

Satish Dhawan Centre for Space Sciences
*(An Advanced research Centre of ISRO, Government
of India)*

सतीश धवन अंतरिक्ष विज्ञान केंद्र



Annual Report
(2025-26)

जम्मू केन्द्रीय विश्वविद्यालय / **Central University of Jammu**

Rahya-Suchani (Bagla), District: Samba – 181143, Jammu (J&K), India

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1. Introduction to Satish Dhawan Centre for Space Sciences

The centre is named after Satish Dhawan, father of experimental fluid dynamics research in India and former Chairman of ISRO (1971-84). He was born in Srinagar and played leading the successful and indigenous development of Indian space programme. The Centre will have facilities for Geospatial Data analysis that will help in sustainable use of natural resources and planning land-use pattern. It will also have ground-based observations for atmospheric studies, research lab for astrophysics, atmospheric/remote sensing and glacier studies lab for better use of large quantity of water stored in the form of seasonal snow, ice and glaciers in the rivers of North India. It will also have Disaster Management Center to take up research in the area of different disasters like flood, landslides, forest fires, drought and climate change. Materials Sciences Lab for space applications will be also established for synthesizing and designing new sensors and materials for space applications.

Vision Statement:

Advances in technology are transforming just about every facet of our lives. Space technology is already an integral, if widely unseen, part of Indian life. It is so heavily integrated into today's economy and wider society that denial of access, for example to global navigation satellite system (GNSS) services, which are of paramount importance in context with India sub-continent. All levels of government, industry and society now rely on data and information applications derived from Earth observations from space. These applications maintain our economic and societal well-being in areas including communications, weather and seasonal forecasting, onshore and offshore mining, mitigation of natural hazards and management of disasters, water resource management, national security, insurance assessment, and land use planning and monitoring. Space science is the essential foundation that enables us to understand and operate technology in the unforgiving environment of space. By virtue of India position on our planet, space technology must play a central role in affordable solutions to many of our pressing national challenges. In fact, an analysis of the space sector and of its prospects for scientific, industrial and economic development must begin with the deep changes taking place in the world of space, provoked by the arrival of large, private companies

that have seen a commercial opportunity in the spillover of space activities: from sub orbital journeys and low orbit tourism to the quantities of data provided by the Earth Observation satellites. For a long time now, space has been a super infrastructure, pervasive and without borders by definition, and we continue to discover its new and intertwined potential every day. In this context, the services and applications arising from Earth Observation are destined to grow, creating a formidable new value chain capable of reaching all users (institutional, commercial and private citizens) thanks to the driving force of the Internet. The satellite service becomes a low cost utility capable of indirectly generating revenue for those companies that are able to anticipate our society's needs. Space technologies increasingly and positively influence our lives. Thanks to Earth Observation, for example, we can monitor the oceans, the dynamics of various ecosystems and vegetation with extreme precision. The key focus of centre is envisaged to make it possible for us to analyze climate change and its indicators in increasingly greater depth, monitor the implementation of international agreements aimed at limiting the effects of human activities on the climate and also provide accurate forecasts allowing us to act more quickly in the event of natural disasters. The information and the data base generated can supplement as one of the key components in the initiatives that have been undertaken by Government of India in NAPCC (National Action Plan on Climate Change). It is in light of this that Dr. Satish Dhawan Centre of Space Science, Central University of Jammu, Vision Document is created. Its purpose is to organize, over the next decade, vast set of responsibilities and commitments and move forward towards the achievement of four strategic goals in collaboration with ISRO:

- ♣ **promoting the development of services and applications for the space economy;**
- ♣ **promoting the development of infrastructures for the space economy;**
- ♣ **accelerating and supporting scientific and cultural progress in a context of international collaboration (science diplomacy);**
- ♣ **increasing the country's international prestige (space diplomacy).**

Significance

It will help in tapping potential of Space Applications for region of J&K in various fields like disaster management, health, education, communication, weather forecasting, land use planning, etc. It will also provide opportunity to youth of the region to contribute to the field of space science as well as to the nation. It will also take care of the emerging Geospatial and Space Technology requirements for development of the region as its economy and habitations are affected by vegetation cover, forest area, snow, landslides, avalanches, ground water, cloud cover, atmospheric conditions etc.

Thrust Research Areas

The various research labs facilities which are coming up at the centre are given below:

1. **Remote Sensing and Geographic Information Systems Lab:** Geographic Information System coupled with remote sensing data application is one of the most important tools in the modern day ecological and other field based studies. It provides new capabilities for analysing the space/time distribution of ecological phenomena. The aim of this lab will be to Promote Space Applications in exploration and other mining activities for “Satellite Based Geological Mapping and Multidisciplinary Exploration of Iron, Diamond and other mineral deposits”. It is a major step forward towards “Digital India” as Space Technology provides real – time data for generation of digital maps. This Lab will be having Licences, “ERDAS” and “ARC-GIS” software along with high end “Workstations”. It is an important area and opens up new opportunities for sustainable use of natural resources; particularly land, water and bio-diversity. Geospatial data will be used to understand the land-use pattern and what changes are needed and how do you manage serious droughts and floods.
2. **Ground based observations for atmospheric studies:** Considering the recurring natural calamities in the region, requirement of strengthening ground based observational capabilities of this region for weather and atmospheric research is to be given importance. ISRO will help CUJ to set up ground-based observation facilities for atmospheric studies like automatic weather stations, GPS radio stations etc., as part of their ongoing programmes. Possibility of establishing a Doppler Weather Radar (DWR)

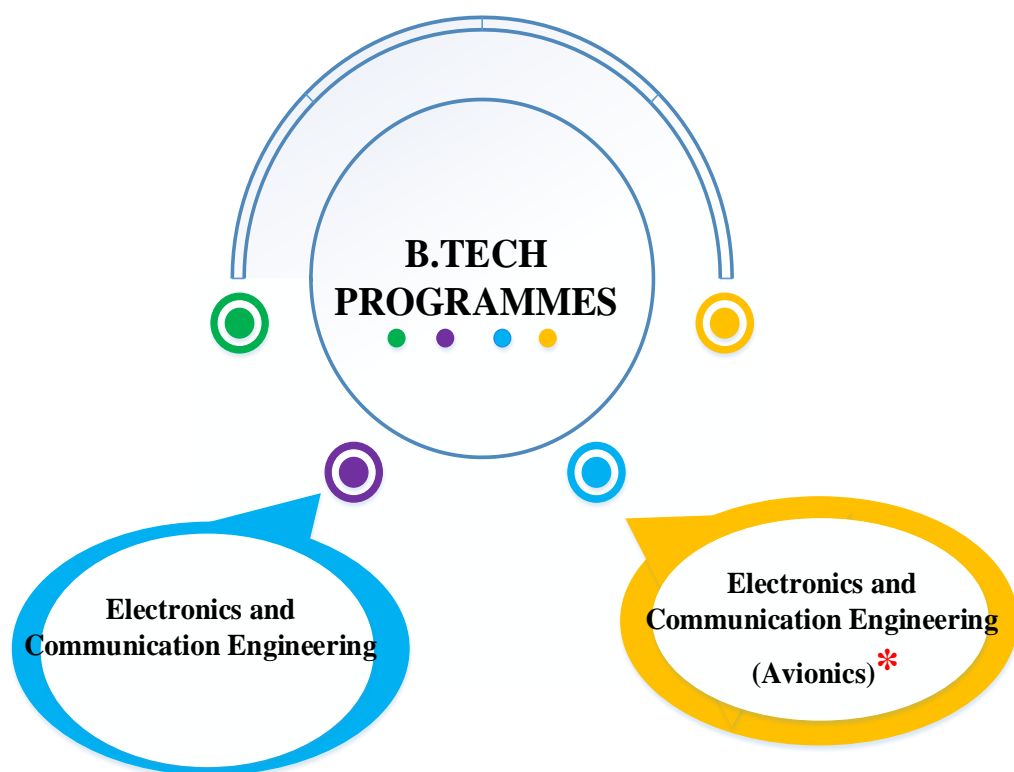
in consultation with IMD will also be explored.

3. **Research lab for astrophysics:** Laboratory astrophysics and complementary theoretical calculations are the foundations of astronomy and astrophysics and will remain so into the foreseeable future. The impact of laboratory astrophysics will range from the scientific conception stage for ground-based, airborne, and space-based observatories, all the way through to the scientific return of projects and missions. ISRO data will be used to understand the under-lying physical processes and the measurements of critical physical parameters that allow us to address fundamental questions in astronomy and astrophysics.
4. **Materials Sciences Lab for space applications:** Based on the faculty expertise at Central University of Jammu in the field of radiation Dosimetry, advanced materials, nanotechnology, sensors, energy and Environmental Science, computational, laser and device Physics, the material research lab for space application will be setup at CU Jammu. Special focus of this lab will be to synthesize and design new sensors and materials for space applications.
5. **Disaster management Unit:** There are different types of disasters encountered in different parts of the country varying in magnitude and occurrence. The following are the types of disasters based on its frequency like Drought, Flood/cyclone, Forest fire and Landslides will be monitored withspace technology.

2. B.Tech programs

The Satish Dhawan Centre for Space Sciences started four-year degree programmes comprising of B.Tech in engineering disciplines such as Electronics and Communication Engineering and Electronics and Communication Engineering (Avionics) with its first batch of students in 2022. The second batch of students got admitted in July-August 2023.

Under the Satish Dhawan Centre for Space Sciences, the following two B.Tech programmes are ongoing. These programs are approved under the mentorship of Indian Institute of Space Science and Technology (IIST) – Indian Space Research Organization (ISRO).



* Under the mentorship of Indian Institute of Space Science and Technology (IIST) – Indian Space Research Organization (ISRO).

