, it is possible to construct multi-functional structures at a reasonable cost that have good</p>

		mechanical, electrical & thermal properties along with stiffness.
<b>8.</b>	<b>Linkages to Space Programme</b>	For all advanced space payload  (Advanced R & D)
<b>9.</b>	<b>Expected deliverables</b>	Manufacture space-qualified components with carbon allotrope materials by 3D printing technology.  Development of a standard prototype part and performance evaluation in predetermined space environment conditions.

## RES-SAC-2024-031: Development of process for realization of seamless ultra-thin wall round tubes

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Development of process for realization of seamless ultra-thin wall round tubes</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Rajat Patel Shri Jigar Patel
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5.	Area of Research	Manufacturing
6.	<b>Summary of the proposed research</b>	<p>Flexible waveguides are being used in satellites for transmission of Microwave signals. To impart flexibility to waveguide, corrugations are being provided on tube. The flexible behaviour of the corrugated profile determines the flexibility of the corrugated tube. This corrugation gets stretched on the outer curve, while they are compressed in the inner curve.</p> <p>This flexibility of corrugated tube is function of the wall thickness of the tube. Higher the wall thickness of tube lesser will be flexibility vice versa. Both surface finish and uniformity of cross section along the length of the tube are crucial features to transfer signals with minimum losses.</p>
7.	<b>Scope of the proposed research</b>	<p>Development process for realization of seamless ultra-thin wall round tubes considering following parameters:</p> <ul style="list-style-type: none"> <li>Material: Brass/Bronze/BeCu Material with copper in excess of 80% (Annealed condition)</li> <li>Wall thickness: 0.15-0.18 mm</li> <li>Outer Diameter of tube: Ø6.49, Ø7.84, Ø11.52, Ø14.08, Ø17.18 mm</li> <li>Length: more than 600 mm.</li> </ul>
8.	<b>Linkages to Space Programme</b>	Communication and Navigation Payloads
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>Tube with uniform wall thickness throughout length</li> <li>Surface Finish shall be of order Ra- 0.4 µm or less</li> <li>No damage inner walls of tube.</li> </ul>



## RES-SAC-2024-032: Specialized language models deployable on end points with low compute resources

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Specialized language models deployable on end points with low compute resources</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Gulshan Gupta
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5.	Area of Research	AI/ML Technologies (Transformers, Language Models)
6.	<b>Summary of the proposed research</b>	<p>The proposal aims to develop specialized language models capable of performing specific text comprehension tasks on low-compute endpoints, such as devices without GPUs or limited processing power. The focus is on creating lightweight, efficient models that can handle tasks like text summarization, sentiment analysis, question answering, and language translation while ensuring minimal computational overhead.</p> <p><b>Key Objectives:</b></p> <p><b>Optimized Model Architecture:</b> Design models with reduced size and complexity, leveraging techniques such as model pruning, quantization, and distillation to maintain accuracy while minimizing resource consumption.</p> <p><b>Low-Resource Adaptation:</b> Tailor the models for deployment on devices that lack high-performance hardware like GPUs, including smartphones, embedded systems, and IoT devices, enabling them to perform advanced text comprehension tasks efficiently.</p> <p><b>Task-Specific Focus:</b> Rather than attempting to generalize across all language tasks, the models will be specialized to handle a narrow set of tasks effectively, ensuring high performance in specific areas such as summarization or sentiment detection.</p> <p><b>Real-Time Performance:</b> Prioritize fast inference times to enable real-time or near-real-time performance on constrained devices, balancing between computational efficiency and the quality of text comprehension.</p>

		<p>Scalability and Flexibility: Develop a framework that allows for easy adaptation to other low-compute environments, ensuring scalability across a range of devices and platforms.</p> <p>The success of this project will make advanced text comprehension capabilities more accessible to a broader range of devices, enabling smarter, more responsive systems in scenarios where computational resources are limited.</p>
7.	<b>Scope of the proposed research</b>	<p>The scope of the proposed research is following:</p> <ul style="list-style-type: none"> <li>• Optimizing the existing models more efficient for specialized tasks</li> <li>• Adapting the models to run on devices with low resources</li> <li>• Making model flexible for variety of platforms</li> </ul>
8.	<b>Linkages to Space Programme</b>	Automation, assistance and improvisation in various tasks involving from data analysis, logical reasoning, summarization etc.
9.	<b>Expected deliverables</b>	Software, Language models, Algorithms

## RES-SAC-2024-033: Advanced Compression Techniques for SAR raw data

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Advanced Compression Techniques for SAR raw data</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Dr. Ameya Anil Kesarkar, Shri Vetral Akshay Pandit, Shri Yogendra Sahu
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5.	Area of Research	Scalar & Vector Compression of SAR data
6.	<b>Summary of the proposed research</b>  (A Simple concise statement about the investigation/theme in around 250 words)	<p>Synthetic Aperture Radars (SARs) produce large amount of on-board data. Due to data rate and onboard storage limitations, it needs to be compressed onboard without compromising on its information content. There are several data compression techniques reported in the literature, which are broadly classified into scalar and vector techniques.</p> <p>Scalar techniques include Block Adaptive Quantization (BAQ), Block Adaptive Polar Quantization (BAPQ), Block Adaptive Histogram Equalization Quantization (BHEQ), Block Adaptive Complex Quantization (BACQ), Block Adaptive Magnitude Phase Quantization (BMPQ), Flexible BAQ (FBAQ), etc. On the other hand, vector techniques include Block Adaptive Vector Quantization (BAVQ), Block Adaptive Tree-Structured Vector Quantization (BATSVQ), Block Adaptive Lattice Vector Quantization (BALVQ), Dynamic Predictive Block Adaptive Vector Quantization (DP-BAVQ), etc.</p> <p>In this proposed research, comparative SQNR analysis will be carried out amongst these scalar and vector techniques for the uncompressed raw data available from ISRO's previously flown SAR missions. Subsequently, it is also aimed to quantify the information loss from SAR images generated based on the data compressed with these techniques. After getting comparative idea about the performances of</p>

		<p>various algorithms, their resource utilization analysis will also be carried out for the given implementable platform.</p> <p>Within this framework, further exploration/development of implementation strategies will be carried out for the superior algorithms, whichever are possible. Research in this direction may result into a superior and implementable data compression algorithm/s for future SAR missions.</p>
7.	<b>Scope of the proposed research</b>	This research will bring out superior technique from the available scalar and vector options for SAR raw data compression in terms of maintaining the fidelity of original data.
8.	<b>Linkages to Space Programme</b>	Future SAR missions of ISRO
9.	<b>Expected deliverables</b>	Softwares, Reports, and publications.

## RES-SAC-2024-034: Design and development of Distributed feedback laser (DFB)

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and development of Distributed feedback laser (DFB)</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Nitesh Thapa Shri K Ajay Kumar
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:niteshthapa@sac.isro.gov.in">niteshthapa@sac.isro.gov.in</a> Phone: 079-2691 3812  E-mail : <a href="mailto:ajaykumar@sac.isro.gov.in">ajaykumar@sac.isro.gov.in</a> Phone: 079-2691 3812
5.	Area of Research	High energy LASERS for LIDAR applications
6.	<b>Summary of the proposed research</b>	Narrow linewidth (<25kHz) DFB laser operating at 1550 nm with fast frequency modulation of >1GHz @ 10kHz repetition rate with typical optical power of > 20 mW. Modulation is to be controlled through external input (voltage/current).
7.	<b>Scope of the proposed research</b>	Realization of the proposed LASER will be a new development for ISRO. This will significantly help in development of LIDARs for soft landing applications.
8.	<b>Linkages to Space Programme</b>	Future planetary missions with soft landing requirements.
9.	<b>Expected deliverables</b>	Narrow linewidth fast tuneable laser module

## RES-SAC-2024-035: Design, Development & Dynamic Characterization of Multi-rotor Small UAV for Moving platform QKD application

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design, Development &amp; Dynamic Characterization of Multi-rotor Small UAV for Moving platform QKD application</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Pradeep Ananthanarayanan
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5.	Area of Research	Drones
6.	<b>Summary of the proposed research</b>	<p>Design and Development of Multi rotor UAV for optical and quantum payload characterization.</p> <ul style="list-style-type: none"> <li>• Configuration and Design of Multi rotor UAV of capacity upto 25 Kg Payload Capacity that is capable of housing sensitive optical and quantum payloads. Failure mode effect and criticality analysis on the UAV design. The UAV shall have in-built failure tolerant and fail safe safety features. It shall adhere to ingress rating of at least IP65 while IP67 is desirable.</li> <li>• Software/firmware development as required to meet the requirements.</li> <li>• Integration of NAVIC for accurate positioning.</li> <li>• Manufacturing assembly, integration and operation of the UAV during characterization</li> <li>• Dynamic Characterization (vibrations, drift, landing shocks etc) of the UAV using variety of sensors like accelerometers, gyros inclinometers etc.</li> </ul>
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• The proposed research is useful in the application of drone based ground testing of quantum key distribution program, Optical communication, SAR sensors and similar systems.</li> </ul>
8.	<b>Linkages to Space Programme</b>	Linked to Quantum Programme
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Multi-rotor UAV with payload capacity upto 25 kg.</li> <li>• Accessories of UAV like remote controller, master computer (laptop) with required software/firmware, charging cables, spare batteries, antenna etc.</li> </ul>