MINOR DEGREE PROGRAMS OFFERED BY ECE DEPARTMENT:

1. Semiconductor and Microelectronics
2. Cyber Security
3. Space Technology

4. Mathematics & Computing
5. AI/ML
6. Quantum Computing

3. Facilities and Research Lab Created

3.1 Equipment and Machines installed in High End Characterization Laboratory

S.No	Name of the Equipment	Quantity	Cost (in Lakhs)
1	Uv-Vis-Nir Spectrophotometer	1	
2	Powder X-Ray Diffraction	Rigaku Miniflex (600 Watt)	1
		Anton Paar (3 Kilowatt)	1
3	Fourier Transform Infrared Spectroscopy	1	
4	Photoluminescence Spectrophotometer	1	
5	Atomic Absorption Spectrophotometer	1	
6	Dynamic Light Scattering Litesizer Series	1	
7	Particle Size Analyser	1	
8	Thermogravimetric Analyser	1	

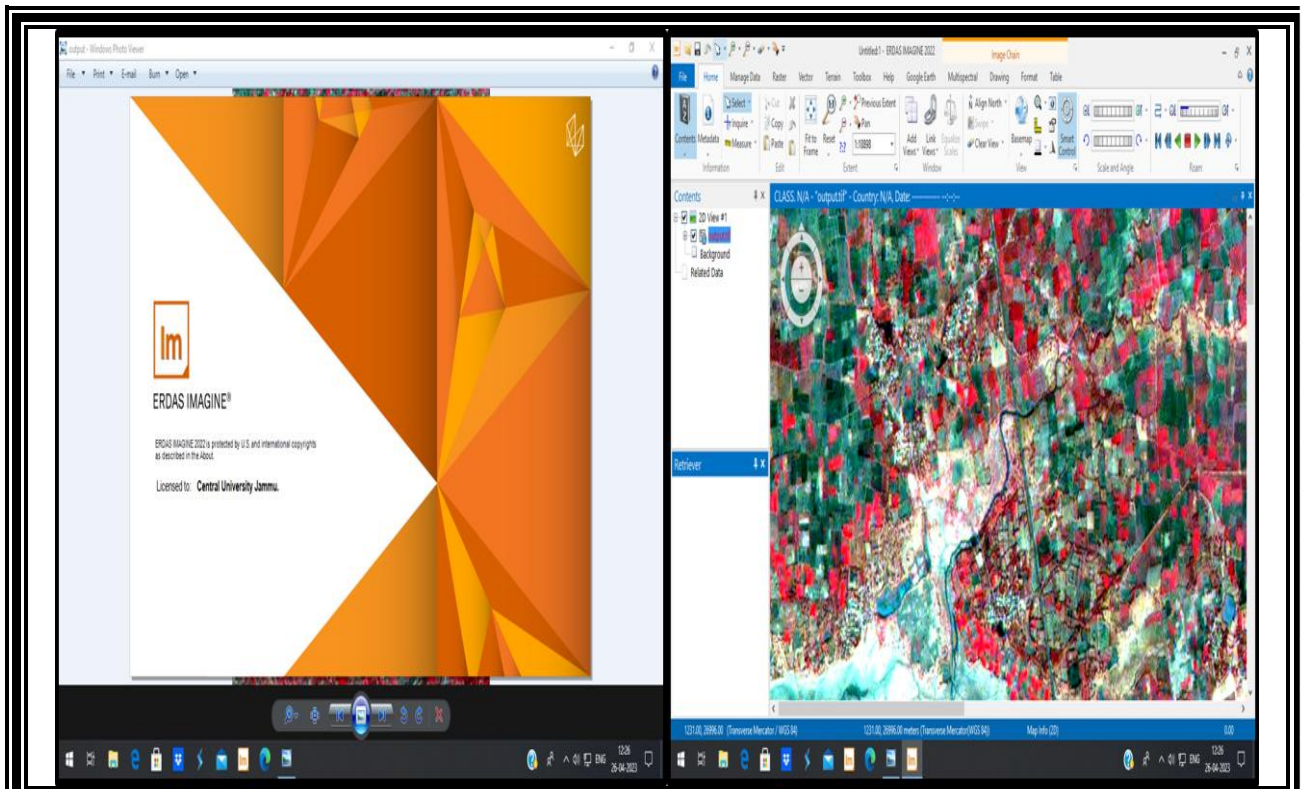
3.2 Software installed in Remote Sensing Laboratory

S.No	Name of the Software	Quantity (Education Server License)	Cost (in Lakhs)
1	ERDAS IMAGINE	10	
2	IGiS	10	

1. ERDAS (Earth Resource Data Analysis System)

ERDAS (Earth Resource Data Analysis System) is a suite of geospatial software products that allows users to process, analyse, and visualize remote sensing and other spatial data. ERDAS software is commonly used in fields such as geology, agriculture, environmental studies, forestry, and urban planning. It includes tools for data management, image processing, vector analysis, terrain analysis, and cartography, among others. The software is developed by Hexagon Geospatial, a provider of geospatial software solutions.

Installation Demo of ERDAS IMAGINE in Remote sensing Lab at SDCSS,CUJ



Application

ERDAS software has a wide range of uses in various industries that rely on geospatial data. Here are some examples of how ERDAS software is used:

Remote sensing and image processing: ERDAS software is used to process, analyze, and visualize remote sensing data such as aerial photographs, satellite imagery, and LiDAR data. It can perform various image enhancement techniques, image classification, change detection, and more.

Cartography and mapping: ERDAS software allows users to create and edit maps, generate terrain models, perform terrain analysis, and more.

Environmental monitoring: ERDAS software is used in environmental studies to monitor and analyze changes in the environment, including vegetation cover, land use, and land cover changes.

Agriculture: ERDAS software is used in agriculture to monitor crop growth, identify plant diseases, and assess soil health.

Disaster management: ERDAS software is used in disaster management to monitor and assess the impact of natural disasters such as floods, hurricanes, and earthquakes.

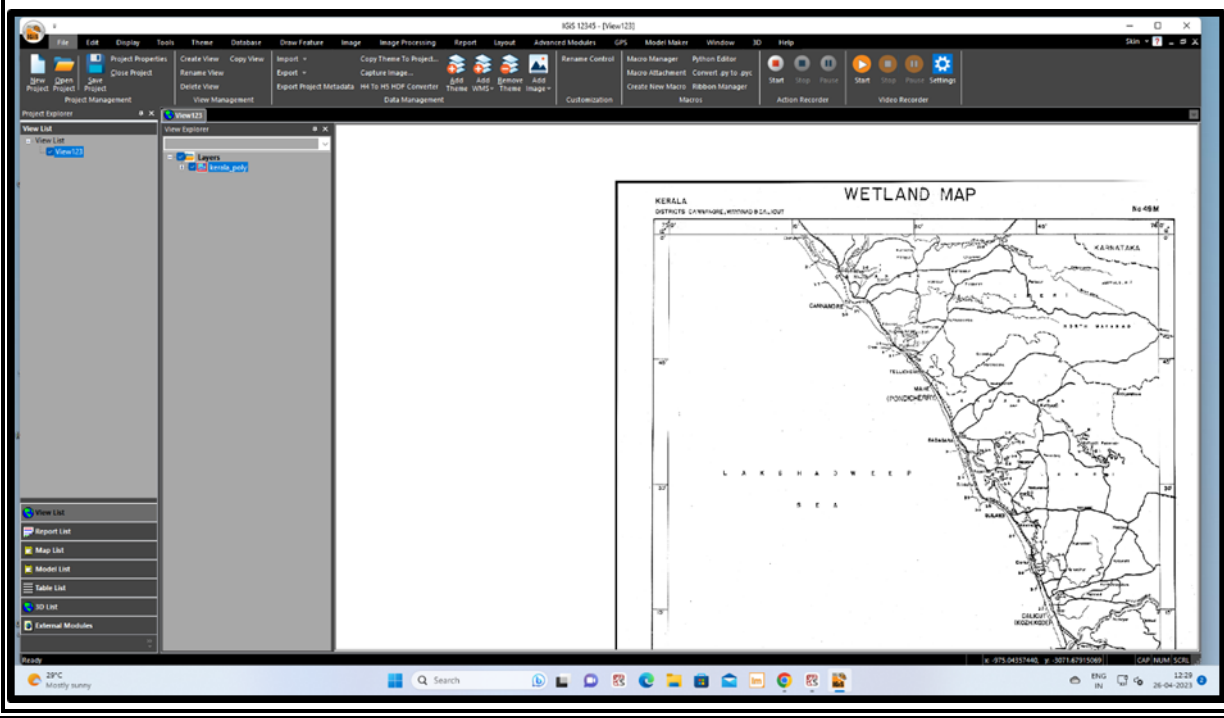
Urban planning: ERDAS software is used in urban planning to create land use maps, assess urban growth, and develop urban infrastructure plans.

Overall, ERDAS software is a powerful tool for processing, analyzing, and visualizing geospatial data, making it an essential tool for various industries that rely on this type of information.

2. IGiS

IGiS enables you to store, manage, and edit geospatial data seamlessly. It is a comprehensive tool that supports data integration for a wide range of geospatial data formats including real-time sensor data and big data. Compliance to OGC Standards enables you to store and share data through privileged authentication.

Installation Demo of IGiS software in Remote sensing Lab at SDCSS, CUJ



Application

The GIS software can be used for a wide range of geospatial data applications, including:

Environmental monitoring: GIS can be used to monitor and analyze various environmental data, such as water quality, air quality, and land use patterns. With its geospatial data processing and analysis capabilities, GIS can help identify trends and patterns in environmental data, and provide valuable insights for decision-making.

Urban planning: GIS can be used in urban planning and development projects to analyze land use patterns, population density, transportation networks, and other spatial data. This can help planners identify areas of need and make informed decisions about development and infrastructure.

Emergency management: GIS can be used to support emergency management efforts, such as disaster response and recovery. With its ability to process and analyze large amounts of geospatial data in real-time, GIS can help emergency responders quickly identify areas of need and allocate resources more effectively.

Agriculture: GIS can be used to analyze various aspects of agriculture, such as crop health, soil quality, and water availability. By using geospatial data to analyze these factors, farmers can make more informed decisions about crop management and resource allocation.

Natural resource management: GIS can be used in natural resource management projects, such as forestry, wildlife conservation, and mineral exploration. By analyzing geospatial data on land use, terrain, and vegetation, GIS can help identify areas of conservation value and inform resource management decisions.

3.3 Equipment installed in Atmospheric Sciences Lab

S.No	Name of the Equipment	Quantity	Cost (in Lakhs)
1	Automated Weather Station	1	
2	LRX-1 Lightning Network Detector and Sensor	1	

1. Automated Weather Station

Automated weather stations have become the global norm for studying climate and meteorology in the boundary layer. The weather station is installed for the safety and planning benefits in the campus and for all current weather monitoring like Sunshine and UV intensity levels; Additional temperature and humidity levels; Parameters of interest in agriculture such as soil moisture and leaf wetness.

Automatic Weather Station designed by Advance Tech India Pvt Ltd installed at SDCSS, CUJ



Application

The aforementioned stations predominantly provide surface weather observations, such as: Temperature, Relative Humidity, wind speed, Wind Direction, Rainfall, Atmospheric Pressure, Soil Temperature, Soil Humidity, Soil Conductivity.