		<ul style="list-style-type: none"><li>• Raw Data acquired during dynamic characterization of UAV.</li><li>• Anything else that is necessary to satisfactorily operate and maintain the UAV.</li></ul>
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## RES-SAC-2024-036: Air bearing based platform to mimic microgravity experiments on earth for a propulsion module

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Air bearing based platform to mimic microgravity experiments on earth for a propulsion module.</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Arvind Singh
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:arvindsingh@sac.isro.gov.in">arvindsingh@sac.isro.gov.in</a> Phone: 079-2691 2267/2233
5.	Area of Research	Propulsion, navigation, structures Mecatronics
6.	<b>Summary of the proposed research</b>	<p>Design and Development of a platform based on air bearing concept to lift, at least 15kg mass about 5-10 micron above the surface and hold the position for desired period of time not less than 10 min.</p> <ul style="list-style-type: none"> <li>• Conceptualize the development of platform (provide mathematical model)</li> <li>• CAD model/ simulation of the development as required to meet the requirements.</li> <li>• Realization of platform.</li> <li>• Test and characterization of the platform.</li> <li>• Demonstration of platform capability.</li> </ul>
7.	<b>Scope of the proposed research</b>	This proposal is targeted for development of air bearing based platform for nullifying/compensating the effect of gravity for on ground testing of free flying robots for BAS/interplanetary missions.
8.	<b>Linkages to Space Programme</b>	Linked to Gaganyaan, BAS and interplanetary missions
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• CAD model and simulation results</li> <li>• Realized platform and anything else that is necessary to satisfactorily operate and maintain the platform.</li> </ul>



## RES-SAC-2024-037: Design and development of RF ASIC for SFCW ground penetrating radar

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Design and development of RF ASIC for SFCW ground penetrating radar</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Ravi Khatri Dr. Piyush Sinha
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail: <a href="mailto:ravik@sac.isro.gov.in">ravik@sac.isro.gov.in</a> Phone : 079 2691 5211  E-mail: <a href="mailto:piyush@sac.isro.gov.in">piyush@sac.isro.gov.in</a> Phone : 079 2691 5270 / 5279
5.	Area of Research	Radio frequency integrated circuit (RFIC)
6.	<b>Summary of the proposed research</b>  (A Simple concise statement about the investigation/theme in around 250 words)	<p>The research proposal aims to design and develop a highly efficient, compact RF ASIC tailored for Stepped Frequency Continuous Wave (SFCW) Ground Penetrating radar (GPR) operating within the 0.1 GHz to 2 GHz frequency range. The proposed RF ASIC will generate an SFCW signal with programmable step size of 2.5 MHz or 5 MHz and a minimum dwell time of 10μsec. It will feature a transmit section delivering an output power of 0dBm, crucial for optimal GPR performance in subsurface detection applications.</p> <p>The receive incorporate a 40dB gain and a 6-bit / 0.5dB step digital attenuator providing high sensitivity and precision in adjusting gain according to signal strength. Furthermore, the receiver will offer an IF output of 50 KHz requiring the generation of a LO signal shifted by 50KHz from the transmit frequency.</p> <p>The research focus on minimizing the RF ASIC size and power consumption which are critical parameters for battery powered GPR system. By addressing the challenges of efficient SFCW signal generation, reception and low power design, this ASIC will enable the development of more portable and durable GPR systems improving field performance in geophysical surveys, utility mapping and subsurface exploration.</p>
7.	<b>Scope of the proposed research</b>	The scope of the proposed research is to design, simulate, fabricate, and test a complete RF ASIC solution for SFCW GPR. The research will begin with the system level design, focusing on defining the

		<p>architecture of RF front-end, including the transmitter and receiver sections, along with the signal generation and reception chains. The design will be based on CMOS technology, balancing performance with power efficiency to ensure suitability for battery operated applications.</p> <p>The core design objectives include generating the SFCW signal with programmable step size (2.5MHz / 5MHz), developing a stable transmit section delivering 0dBm output, and implementing a receiver with 40dB gain and 6 bit digital attenuator. Moreover, the system will incorporate a 50 KHz IF output requiring generation of SFCW LO signal shifted by 50 KHz and coherent with transmit signal.</p> <p>The research will also focus on minimizing the overall power consumption and physical footprint of the ASIC to enhance its portability and suitability for field use. Testing will validate the system performance across required environmental condition to ensure robustness and reliability in real world GPR applications.</p>
<b>8.</b>	<b>Linkages to Space Programme</b>	GPR for interplanetary missions
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Design of RF ASIC with SFCW transmit output and receiver with 50 KHz IF output</li> <li>• RF ASIC prototype</li> <li>• Test result demonstrating ASIC performance.</li> </ul>