2. LRX-1 Lightning Network Detector and Sensor

The LRX-1 is a high precision / high accuracy lightning network detector that delivers strike data to up to three separate servers within milliseconds of a strike occurrence.

BOLTEK lightning Network sensor and Detector installed at SDCSS,CUJ



Application

The LRX-1 Lightning Network Detector allows users to create a lightning detection network. In the standard configuration, data from multiple distributed lightning detectors is sent over the internet to a central server for processing. Once the exact strike location is calculated the data is both stored in a database on the server and sent back over the internet to live display clients. Static and animated lightning maps can also be created for display on a web site.

4. Other Activities:

4.1 CANSAT PROJECT: ASTRO Team selected for final round of IN-SPACE CANSAT Competition at Kushinagar in October 2025

The CUJAMMU ASTRO team from Central University of Jammu was selected to compete in the final round of the IN-SPACE CANSAT Student Competition-2025, that took place from October 25, 2025, in Kushinagar, Uttar Pradesh. The eight-member team includes Arpan Dey, Shalini Gupta, Kritish Nagyal, Tushar Pandey, Ritwik Aggarwal, Balakrishan, Arnav Mathur, Visheshwar Pandey. from B.Tech (ECE and Avionics which is mentored by IIST and ISRO). They are working under the Faculty Advisor Prof. Rakesh Kumar Jha (HoD, ECE department) and under the mentorship of Dr. Misbah Shafi and Dr. Haneet Kour from ECE department.



ASTRO Team for IN-SPACE CANSAT Student Competition-2024

The IN-SPACe CANSAT Student Competition, organized by the Indian National Space Promotion and Authorization Centre (IN-SPACe) in association with The Astronautical Society of India (ASI), aims to inspire the next generation of space enthusiasts and foster innovation in space science and technology. The competition provides a platform for students to showcase their talent and creativity, preparing them for the challenges of the space industry. The competition was graced by Chairman- ISRO, President- ASI, Dr. Pawan Goenka, Chairman of IN-SPACe, Dr. Vinod Kumar, Promotions Director, In-SPACe.



IN-SPACe CANSAT Student Competition-2025 Prize distribution.

4.2 ROCKETRY PROJECT: CU JAMMU ASTRO Team received Best in Design in final round of IN-SPACE CANSAT Competition at Kushinagar in October 2025

CU Jammu ASTRO Team) has brought laurels to the institution by winning the ‘Best Design Award’ in the *Model Rocketry* category at the Model Rocketry/CANSAT India Student Competition 2025, held from October 26 to 30 at Tumkahiraj, Kushinagar, Uttar Pradesh.

The four-day grand finale, organised by the Indian National Space Promotion and Authorisation Centre (IN-SPACE) in collaboration with the Indian Space Research Organisation (ISRO) and the Astronautical Society of India (ASI), is one of India’s largest student-led space competitions. This year’s event saw participation from 71 student teams comprising around 600 students representing premier institutions across the country. Of these, 35 teams competed in *Model Rocketry* and 36 teams in the *CANSAT* category.



CU Jammu ASTRO team-2025 at Kushinagar, UP for final launch of Rocket.

The competition aimed to promote innovation and hands-on experience in designing, developing, and launching model rockets capable of deploying miniature satellites at an altitude of 1.5 km. Expressing pride in the achievement, the CU Jammu team highlighted that the recognition for *Best Design* reflects their innovative approach, teamwork, and technical precision in rocket structure and payload integration.

The teams were supervised by faculty coordinator Prof. Rakesh Kumar Jha from the Satish Dhawan Centre for Space Science, Department of Electronics and Communication Engineering. The teams consisted of eight student members each in CANSAT and ROCKETRY team respectively from B.Tech ECE and B.Tech ECE-Avionics, mentored by Dr. Misbah Shafi and Dr. Haneet Kour. The participation was made possible with the encouragement and constant support of Hon'ble Vice Chancellor, Prof. Sanjeev Jain.

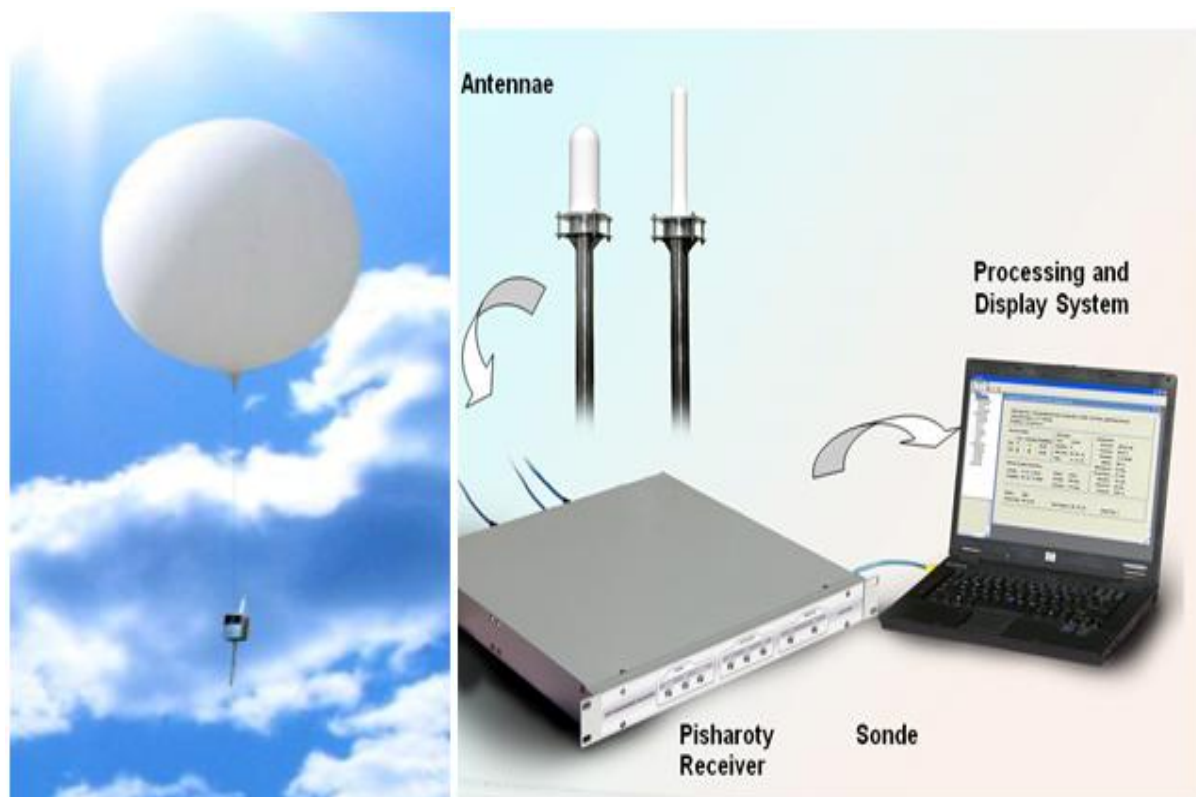
4.3 Radio Sonde (Weather Balloon) launched from ISRO Centre at CU Jammu

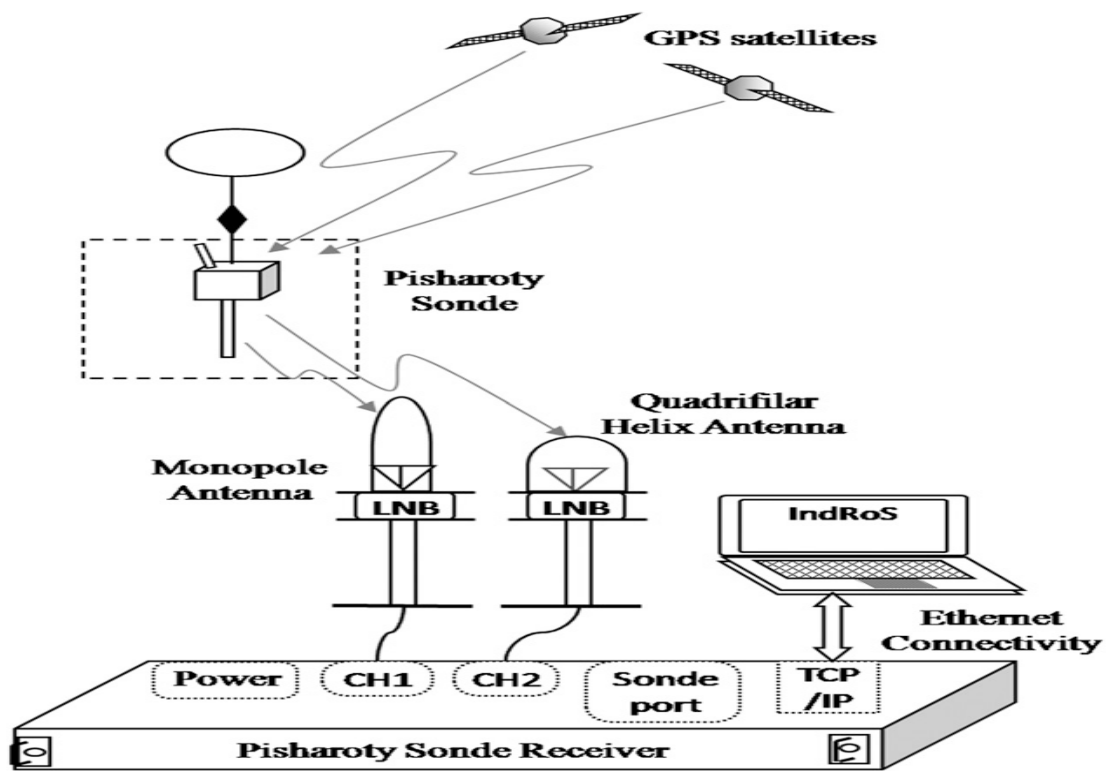
The Memorandum of Understanding was made between Central University of Jammu and National Remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO), Department of Space, Government of India, Hyderabad, Telangana on 25th October, 2022. The purpose of the MOU is to measure the vertical profiles of Temperature, relative humidity and winds using GPS aided radiosonde. The Radiosonde Network for NICES (RANN) project falls under the NICES program (National Information System for Climate and Environment Studies), which was formulated by ISRO with a mandate to build information base for climate change impact assessment and provide recommendation for mitigation. Radiosonde is a telemetry device for the measurement of vertical profiles of temperature, relative humidity and winds. Under the MOU, the radiosondes are launched from the Satish Dhawan Centre for Space Science, an advanced research centre of ISRO, Government of India, at the Central University of Jammu.