## RES-SAC-2024-038: Wide band wide beam circularly polarized antenna for Spectrum Monitoring Applications

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Wide band wide beam circularly polarized antenna for Spectrum Monitoring Applications</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Mohit Anand Shri Shibasish Prusty Shri Alok Kumar Singhal
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:mohitanand@sac.isro.gov.in">mohitanand@sac.isro.gov.in</a> Phone : 079-2691 2134/2133/2136  E-mail : <a href="mailto:shibasishprusty@sac.isro.gov.in">shibasishprusty@sac.isro.gov.in</a> Phone : 079-2691 2134  E-mail : <a href="mailto:alok@sac.isro.gov.in">alok@sac.isro.gov.in</a> Phone : 079-2691 2143/2132
5.	Area of Research	Microwave & Antenna Engineering
6.	<b>Summary of the proposed research</b>	Wide band circularly polarized antennas are required in various applications for signal reception from various directions. There is a requirement to not only receive the data transmitted from far end as well as spacecraft's but It is also required to determine the direction of the transmitted signal. The signals intended to be received may be of linear, elliptical or circularly polarized. For these applications the frequency band of interest may be from 100 MHz to 25 GHz and this full bandwidth may be split between 2, 3 or 4 bands. The typical gain required for this antenna is ~8dBi and should be right hand circularly polarized with bore sight axial ratio better than 3dB (<3dB) over the band of interest. The antenna should have a high front to back ratio and of the order of 15dB. The antenna should also have better than 17dB return loss. The antenna must be mechanically robust and should have compact and miniaturized in size and must have environment protection.
7.	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>Study of wide band radiating elements covering the full frequency band in a single unit or splitting the full bandwidth into maximum four bands. Design of Antenna elements for the individual frequency bands (1/2/3/4). Optimize the design under mechanical constraints. Realization of Antenna &amp;</li> </ul>

		characterization of antenna to validate the performance.
8.	<b>Linkages to Space Programme</b>	Spectrum monitoring payloads in various frequency bands.
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>Depending upon band splitting topology , One unit/Two/Three/Four unit Wideband, Wide beam circularly polarized antenna catering full frequency band ranging from 100 MHz to 25 GHz</li> </ul>

## RES-SAC-2024-039: Optical Beam Steering Photonic Chip for Lidar

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Optical Beam Steering Photonic Chip for Lidar</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri. Neeraj Keshav Dubey
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:neeraj_dubey@sac.isro.gov.in">neeraj_dubey@sac.isro.gov.in</a> Phone: 079-2691 3855/3880
5.	Area of Research	Photonic Lidar Optical Beam Steering
6.	<b>Summary of the proposed research</b>	<p>In a Lidar, a laser beam is formed to concentrate the optical power within single pixel instead of the whole scene, which makes it a point-wise measurement system. To form an image, the beam is scanned through the FOV. Namely, a beam scanner. Scanning LiDAR achieves higher signal-to-noise ratio (SNR) at the cost of lower points per second (i.e. point throughput) and slower frame rate, and more importantly, at the cost of having a beam scanner. Beam scanner is often realized through mechanical actuation of either the source itself or the discrete optics around the source. While mechanical optical beam scanner design is already an established domain of engineering, there is a fundamental challenge associated with achieving good control precision and reliability goals for automotive vehicles using a low-cost mechanical system. To reduce the unit cost of a scanner module and make it feasible for consumer electronics, various solid-state beam scanning solutions are the preferred option. There are many approaches to realize a photonic chip for Optical beam steering like MEMS Switch based array of grating coupler, Optical phased array, true time delay based beam steering, etc. The beam steering chip shall define the beam width of less than 0.2 degree and shall steer the beam within 20 degrees in both axes.</p>
7.	<b>Scope of the proposed research</b>	Design & Development of Photonic Lidar chip for optical beam steering
8.	<b>Linkages to Space Programme</b>	Future Lidar Programme for Soft landing
9.	<b>Expected deliverables</b>	Complete chip & Electronics for Optical Beam steering

## RES-SAC-2024-040: Development of metallized Graphite electrodes

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed Research	<b>Development of metallized Graphite electrodes</b>
3.	Name of Co-PI (Focal Point) from ISRO/DOS Centre/Unit	Shri Ramagiri Santhosh Kumar Smt. Shilpi Soni
4.	Contact Address of Co-PI (Focal Point), Phone Number and Email ID from ISRO/DOS	Email: santhoshr@sac.isro.gov.in Phone: 079-2691 8468/8408/8410  Email: shilpi@sac.isro.gov.in Phone: 079-2691 8455/2292
5.	Area of Research	Metallization on graphite for braze ability
6.	<b>Summary of the proposed research</b>	The Vacuum Electron Devices have a source emitting electrons and a collector that collects the electrons. The collector has a set of electrodes and for minimum power consumption these electrodes need to have very low secondary electron yield when they are hit by primary electrons. The resent proposal is for development of electrodes made of graphite which has low secondary electron yield and with suitable metallization so that they can be brazed with alumina insulators.
7.	<b>Scope of the proposed research</b>	To develop shaped graphite electrodes with suitable metallization (nickel/copper/gold) for brazing with Moly-manganese coated alumina ceramics <ul style="list-style-type: none"> <li>• Brazing Temperature: 1010 °C</li> <li>• The metallization shall survive temperatures up to 1050 °C</li> <li>• The electrodes shall be made of POCO graphite</li> </ul>
8.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• 5 sets of electrodes (each set consisting of 4 electrodes)</li> <li>• Dimensional inspection report including surface roughness and metallization thickness</li> <li>• Report of adhesion of metallization and maximum working temperature</li> <li>• Report on secondary electron emission properties of electrodes</li> </ul>
9.	<b>Linkage with SAC-ISRO mission/ programme</b>	TWTA development for communication payloads

## RES-SAC-2024-041: Acoustic Monitoring System

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Acoustic Monitoring System</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Anurag S Verma Shri Savit Anantharm
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:anuragsverma@sac.isro.gov.in">anuragsverma@sac.isro.gov.in</a> Phone: 079-2691 2227  E-mail : <a href="mailto:savit-hsfc@isro.gov.in">savit-hsfc@isro.gov.in</a> Phone: 080-6145 8666
5.	Area of Research	Sensors and processing
6.	<b>Summary of the proposed research</b>	<p>Acoustic Monitoring System is required to be developed to measure sound levels to ensure the noise level are within human tolerance limits. The proposal includes study, design and realization of Acoustic Monitoring system including sound level meters and accumulated acoustic dosage. This is intended for usage in microgravity environment.</p> <p>The instrument should provide average sound pressure level measurements and spectral measurement as a function of frequency over a range of 63Hz to 20kHz and measure audio levels in three user selectable measurement ranges (40-130 dB RMS. The instrument should provide overall Sound Pressure Levels at a definite interval (~30 seconds)</p> <p>DC supply operated, Low power, miniaturized , data interface to connect with PC(USB or equivalent)</p>
7.	<b>Scope of the proposed research</b>	Noise Exposure on Human Space Missions poses significant risk to crew, including sleep disruptions, hearing loss, reduction in alarm audibility. Both real time and accumulated dosages have to be quantified. Miniaturized Acoustic Monitoring System is to be realized for the same.
8.	<b>Linkages to Space Programme</b>	Linked to human space program, Gaganyaan and Bharatiya Antariksh Station.
9.	<b>Expected deliverables</b>	Acoustic Monitoring System prototype hardware. Hardware design details, Software Applications and Source Codes

## RES-SAC-2024-042: Characterization of Polymeric Materials for Human Space Missions from Human Rating Aspects

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Characterization of Polymeric Materials for Human Space Missions from Human Rating Aspects</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Prateek Bansal Shri Divyanshu Singh Shri Ravi Kumar Varma Shri Amit Kumar Gupta
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:prateek@sac.isro.gov.in">prateek@sac.isro.gov.in</a> Phone: 079-2691 4548  E-mail : <a href="mailto:divyanshu-hsfc@isro.gov.in">divyanshu-hsfc@isro.gov.in</a> Phone: 080-2217 2637  E-mail : <a href="mailto:rkv@sac.isro.gov.in">rkv@sac.isro.gov.in</a> Phone: 079-2691 4593  E-mail : <a href="mailto:amitgupta@sac.isro.gov.in">amitgupta@sac.isro.gov.in</a> Phone: 079-2691 4548
5.	Area of Research	Polymeric materials
6.	<b>Summary of the proposed research</b>	<p>Gaganyaan is the milestone ISRO project to carry crew(s) to low earth orbit and bringing them back to earth safely.</p> <p>Crew Module shall be designed to have comfortable &amp; safe for humans. This requires strict scrutiny of materials inside crew module considering human safety as utmost importance.</p> <p>Flammability and Off-gassing tests are two of the four major “required” tests as per NASA-STD-6001B, that has to be passed by every Polymeric material used within habitable environment (crew module) before use in manned mission.</p> <p>Considering long term human mission program that included test flights, unmanned mission, manned mission and further extending to Bhartiya Antariksh Station (BAS), there is a need to study the suitable methods to characterize such materials for flammability and Off-gassing assessment.</p>