The RadioSonde system consists of the balloon borne segment referred as PisharotySonde and the ground segment referred as PisharotySonde Ground Station. PisharotySonde uses sensors for measuring the atmospheric temperature & relative humidity and GPS receiver module for

acquiring the wind parameters, altitude, date and time. Pressure information can be derived from the height and temperature information using software. Sensor and GPS data are processed and transmitted to ground station. The PisharotySonde System is used by scientists for boundary layer studies and upper atmospheric observations. The Weather Balloon along with the Radiosonde records the study of the atmospheric profiles of the humidity, pressure, Temperature, wind speed and direction. These launches contribute to the meteorological research related to the Climate change and atmospheric conditions.

This Radiosonde Ground Station is indigenously developed at the Semi-Conductor Laboratory, Government of India Ministry of Electronics & Information Technology (Meity), Mohali, Punjab, India in collaboration with the National Remote Sensing Centre (NRSC), Government of India (ISRO), a make in India product. The data collected from Radiosonde will contribute in the field of atmospheric and Space research. The first radiosonde from the Central University of Jammu was launched on 29th May, 2024 and till date eighteen radiosondes have been launched.





CUJ ISRO Centre launches Radio-Sonde for atmospheric data collection

The SDCSS Centre is only the third testing facility of its kind established by ISRO at CUJ. This entire Radio-Sonde system is fully developed indigenously by ISRO under the 'Make in India' vision of Prime Minister Narendra Modi.

The centre launched the weather balloon in the afternoon. It provided a unique set of data as the convection layer is fully developed by this time. Other centres and institutions are collecting data only in the morning and evening hours. The balloon ascended upwards at a rate of five metres per second up to a maximum height of 40 km. The launch of Radio-Sonde is expected to pave the way for future research endeavours and collaborations in the field of space and atmospheric sciences. The data collected from Radio-Sonde is analysed and utilised for various research projects, ultimately contributing to the broader field of space sciences at the institution's ISRO centre.



Atmospheric Data Collection Tool Radio-Sonde Launched From ISRO Centre At Samba

4.4 Popularization of Satish Dhawan Centre for Space Sciences, CUJ in Jammu and Kashmir

An Awareness Programme was conducted with the aim of enlightening young minds. The youth of Jammu was the target audience for this programme designed to educate and inspire them. The programme aimed to enhance the knowledge of students in Jammu and Kashmir regarding space materials, space sciences, and remote sensing. The objective is to advance the promotion of the Space Dhawan Centre for Space Science (SDCSS), while also motivating students to actively participate in the field of space science and make valuable contributions to the nation. Students from various schools in Jammu visited the Satish Dhawan Centre for Space Sciences, Central University of Jammu.



Educational trip of Govt. Higher Secondary School, Dablehar at SDCSS.

The visit started with a brief introduction to the Centre and its facilities by the staff. The students were then divided into smaller groups and taken on a tour of the Centre. Following schools visited in the SDCSS:



Educational trip of Govt. Higher Secondary School, Bahu Fort at SDCSS.



Educational trip of Govt. Higher Secondary School, Samba at SDCSS.



Educational trip of British International School, Sainik Colony, Jammu at SDCSS.

4.5 National Space Day organized at SDCSS, ISRO on 23rd August 2025

National Space Day 2025 was observed with enthusiasm and innovation at the Central University of Jammu, Department of Electronics and Communication Engineering (ECE) The day commenced with a formal opening ceremony, where Dr. Sanjeev Yadav Associate Professor Department of ECE, Central University of Jammu, highlighted the importance of space science and technology.

Scientist Alok Kumar Singhal has delivered the expert talk on Satellite Communication and its applications. Dr. Sanjeev yadav has delivered expert talk on 5G Communication and effect of radiation on human beings. Poster Competition for Students.

A quiz competition tested participants' knowledge of space science, astronomy, and space missions. Winners received certificates and space-themed prizes. Vote of thanks Dr. Priyank Sharma, Assistant Professor the Department of Electronics and Communication Engineering extends heartfelt thanks to all guest speakers, participants, and volunteers who made National Space Day 2025 a resounding success by providing the Prizes.



4.6 Internships and Training program for students at SDCSS, ISRO CU Jammu (Summer Internship at IIST, Thiruvananthapuram for B.Tech ECE and Avionics)

A group of 30 B.Tech. students from the Central University of Jammu, Samba, participated in an esteemed internship program at the renowned Indian Institute of Space Science and Technology (IIST) in Thiruvananthapuram, Kerala. The programme offered an exceptional opportunity for these students to gain hands-on experience and valuable insights into the field of space science and technology. The selected students, who are pursuing their Bachelor's degrees in Electronics and Communication (ECE) – Avionics and ECE, will have the privilege

of working alongside distinguished scientists and researchers at IIST, which is known for its contributions to the Indian space program.



B.Tech ECE and Avionics students visit IIST Thiruvananthapuram for Summer Internship Program from June – July 2023, 24 and 25.

Dr. Haneet Kour and Dr. Gourav Kumar accompanied the students as Faculty Coordinators from the Central University, Jammu, on the one-month internship. The students were allotted different mentors based on their areas of interest. Different areas included UAV Networks, Satellite based IoT, Device to Device Communication, 6G Satellite integration, RADAR signal processing among others. The students received valuable training from their respective mentors during the internship program.



Nano Satellite development group from B.Tech ECE- Avionics at IIST Thiruvananthapuram for Summer Internship Program.

4.7 Visit to SCL Mohali by B.Tech ECE and ECE-Avionics Students

The Department of Electronics and Communication Engineering, Central University of Jammu, organized an educational and technical visit to the Semiconductor Laboratory (SCL), Mohali on 22 August 2025.

The visit offered participating students a valuable opportunity to gain exposure to the nation's premier semiconductor research and development facility. Under the guidance of eminent scientists and engineers at SCL, the students observed advanced processes including cleanroom operations, wafer fabrication, lithography, etching, doping, and semiconductor packaging. They also toured testing laboratories, where integrated circuits are rigorously validated prior to their use in critical sectors such as space, defence, and high-speed communication systems.

A total of 25 students from the 2nd and 3rd year of the B.Tech. ECE program took part in the visit. This initiative reflects the vision of Hon'ble Vice Chancellor, Central University of Jammu, Prof. Sanjeev Jain and aligns closely with the goals of India's Semiconductor Mission.

The visit was coordinated by Dr. Sunil Datt Sharma Associate Professor, DoECE, Dr. Misbah Shafi Assistant Professor, DoECE and Mr. Mithul Dubey Lab Assistant, DoECE, under the supervision of Prof. Rakesh Kumar Jha, Head, DoECE.



Industrial Visit to SCL Mohali for B.Tech ECE and ECE-Avionics 23 and 24 Batch.

4.8 Internship and Training Programs in SDCSS

A Summer Internship Program was successfully conducted at the SDCSS Space Lab under the mentorship of Prof. (Dr.) Rakesh Kumar Jha, Head, Department of Electronics and Communication Engineering. The internship, titled “*Hands-on Internship in Satellite and Space Communication,*” was designed to give students practical exposure to the rapidly advancing field of space and satellite technologies. During the program, students engaged in experiential learning sessions covering satellite link fundamentals, modulation techniques, antenna concepts, orbital mechanics, and communication system design. They also performed hands-on activities using software tools, hardware modules, and small-scale satellite communication setups available in the space lab. The internship emphasized real-world problem-solving, enabling participants to understand critical aspects of modern satellite systems, including link budgeting, signal propagation, and communication impairments. The program greatly enhanced the technical competence of students and motivated them to pursue research and careers in space communication and allied domains.



Summer Internship Program at SDCSS, Space Lab titled “*Hands-on Internship in Satellite and Space Communication*”

4.9 Invited Talk

4.11.1 Expert lecture by Dr. Raj Kumar Choudhary on Radio Science Technique: Introduction to a Tool to explore a Planetary Body

Dr. Raj Kumar Choudhary delivered an enlightening and highly informative expert lecture on the topic “*Radio Science Technique: Introduction to a Tool to Explore a Planetary Body.*” His talk focused on how radio science has emerged as one of the most powerful and precise methods for studying the internal and external properties of planets, moons, and other celestial objects. He began by explaining the fundamental principle of radio science — the use of radio waves transmitted between spacecraft and ground stations to infer critical information about a planetary body. Through changes in frequency, phase, amplitude, and time delay of these radio signals, scientists can accurately determine atmospheric composition, surface characteristics, gravity fields, ionospheric properties, and even subsurface structures.



The poster features logos for ISRO (इसरो), Central University of Jammu, and the Himalayan High Altitude Atmospheric & Climate Research Centre. The text is centered and uses a mix of bold and regular fonts. It lists the patron, convener, and guest speaker with their respective titles and affiliations. The venue and time/date are clearly stated at the bottom.

Central University of Jammu
(Satish Dhawan Centre for Space Sciences)
INVITES YOU TO
INTERACTIVE SESSION
ON
**RADIO SCIENCE TECHNIQUE: INTRODUCTION TO
A TOOL TO EXPLORE A PLANETARY BODY**

Patron:
Prof. Sanjeev Jain
Honorable Vice Chancellor

Convener:
Prof. Vinay Kumar
Dean, School of Basic & Applied Sciences
Convener, SDCSS

Guest Speaker:
Dr. Raj Kumar Choudhary
Scientist-G, & Head, RSIM Division
SPL, VSSC, Trivandrum

VENUE
Conference room,
Second floor, SDCSS
Central University of Jammu

TIME & DATE
03:00 PM
24th July, 2025

RSVP
DR. SHWETA YADAV
Centre Incharge, Himalayan High Altitude Atmospheric & Climate Research Centre

Dr. Choudhary illustrated how radio occultation, Doppler tracking, and bistatic radar techniques have been successfully used in missions such as Mars Reconnaissance Orbiter, Cassini, Venus Express, and Chandrayaan. He highlighted their major scientific contributions, including mapping temperature and pressure profiles, analyzing atmospheric dynamics, measuring gravitational anomalies, and detecting hidden layers beneath planetary surfaces. Emphasizing the importance of radio science in future exploratory missions, he noted that the technique remains indispensable for understanding the evolution, environment, and habitability potential of planetary bodies. He encouraged students and researchers to explore interdisciplinary opportunities that connect radio engineering, space science, and planetary studies. Overall, Dr. Choudhary's lecture provided a comprehensive introduction to radio science, showcasing its strength as a non-invasive, highly sensitive, and versatile tool in modern planetary exploration.