		Suitable test setups need to be developed to perform complete characterization. A complete set of detailed literature shall be made available to SAC upon completion of test setup developments.
<b>7.</b>	<b>Scope of the proposed research</b>	<ul style="list-style-type: none"> <li>• Establish most suitable method to characterize various Polymeric materials for use in Human Space missions from flammability and Off-gassing aspects considering acceptable limits as in international standards for habitable environment.</li> <li>• Develop test setup(s) to perform end-to-end characterization of materials as per above requirement.</li> <li>• Provide step-by-step procedure for performing tests, calibration and maintenance of test setups.</li> </ul>
<b>8.</b>	<b>Linkages to Space Programme</b>	Human Space Program (current manned/ unmanned Gaganyaan and future BAS)
<b>9.</b>	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Study report on most suitable method to characterize various materials for use in Human Space missions from flammability &amp; Off-gassing aspects considering acceptable limits as in international standards for habitable environment.</li> <li>• Established Test setups for performing characterization for flammability and Off-gassing assessment.</li> </ul>

## RES-SAC-2024-043: Custom Voice Command Identification

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Custom Voice Command Identification</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Saket Chawla Shri Ansuman Palo
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:chawlasaket@sac.isro.gov.in">chawlasaket@sac.isro.gov.in</a> Phone: 079-2691 2228/2245  E-mail : <a href="mailto:apalo-hsfc@isro.gov.in">apalo-hsfc@isro.gov.in</a> Phone: 080-6145 8656
5.	Area of Research	Artificial Intelligence
6.	<b>Summary of the proposed research</b>	<p>A lightweight neural network model is required to isolate background noise and identify commands using customized phrases. The model should have low computation needs to optimize the use of power in space based applications.</p> <p>The developed model will require to be compared against other freely available solutions to develop a benchmark</p>
7.	<b>Scope of the proposed research</b>	<p>In a long duration mission astronauts will issue a lot of commands. Some of the commands may also be required to be issued while the astronauts are engaged physically in other work.</p> <p>In such scenarios voice based commanding for non-critical actions provide a viable and very intuitive alternate to traditional input through buttons or touch display.</p> <p>The model will be used in digital assistant to astronauts for voice based interactive commanding.</p>
8.	<b>Linkages to Space Programme</b>	Human Space Program
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Code for custom phrase data collection and preparation</li> <li>• Code for model training</li> <li>• Code for realtime multi-word command identification</li> </ul> <p>Preferred Code Language : Python or C</p>

## RES-SAC-2024-044: AI/ML based airborne LiDAR full waveform data processing for noise, feature extraction and annotation

1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>AI/ML based airborne LiDAR full waveform data processing for noise, feature extraction and annotation</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Sandip Paul Shri Jimit j Gadhia
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:san@sac.isro.gov.in">san@sac.isro.gov.in</a> Phone: 079-2691 3865  E-mail : <a href="mailto:jimit@sac.isro.gov.in">jimit@sac.isro.gov.in</a> Phone: 079-2691 3857/3898/3881
5.	Area of Research	Optics: Active remote sensing, airborne LiDAR
6.	<b>Summary of the proposed research</b>	<p>Full waveform LiDAR are upcoming state- of the art instruments having data in terabytes. The challenge here is to extract relevant information to convert the same into 3D annotated images and reduce the data volume.</p> <p>The proposal requires Noise and outliers' reduction from the raw full waveform dataset. LiDAR data is expected to have background noise from atmosphere, background clutter and instrument itself.</p> <p>Various features like buildings, roads, trees, understory vegetation, ground surface, etc. need to be automatically identified and annotated with semantic labeling for large boundaries for land applications.</p> <p>Various features from water bodies, underwater objects near coastline, etc. need to be automatically identified and annotated with semantic labeling for large boundaries.</p> <p>Internet based *.LAS/*.LAZ files may be used for initial training, testing and benchmarking.</p>
7.	<b>Scope of the proposed research</b>	<p>The scope includes Machine learning and AI techniques for robust algorithm development &amp; near real time processing. The development includes</p> <ul style="list-style-type: none"> <li>• ML and AI algorithms development</li> <li>• Labelled dataset development (real &amp; synthetic)</li> </ul> <p>Test/ Characterization</p>

8.	<b>Linkages to Space Programme</b>	<p>Airborne LiDAR</p> <p>SAC is developing airborne LiDAR for topography and bathymetry remote sensing applications. The LiDAR has two bands (1064nm &amp; 532nm) and will image the earth from approximately 1km altitude. The instrument is based on full wave form processing which will provide insight to type of reflections from the source other than ranging. A RGB camera will be integrated to the system for augmenting LiDAR data. Further, an IMU and GPS system will provide the additional information for placing the pixels in 3D world coordinates.</p>
9.	<b>Expected deliverables</b>	<ul style="list-style-type: none"> <li>• Algorithm/ models</li> <li>• Trained dataset &amp; models</li> <li>• Test bench/ hardware if any</li> </ul>

## RES-SAC-2024-045: Water quality monitoring System for microgravity environment

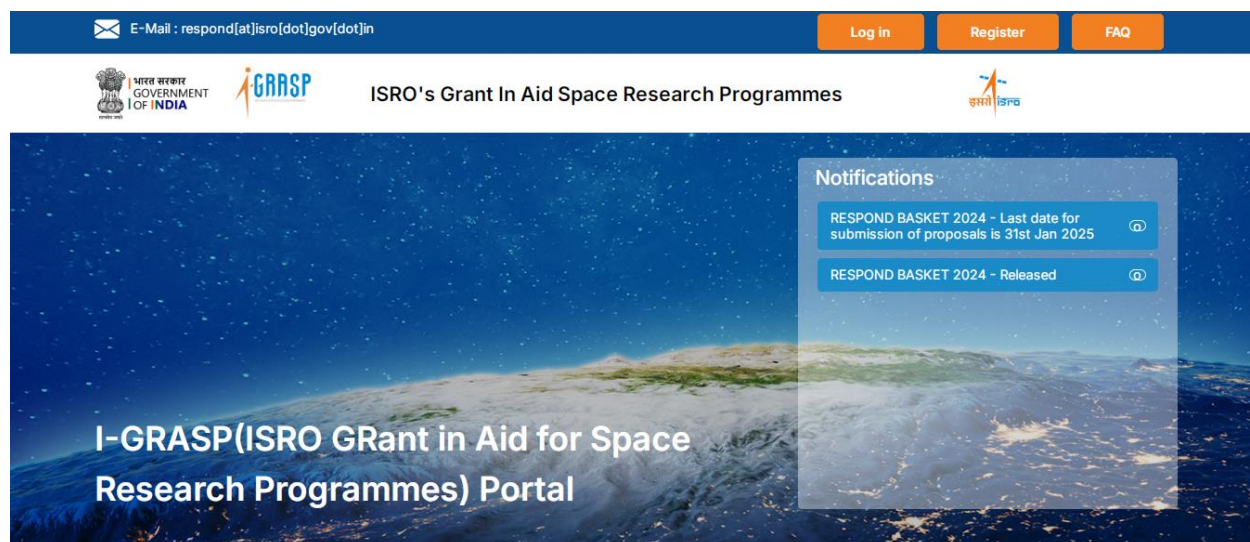
1.	Name of ISRO/DOS Centre/Unit	Space Applications Centre, Ahmedabad
2.	Title of the proposed research proposal	<b>Water quality monitoring System for microgravity environment</b>
3.	Name of Co PI (Focal Point) from ISRO DOS Centre/Unit	Shri Anurag S Verma Shri Priyesh Kumar Jain
4.	Contact details of Co-PI (Focal Point), and Email ID from ISRO/DOS	E-mail : <a href="mailto:anuragsverma@sac.isro.gov.in">anuragsverma@sac.isro.gov.in</a> Phone: 079-2691 2227  E-mail : <a href="mailto:priyesh-hsfc@isro.gov.in">priyesh-hsfc@isro.gov.in</a> Phone: 080-6145 2640
5.	Area of Research	Sensors
6.	<b>Summary of the proposed research</b>	<ul style="list-style-type: none"> <li>Design and Realization of water monitor pH, TDS, Total Organic Carbon (TOC) etc, for usage in microgravity environment. For potable water TOC has to be limited to &lt;160mg/L, hence the range has to be selected accordingly.</li> <li>Total Organic Carbon is a key indicator of water quality as carbon is present in most dangerous contaminants. The unit should measure TOC in ug/L at a fixed sampling rate</li> <li>Battery operated, Low power, miniaturized ,data interface to connect with PC(USB or equivalent)</li> </ul>
7.	<b>Scope of the proposed research</b>	Design and development of quality of onboard water monitoring including parameters like pH, TDS, Content, TOC etc. are of prime importance in case of recycled water to ensure a safe supply of potable water is available to the crew. Water monitoring is essential in long term missions.
8.	<b>Linkages to Space Programme</b>	Linked to human space program, Gaganyaan and Bharatiya Antariksh Station
9.	<b>Expected deliverables</b>	Water Monitoring System prototype hardware. Hardware design details, Software Applications and Source Codes,

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## **Annexure -1: Screenshot of “I-GRASP” online portal**

Submission of RESPOND Basket 2024 Proposal through “I-GRASP” online portal  
(ISRO GRant in Aid for Space Research Programmes)

→ Link <https://igrasp.isro.gov.in/>



### **Welcome To i-GRASP**

Academic Interface is one of the most important activities of CBPO and it aims at encouraging joint collaborative research with academia/Labs/institutes and establishing the Knowledge/incubation/research etc., across the country. Recognising the need for a broader academic interface with institutions across the country, a series of capacity building initiatives have been taken up to further strengthen the involvement of academia for ISRO programmes. These initiatives include R&D Projects (RESPOND Basket); Space Technology Cells (STCs); Regional Academic Centres for Space (RAC-S); Space Technology Incubation Centres (S-TICs).