4.11.2 Expert lecture and Interaction Session by Dr. Deepak Mishra from IIST Trivandrum on “ Vision Transformers and its Applications”

A distinguished expert from the Indian Institute of Space Science and Technology (IIST), Dr. Deepak Mishra, delivered an enlightening talk on the topic “Vision Transformers and Their Applications.” The session provided a comprehensive understanding of how Vision Transformers (ViTs) are revolutionizing the field of computer vision by leveraging principles originally developed for natural language processing. Dr. Mishra began by explaining the limitations of traditional convolutional neural networks (CNNs) and highlighted how Vision Transformers overcome these challenges by using self-attention mechanisms to capture global relationships within an image.

He elaborated on the architecture of Vision Transformers, emphasizing how images are divided into patches and processed in a sequential manner similar to tokens in text. This approach enables the model to learn long-range dependencies more efficiently and with improved accuracy. Dr. Mishra also showcased a variety of applications where ViTs have demonstrated

state-of-the-art performance, including image classification, object detection, remote sensing image analysis, medical imaging, and satellite data interpretation.

The talk was highly insightful for students and researchers, especially those working in artificial intelligence, machine learning, and space-based image analytics. Dr. Mishra’s clear explanations and real-world examples made the complex topic accessible and engaging. The session concluded with an interactive discussion, leaving the audience inspired to explore Vision Transformers further.



Prof. Deepak Mishra from IIST Trivandrum delivering talk on “Vision Transformers and its Applications” at SDCSS on 16 July 2025.

1. Research Projects

The numbers of research works carried by research staff and other students are ongoing at Satish Dhawan Centre for Space Sciences, CUJ. The progress of which are as under:

5.1 Research work on Nano Satellite Development at the Satish Dhawan Centre for space sciences, Central University of Jammu

The Nano satellite project is a space exploration initiative aimed at developing and deploying small satellites known as Nano satellites or CubeSats. These satellites are significantly smaller and lighter than traditional satellites, typically weighing a few kilograms or less.

The objectives of Nano satellite projects can vary depending on the specific mission and organization involved. However, some common goals include:

1. **Technology Demonstration:** Nano satellites are often used as a platform to test and validate new technologies and components for space missions. This includes experiments related to communication systems, miniaturized sensors, propulsion systems, and advanced materials.
2. **Earth Observation:** Nano satellites can be equipped with cameras and sensors to observe and monitor the Earth's surface. They can provide valuable data for applications such as environmental monitoring, agriculture, disaster management, and urban planning.
3. **Scientific Research:** Nano satellites can facilitate scientific experiments in space, enabling researchers to study various phenomena. They can be used to gather data on atmospheric conditions, space weather, climate change, and astronomical observations.

Each Roles and the Duration: -

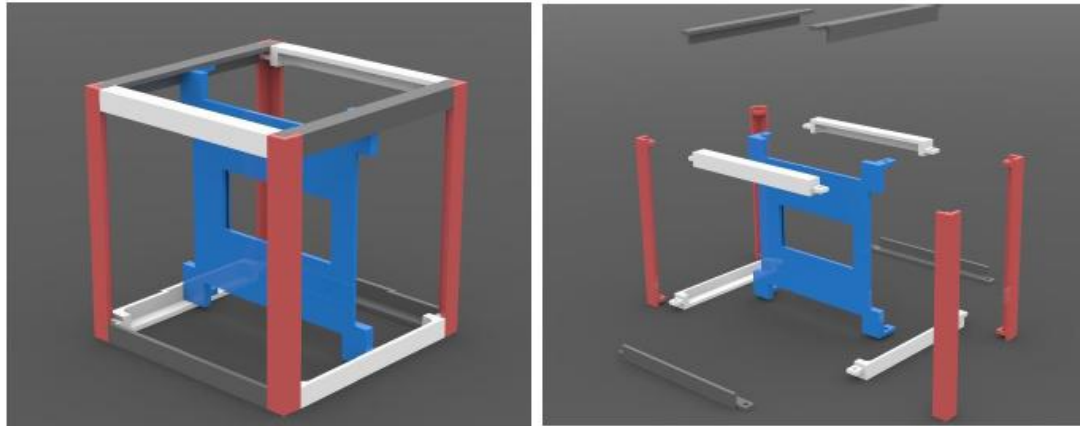
Project Module: -

1U CubeSat outer structure

The material used to make the outer structure of a nano satellite, such as a CubeSat, can vary depending on the specific design and requirements of the satellite. However, commonly used materials for the outer structure of nanosatellites include aluminium alloys, carbon Fiber composites, and 3D-printed polymers.

1. **Aluminium Alloys:** Aluminium and its alloys are widely used in satellite construction due to their lightweight nature, good strength-to-weight ratio, and high corrosion resistance.

Aluminium alloys provide structural integrity while keeping the satellite's weight low, which is crucial for small satellites.



1U CubeSat outer structure

2. Carbon Fiber Composites: Carbon Fiber composites offer high strength and stiffness properties while being lightweight. These composites consist of carbon Fibers embedded in a resin matrix. Carbon Fiber-reinforced polymers (CFRP) are used to create the satellite's structural components, providing excellent mechanical properties and dimensional stability. 3. 3D-Printed Polymers: With the advent of additive manufacturing techniques, 3D-printed polymers have emerged as a viable option for constructing the outer structure of nanosatellites. Materials like nylon, polycarbonate, or other thermoplastics can be used for 3D printing satellite components. 3D printing allows for complex geometries and customization, facilitating rapid prototyping and reducing manufacturing costs.

Aluminium 6061 has good corrosion resistance, mechanical properties, formability, weldability, and machinability. Generally suitable for medium to high strength requirements and has good toughness. Applications range from food and beverage packaging, electronic products and home appliances, architectural decoration, transportation to aerospace components.

- What will the satellite do?
- Communicates – Interactive

- Echo Back System

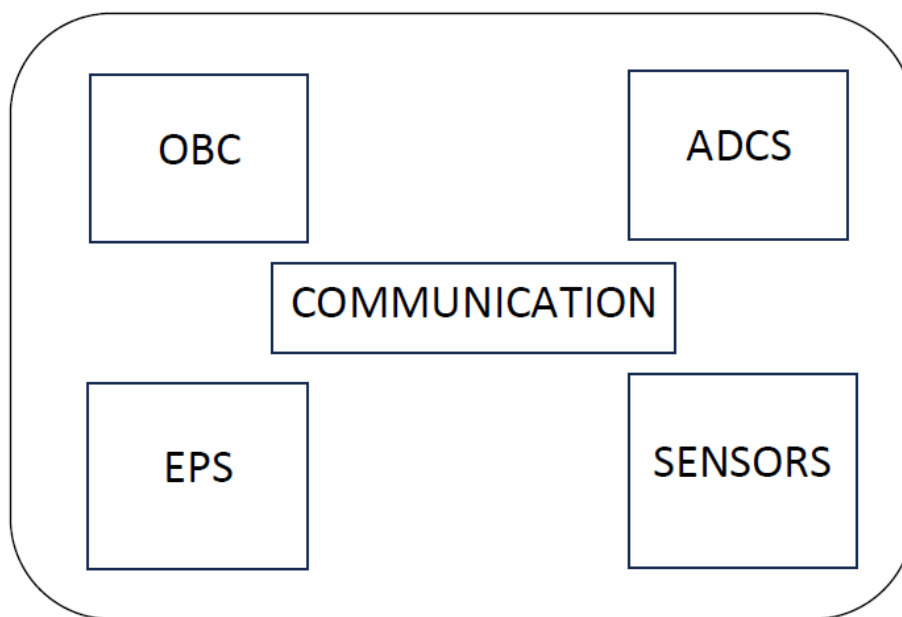
- Digipeater

➤ Purpose:-

- Science

- Technology Demonstration

PCB:- Printed Circuit Board



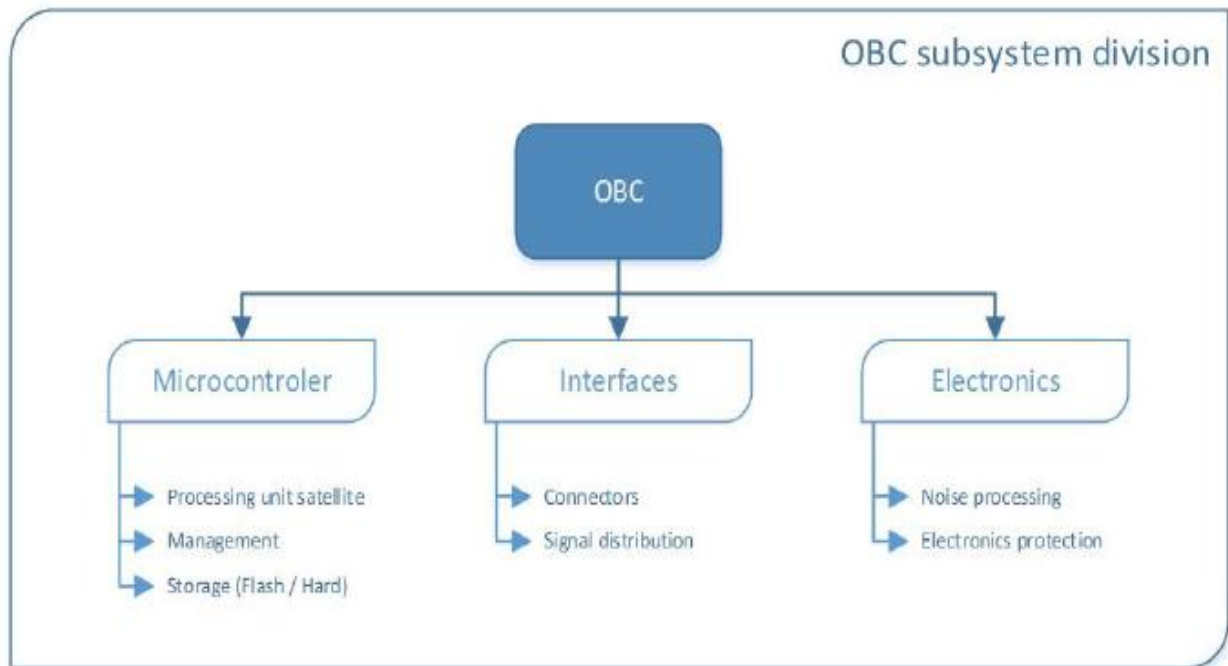
- OBC – On Board Computer
- EPS – Electrical Power System
- ADCS – Attitude Determination and Control System(Passive ADCS)
- Communication
- Sensors

SUBSYSTEM DESCRIPTION –

- OBC – On Board Computer

Introduction

The On Board Computer, or OBC, is the brain of the satellite and has different missions such as the coordination of all the actions, sending orders to the different modules, the reception and storage of information of the Cube Sat, sending this information back to Earth via the TCS error handling within the Cube Sat.