Research proposals are supported by ISRO in the areas of Space Science, Space Technology and Space Applications which are of relevance to Space Programme. RESPOND Basket document published annually comprises of the most urgent and important research problems identified by ISRO/DOS Centre / Units on the basis of ISRO's upcoming programmatic R&D requirements. And Research Area for Space Document published bi-annually with same moto. Each research problem comprises of a brief write-up about the topic for the faculty of the Academic Institutions/R&D laboratories to select and prepare the proposals. A Co-PI from ISRO/DOS Centres has also been identified for each topic proposed in the Basket.

<https://igrasp.isro.gov.in/>

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## **Annexure -2: Declaration Form (Form-C)**

### **Form –C**

#### **Terms and Conditions of ISRO Research Grants**

1. The approved funds should be utilized solely for the purpose for which they have been granted unless ISRO agrees otherwise. A Certification that the funds have been so used should be produced by the grantee Institution after the end of each year of the support.
2. Due acknowledgement to ISRO should be made in all reports and publications arising out of the part of the work supported by ISRO. The grantee will take prior permission of ISRO before publishing any work based on the ISRO supported project.
3. Two copies of all the publications resulting from the research conducted with the aid of the grant should be submitted to ISRO.
4. Any intellectual property rights or such information/knowledge being able to sustain or create or any such right arising out of the projects sponsored by ISRO will be held jointly by the Academic Institution/R & D institution and ISRO as per RESPOND norms. Academic Institute/R & D institution and ISRO shall inform each other before filing for any protection of any Intellectual Property Rights resulting from any of the project sponsored by ISRO. Academic institute/R & D institution and ISRO will ensure appropriate protection of Intellectual Property Rights generated from cooperation, consistent with laws, rules and regulations of India. The expenses for filling the Patent protection in India and abroad shall be borne equally between Institute and ISRO. Any/all financial accruals due to any commercial exploitation, of this patent shall be shared equally between them, on 50:50 basis. However any of the parties is free to utilize the IPR for their own use on non commercial basis.
5. The principal Investigator is required to submit two copies of yearly reports indicating the progress of the work accomplished. He is also required to submit two copies of a detailed technical report on the results of the research/development after the completion of the project. The reports will become the property of ISRO.
6. In addition, ISRO may designate Scientists/specialists to visit the Institution periodically for reviewing the progress of the work.
7. An inventory of items purchased from ISRO funds should be sent to ISRO, giving the description of equipment, cost in rupees, date of purchase and name of the supplier along with a purchase certificate from the Administration of the Institution. All items of equipments and unconsumable items costing more than Rs. 5,000/- shall remain the property of ISRO and ISRO reserves the right to transfer them or dispose of them on the termination of the project as ISRO may deem fit.
8. The accounts of the expenses incurred out of ISRO funds should be properly maintained and should be authenticated by an approved auditor. The final accounts statement in duplicate duly audit should be sent to the pay & Accounts Officer, DOS/Senior Accounts Officer, ISRO Headquarters, as the case may be, at the end of each financial year of support.
9. If the total amount sanctioned is not spent during the period of support, the remainder amount should be surrendered to the Pay & Accounts Officer, ISRO Headquarters, as the case may be, within one month after the completion of the project.
10. The assets acquired wholly or substantially out of the ISRO grant should not, without its prior sanction, be disposed off, encumbered or utilized for purposes other than that for which the grant is sanctioned.
11. A register of assets permanent and semi-permanent should be maintained by the grantee Institution, which should be available for scrutiny by Audit.

12. The grantee institution should not divert the grants-in-aid for utilization of the same for similar objects of another institution if it is not in a position to execute or complete the assignment. The entire amount of the grant should then be immediately refunded to ISRO by the institution.

13. The terms and condition of ISRO research grants are subject to change from time to time, but the funding of any project will be governed by the terms and conditions existing on the date of starting of the project with ISRO funds.

### Declaration

I / We have clearly read the above terms and conditions and 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.

	<b>Signature &amp; Name</b>	<b>Designation</b>
Principal Investigator		
Head of the Department / Area		
Head of the Institution		

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रिसपांड एवं अनुसंधान प्रबंधन प्रभाग  
**RESPOND and Research Management Division**  
अनुसंधान, बाह्यसंपर्क एवं प्रशिक्षण प्रबंधन समूह  
**Research, Outreach and Training Management Group**  
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