Subsystem division

The OBC is divided into three subsystems which are Microcontroller, Interfaces and Electronics. The Microcontroller is a processing unit of the OBC dedicated to the Satellite Management (SM). Its has to manage the data from other modules collected through the interface and to use it to give orders. The interface subsystem is responsible for the communication with other modules. It ensures a good connection with other systems of the satellite and allows them to send information. It is also in charge of collecting the power supplied by the EPS. The microcontroller is in charge of the storing system data, operation data, logs and measurements.

The electronics subsystem protects all the electronic components of the OBC chip from radiation and magnetic fields. It also prevents destructive noise on the signals processed within the OBC.

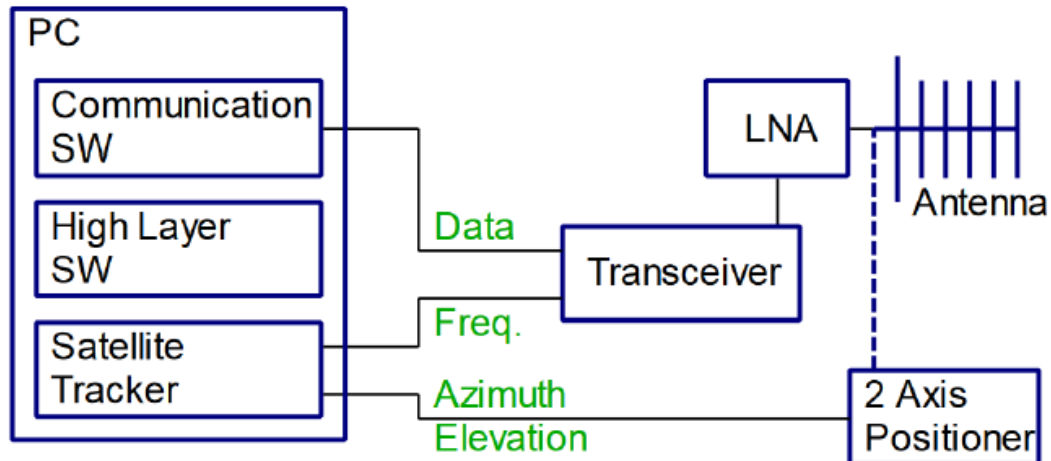
CubeSat Communication Subsystems



CubeSats, are launched on sun synchronous orbits with altitudes between 250 and 900 km above ground. This yields the angular range (the maximal communication distance ground station – satellite, when the satellite is on the horizon) from 1800 to 3500 km and the orbit revolution time 89 to 102 minutes. For one ground station, approximately 6 radio contacts are possible a day, where 2 or 4 contacts are long. During long contact, the satellite will reach a high elevation and the radio contact window could be maintained up to 15 minutes. Other radio contacts are shorter and communication distance is longer. On the other hand, the Doppler shift

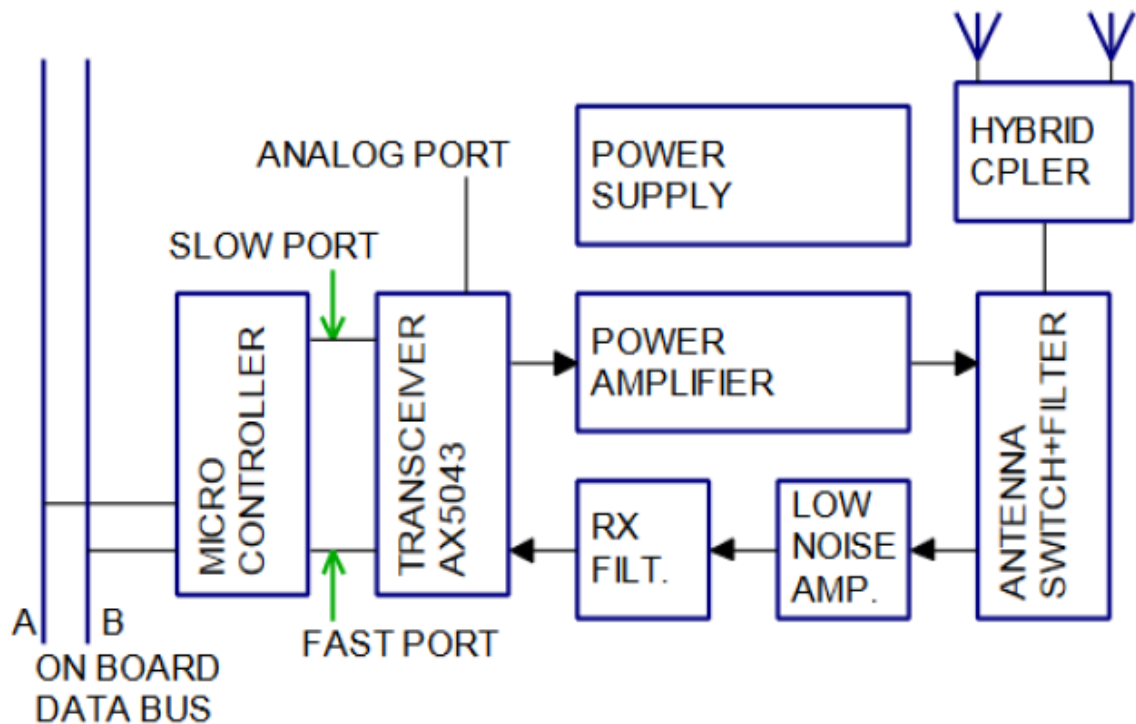
is changing rapidly during long contacts, and also demands on the antenna positioning system are higher.

The Ground Station



The same design concept of the radio transceiver subsystem can be used also on the ground station side. The satellite on-board bus interface is replaced by a computer interface, the microcontroller software has to be modified and a power amplifier need to be added. As advantage, the analog modulation signal and the demodulated signal are removed. The frequency deviation, the output power, etc. are set in digital registers as exactly defined values. The software and TRX-PC communication protocol can be tailored to optimal performance for effective data transfer and for quick radio frequency update to compensate the Doppler shift. Another advantage of the proposed ground station structure is absence of the TNC. In case of proprietary undocumented radio transfer protocols, the TNC is a key subsystem. Failure of the TNC usually means the ground station operation stop in the current satellite mission. Our ground station radio is based on widely available and well documented components, it is repairable. Known, defined structure also helps to build ground station networks, with identical hardware on each ground station. Software radio implementation (using the GNU Radio or other platform) is also possible.

Satellite Radio Design



Our proposed satellite radio is based on modern monolithic radio transceiver chip AX5043 from On Semiconductors. The transceiver circuit is controlled by a microcontroller which also implements features of simple OBC (On Board Computer) in the first communication unit version. There are four signal blocks added to the radio side, a power amplifier, a low noise amplifier, a receiver filter and an antenna switch, combined with an antenna filter.

*Annual Progress Report of the Research staff
working at the Satish Dhawan Centre for
Space Sciences, Central university of Jammu*

5.2 Research Project I

Annual Progress Report of Dr. Haneet Kour, Research Associate at SDCSS, CUJ

1. Project title: **BATTERY LIFE ENHANCEMENT FOR HYBRID SATELLITE TERRESTRIAL SYSTEMS USING MACHINE LEARNING**
2. PI (name & address): Prof. Vinay Kumar, Satish Dhawan Centre for Space Sciences, Central University of Jammu, JK, India.
3. Date of start: 25 -08- 2022
4. Duration: - 3 years
 - Objectives of the proposal: 1. To address power allocation problem for Satellite-Ground Communication
 - 2. Optimization of battery in satellite unit in absence of solar light.
 - 3. Extend battery lifetime of overworked satellites
 - 4. Control transmission power of satellite based on traffic volume and battery status.
 - 5. Study of performance parameters indicative of life of battery such as Depth of Discharge (DOD), Discharge rate, temperature.

Methodology: We consider a constellation that includes LEO satellites with degraded batteries as a result of a test operation conducted prior to the constellation's completion. The LEO satellite must process the traffic according to the transmission power regulation mechanism used in the current satellite communication system, regardless of how much the satellite battery is degrading. It is challenging to anticipate how much traffic demand will be generated because it depends on the location and the time. As a result, communication requires the allocation of the satellite's maximum transmitting capacity.

This technique radiates power in a way that allows traffic to be managed independent of the amount of demand created on the ground. This will in turn degrade the battery life of the already deteriorated satellite if they continue to handle the generated traffic as efficiently as possible

in the same way, since the DOD will increase due to the battery's maximum capacity compared to batteries with less deterioration.

Additionally, if we take into account the battery of the satellite that is degraded, it will most likely not process the data till the time the battery of the adjacent satellite improves to some level, and the degraded battery of the satellite next to it might not process this untreated traffic in addition to newly generated one. Although, as more traffic must be treated, the strain on nearby satellites grows, hastening the depletion of their individual batteries. As a result, the LEO constellation's average life will be shorter. We intend to devise a method for efficient power control such that the traffic load on a satellite with very reduced battery levels can be offloaded. This can be done if an adjacent satellite with lesser traffic load and high battery levels can take over some of the traffic from the 1st satellite. This can be managed with the use of an appropriate machine learning technique so that the link characteristics, signal to noise ratio, demand of the user, cover area of each satellite and battery status of the serving satellite are taken into consideration and then a decision is formed as to which satellite will serve a particular user.

5. Interim modification of objectives/methodology (with justifications):
6. Detail progress of the work carried out during the period: A system model has been prepared for the proposed battery life enhancement technique considering 3D Channel model for satellite communication system. The mathematical model has been prepared that incorporates Satellite Link Budget Analysis with Mathematical modelling for calculation of Path Loss, Friis Free Space Propagation Equation, Calculation of Satellite Received Power, Calculation of Losses such as Scattering loss, spatial loss, rain attenuation, polarisation loss, pointing loss, Calculation of SNR (Signal to Noise Ratio) and Link margin, Calculation of Channel Capacity, Battery life parameters such as life cycle calculation, Depth of Discharge, discharge rate.
7. A summary sheet of not more than two pages under following heads (Title, Introduction, Rationale, Objectives, Methodology, Results, Translational Potential):

**Title: BATTERY LIFE ENHANCEMENT FOR HYBRID SATELLITE
TERRESTRIAL SYSTEMS USING MACHINE LEARNING**

Introduction: Satellite communications are used for a wide range of purposes, such as news gathering, backhauling, and media broadcasting. Satellite communications (SatComs) are currently undergoing a phase to focus the system architecture on high data services, specifically broadband Satellite communication, as a result of the development of Internet-based applications. The primary motivators are: a) the rapid transition from linear to streaming media transmission; and b) the pressing requirement to expand broadband access to sectors (such as emerging nations, aviation and maritime, and rural areas). Furthermore, the fifth generation of communication systems has made significant progress in the fusion of various wired and wireless technologies (5G). SatComs, in this case, open the door to seamless integration aimed at specific use cases that can benefit from their unique characteristics.

Parallel to this, a variety of manufacturing and launching possibilities that were previously exclusively available to governments and a select few major international enterprises have been developed by private ventures. Many cutting-edge broadband and earth observation missions have resulted from this New Space programme, all of which call for improvements in SatCom systems.

A. TYPES OF CONFIGURATIONS IN SATELLITE COMMUNICATION

The altitude of the orbit, a key component of satellite constellations, has a significant impact on the coverage, signal attenuation, and communication delay. LEO, MEO, and GEO are the three fundamental orbital configurations. The corresponding altitude ranges for LEO, MEO, and GEO are 500 to 900 km, 5,000 to 25,000 km, and 36,000 km, respectively. A GEO satellite can cover almost 1/3 of the earth's surface excluding the polar regions. Almost 99% of the population on the planet and the economic activity taking place is covered in this area. There must be a large number of satellites to provide service in LEO and MEO orbits.

The eccentricity of satellite orbits is another important factor. While circular orbits are the norm for SatCom services, some elliptical orbits have high eccentricity, sometimes known as highly elliptical orbits (HEO). Molniya orbits and Tundra orbits are two examples of inclined HEO.

Long durations at a specific location during the approach to and descent from apogee are a benefit of such extremely long orbits. Bodies traversing the apogee move slowly and spend a significant amount of time at high altitude over high-latitude ground sites. As a result, communications to high latitude regions can benefit from the use of elliptical orbits.

In designing a satellite constellation for SatCom services, it is crucial to consider a variety of factors and weigh the trade-offs involved. Some constellations such as GEO cover a very large area, but they have very high latency due to the far-off distance, and also high path loss associated. Additionally, the satellites which are low in altitude move a little quickly. This increases the Doppler frequency offset and drift which can be very important when designing user equipment, particularly for wideband communications.

- **Objectives:** Objectives of the proposal: 1. To address power allocation problem for Satellite-Ground Communication
- 2. Optimization of battery in satellite unit in absence of solar light.
- 3. Extend battery lifetime of overworked satellites
- 4. Control transmission power of satellite based on traffic volume and battery status.
- 5. Study of performance parameters indicative of life of battery such as Depth of Discharge (DOD), Discharge rate, temperature.
-

Methodology: The methodology for work flow is as follows:

We intend to devise a method for efficient power control such that the traffic load on a satellite with very reduced battery levels can be offloaded. This can be done if an adjacent satellite with lesser traffic load and high battery levels can take over some of the traffic from the 1st satellite. This can be managed with the use of an appropriate machine learning technique so that the link characteristics, signal to noise ratio, demand of the user, cover area of each satellite and battery status of the serving satellite are taken into consideration and then a decision is formed as to which satellite will serve a particular user.

B. PROPOSED LAYERED ARCHITECTURE FOR BATTERY LIFE ENHANCEMENT

An architecture has been proposed involving horizontal and vertical handover for battery life enhancement in a hybrid satellite and terrestrial communication system. It involves two layers : Layer 1 depicting horizontal handover between adjacent satellites and Layer 2 depicting vertical handover i.e. between satellite communication and ground communication. Each of the satellite has its own coverage area that it can serve. For a high mobile user when it crosses the coverage area of one satellite and falls in the blank space, it can be served by terrestrial communication system i.e. base station. Satellite communication system can serve the remote areas where the base stations have not been deployed as well as their respective coverage areas.

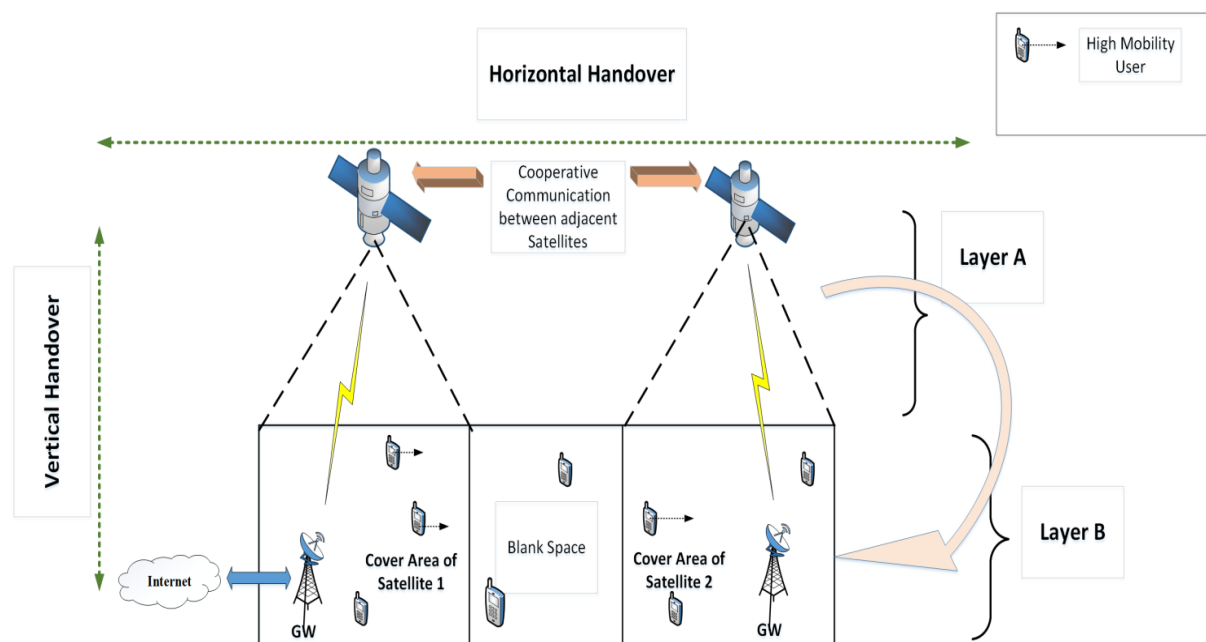


Fig. 1 Proposed Layered Architecture

It consists of the following: Satellite Link Budget Analysis, Mathematical modeling for calculation of Path Loss, Friis Free Space Propagation Equation, Calculation of Losses such as Scattering loss, spatial loss, rain attenuation, polarisation loss, pointing loss, Calculation of Satellite Received Power, Calculation of SNR (Signal to Noise Ratio) and Link margin, Calculation of Channel Capacity, Battery life parameters such as life cycle calculation, Depth of Discharge, discharge rate.

A data set will be acquired to study the battery optimization parameters. It will be preprocessed to identify the condition indicators that will help in changing the link budget analysis. The model will be trained using a suitable machine learning technique and based on that a decision will be travel regarding the remaining useful life of a battery i.e. its actual value and predicted value.

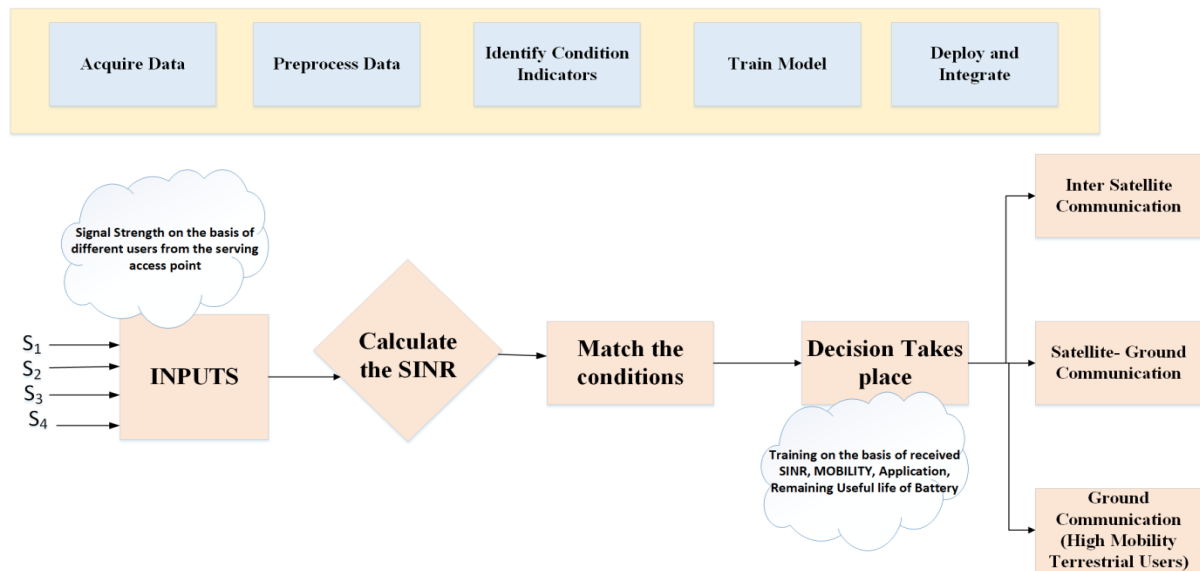


Fig. 2: Workflow of efficient power control in satellite communication system using machine learning

Satellite Link Budget analysis

- 3D Satellite Channel Model

The channel Impulse Response (CIR) of Satellite communication at Ku/Ka-band

$$H(t) = h_1(t) + h_2(t) + h_3(t)$$

where $h_1(t)$ and $h_2(t)$ represent the free space path loss (FSPL), $h_2(t)$ is a markov chain process. The notation $h_3(t)$ depicts small -scale fading which occurs because of scattering multipath and movement of mobile receiver.

- FSPL (Free Space Path Loss)

FSPL is calculated by the distance between the satellite and receiver. It predicts how the area mean varies with the distance between the satellite and the receiver.

- The expression is as follows:

$$h_1(t) = \sqrt{10^{\frac{4\pi f_c \|D^{LOS}(t)\|}{10c}}}$$

where f_c is carrier frequency, c is speed of light, the initial distance D^{LOS} between the satellite and Rx can be calculated by

$$\|D^{LOS}(t)\| = \sqrt{(R_E^2 \sin^2 \theta^{LOS} + L^2 + 2LR_E)} - R_E \sin^2 \theta^{LOS}$$

Where $\|D^{LOS}(t)\|$ is the initial distance between satellite and Rx, R_E is the radius of the earth (L and θ^{LOS} respectively present the altitude of the satellite and elevation angle)

SHADOW FADING

- The long-term variations of the amplitudes are modeled as a chain of distinct states using a first order Markov-chain process.
- The differentiated received signal amplitude level is related to the underlying signal propagation condition, which is represented as a state of the Markov model.
- The bad state corresponds to the situation that the received signal cannot be detected because of the link budget. The moderate state occurs in bad weather conditions, and corresponds to the deep fading which can be detected by the satellite communication receiver system.
- State Transition Probability Matrix (STPM):

$$P_t = \begin{bmatrix} P_{GG} & P_{GM} & P_{GB} \\ P_{MG} & P_{MM} & P_{MB} \\ P_{BG} & P_{BM} & P_{BB} \end{bmatrix}$$

- The channel impulse response of small-scale fading can be presented as

$$h_3(t) = h_3^{LOS}(t) + h_3^{NLOS}(t)$$

EVALUATION OF THE NN (NEURAL NETWORK) PERFORMANCE

- Across the five batteries, when the actual cycle life is small, the model is good at predicting the remaining useful life.
- As a battery gets closer to the end of its life, the model is good at predicting the remaining cycle life.
- During the early part of a battery's life when the actual cycle life is larger, the model has greater uncertainty.
- The model also seems to generally overestimate the remaining cycle life during the initial period of a battery's life.

Results: Deep learning has been used to estimate the remaining useful life of battery using Randomised data set. The block diagram is shown as follows as depicted in Fig. 3.

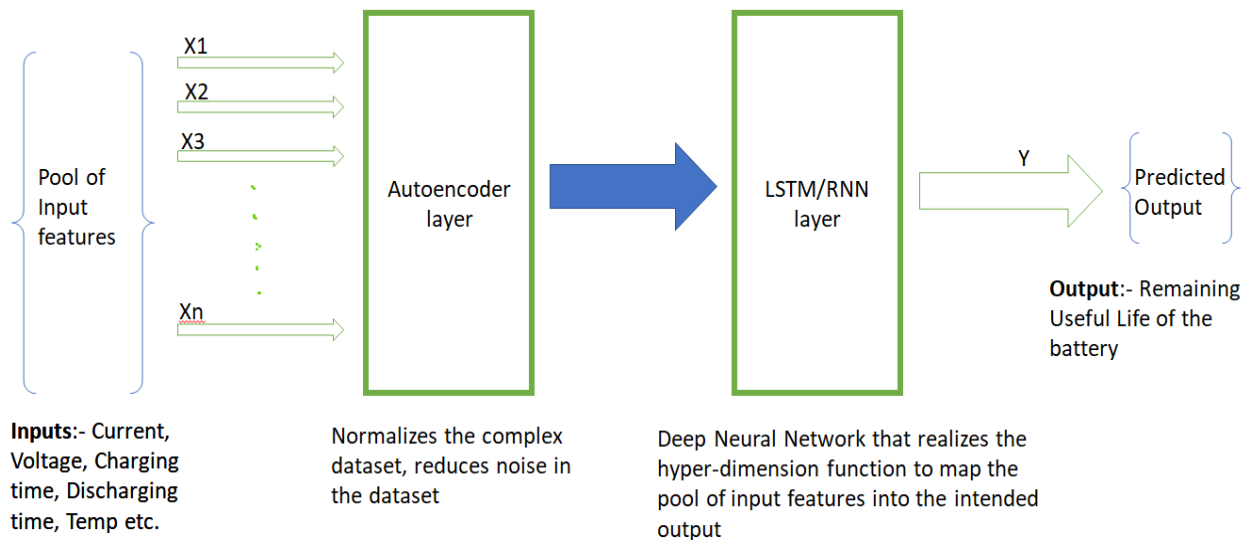


Fig. 3 Block diagram of deep neural network to estimate remaining useful life of battery.

The data set used consisted of the following:

A set of four 18650 Li-ion batteries were operated under different conditions and recorded to produce the dataset:

operated using a sequence of charging and discharging currents between -4.5A and 4.5A

operated by repeatedly charging them to 4.2V and then discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 4A

operated by repeatedly discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 4A

operated by repeatedly charging them to 4.2V and then discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 5A. The ambient temperature was held at approximately 40.

operated by repeatedly charging them to 4.2V and then discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 5A. The ambient temperature was room temperature.

operated by repeatedly charging them to 4.2V and then discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 5A.

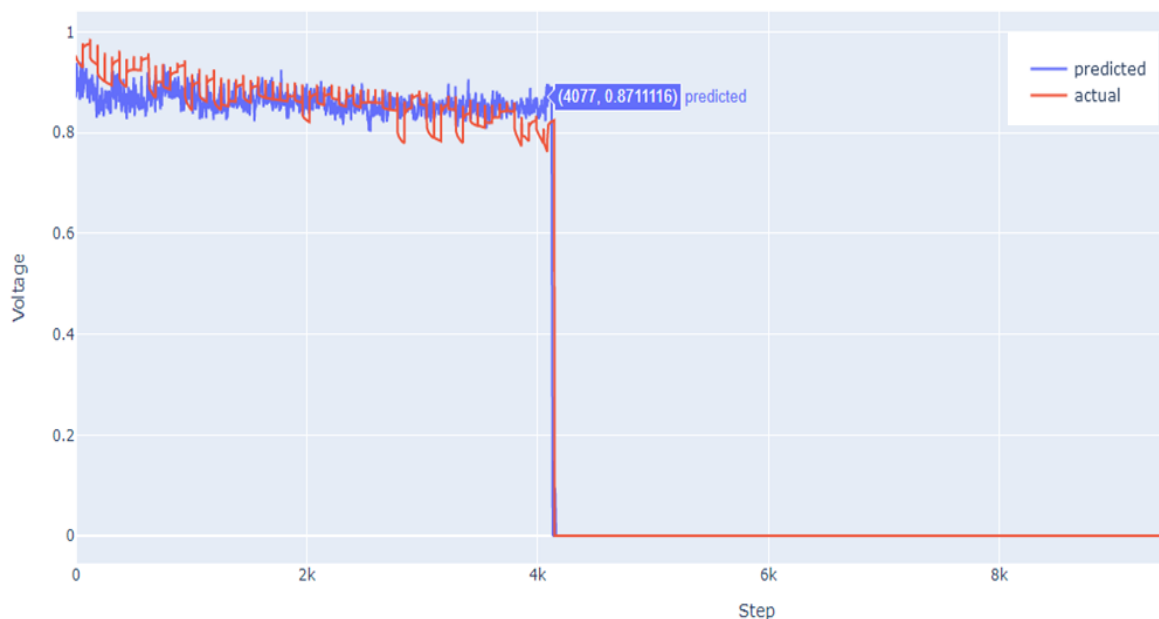


Fig. 4 Plot of predicted v/s actual voltage after training of dataset.

A customized probability distribution is used in this experiment to select a new load setpoint every 1 minute during RW discharging operation. The ambient temperature was held at

approximately 40C.operated by repeatedly charging them to 4.2V and then discharging them to 3.2V using a randomized sequence of discharging currents between 0.5A and 5A. A customized probability distribution is used in this experiment to select a new load setpoint every 1 minute during RW discharging operation. The ambient temperature was room temperature.

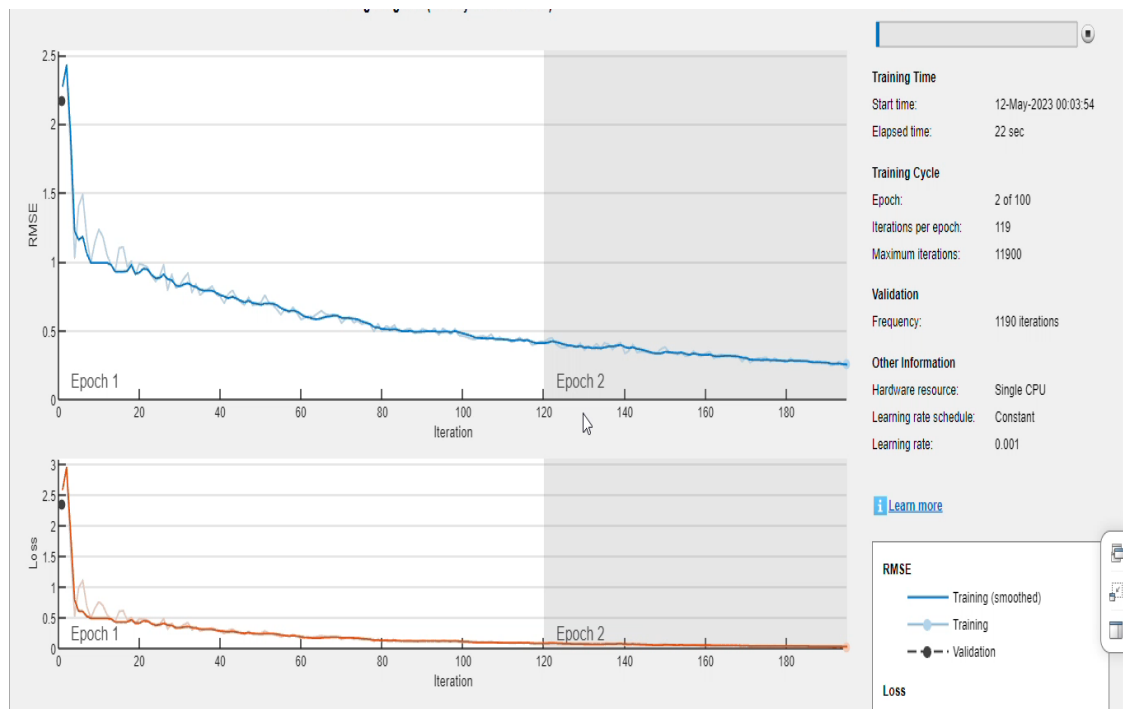


Fig. 5 Training of the CNN model.

8. Research work which remains to be done under the project: Further Results and analyses have to be obtained for the proposed methodology using machine learning.
9. Applied value of the project
10. **Any patents applied for:** Patent filed entitled: “Mobility Management for Hybrid Satellite Terrestrial Systems Along With Battery Life Enhancement.”

Patent Granted: A System and Method For Reduction Of Electromagnetic Radiation In Wireless Network on 27-05-25.

11. If additional budget or staff is required for the remaining part of the research work, please give justifications and details.

Any publications:

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