

TELEKINESIS

ELECTRONICS AND COMMUNICATION ENGINEERING
DEPARTMENT MAGAZINE



VOLUME I
OCTOBER 2024



National Institute of Technology Meghalaya

An Institute of National Importance

“Telekenesis”

“Telekinesis” combines “Tele,” meaning “Distance,” and “Kinesis,” meaning “Movement” or “Motion.”

Together, “Telekinesis” can be interpreted as “Movement at a Distance.” It symbolizes the ability to control or influence from afar, aligning with the essence of electronics and communication engineering, where invisible signals, waves, and technologies bridge distances. The name suggests innovation, unseen power, and forward-thinking approaches in the field, making it a great name for this magazine that highlights the latest trends and breakthroughs in electronics and communication engineering.

“Nothing is too wonderful to be true, if it be consistent with the laws of nature.”

**-Michael Faraday
(Father of Electronics Engineering)**



“The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point.”

**-Claude Elwood Shannon
(Father of Communication Engineering)**

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About the Institute

The National Institute of Technology (NIT) Meghalaya is one of the thirty-one NITs in India established under the NIT Act 2007 (Amended 2012) of the Parliament of India as Institutes of National Importance with full funding support from the Ministry of Education (Shiksha Mantralaya), Government of India.

The Vision

A Centre of Excellence vibrant with academic activities and bubbling with youthful creative energy, making significant contributions to the World of Knowledge and Technology and to the Development of the State, the Region and the Nation.

The Mission

To impart quality education in the fields of engineering, science, and technology at undergraduate and postgraduate levels, with special attention to encouraging innovation and creativity in these fields in a clean and healthy environment.



About the Department

The Department of Electronics and Communication Engineering (ECE) was established in 2010 with the inception of the NIT Meghalaya. The department offers a B. Tech Programme with an intake capacity of thirty & an M. Tech Programme with an intake capacity of twenty in ECE and a Ph.D. Program in various specialized areas. The major research areas of the department include high-speed and low-power VLSI, Computer Arithmetic, Wireless Sensor Networks, Cognitive Radio, Antenna Design, and Signal Processing. The major objective of the Department is to impart high-quality technical education and research with a strong foundation in Electronics and Communication Engineering. The department's major areas of faculty expertise include VLSI Systems, High Performance Computing, Signal Processing, Digital Signal Processing, Communication, and RF & microwave engineering.

The Vision

A Centre of Excellence in knowledge and technological innovation research hub in the field of Electronics and Communication Engineering by the creation of skilled manpower to meet the local, national, and global needs of industry and society.

The Mission

- To impart research & training on cutting-edge technologies on VLSI, Signal Processing, and Communication for societal issues.
- To promote competitive academic programs through industry-relevant skills that support entrepreneurial growth and industry readiness.
- To strengthen moral values and ethics with managerial skills to become technocrats and entrepreneurs.



Director's Message

Prof. Pinakeswar Mahanta



Dear All,

It is with immense pride and enthusiasm that I introduce the inaugural edition of ECE departmental magazine “Telekinesis”. Telekinesis symbolizes the dedication and innovative spirit of our students, staff and faculty members for capturing the vibrant energy that drives this dynamic field.

The “Telekinesis” offers an insightful platform for readers to explore the fascinating world of electronics and communication technology, delving into cutting-edge research, emerging trends, impactful projects, and technological breakthroughs that are shaping the future. From student-driven initiatives to the contributions of leading experts, this magazine encapsulates the remarkable work happening within the department.

The launch of this magazine comes at a pivotal moment, as the fields of electronics and communication are advancing at an extraordinary pace. This publication serves as a crucial platform to showcase the cutting-edge research, technological innovations, and accomplishments of our faculty, staff, and students. Through this magazine, we strive to bring these achievements to the forefront, ensuring they are recognized not only within our institute but also across the broader academic and professional communities.

I extend my heartfelt congratulations to the entire editorial team, contributing writers, and designers, whose collective efforts have brought this magazine to life.

I encourage everyone—students, faculty, alumni, and industry partners—to actively engage with the magazine. Your ideas, experiences, and perspectives will enrich future editions and foster a culture of learning, collaboration, and innovation.


- Prof. Pinakeswar Mahanta
Director



Message from Head of Department



Dear Students, Colleagues and Esteemed Readers,

I am delighted to present the inaugural issue of our Electronics and Communication Department E- magazine. This initiative marks a significant milestone in our journey, providing a platform to celebrate our achievements, share knowledge, and foster a sense of community within our department.

In today's fast-paced technological landscape, the importance of a robust technical education cannot be overstated. As we navigate the realms of electronics and communication, our curriculum is designed to equip students with the essential skills needed to tackle real-world challenges. Through hands-on experiences and innovative learning methodologies, we encourage our students to become not just consumers of technology, but creators and innovators.

Research is at the heart of our mission. Our faculty and students are engaged in cutting-edge research that pushes the boundaries of knowledge and application. From Microelectronics & VLSI to Embedded Systems & IOT, Electromagnetism to Signal Processing and Communication Systems & Networks, our projects reflect the diverse interests and expertise within our department. This magazine will showcase our ongoing research endeavors, highlighting the contributions of our faculty and students. I urge everyone to take inspiration from these stories and consider how you can contribute to our collective pursuit of knowledge. Collaboration is the cornerstone of progress in the field of electronics and communication. It is through partnerships, both within our institution and with industry leaders, that we can create impactful solutions to complex problems. This magazine will serve as a hub for collaborative initiatives, where we can share insights, explore opportunities, and connect with professionals who are shaping the future of technology. I encourage you all to engage actively in this collaborative spirit, as it enriches our learning experience and opens new avenues for innovation.

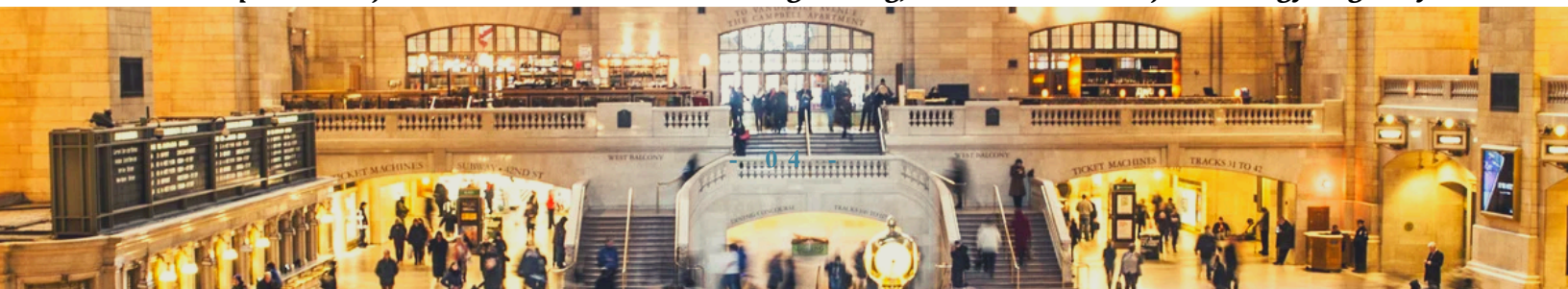
As we embark on this exciting journey with our magazine, I invite all our students, colleagues and alumni to contribute your thoughts, ideas, and experiences. Your participation will not only enhance the content but will also strengthen our community. Together, let us continue to inspire one another and strive for excellence in our field.

Thank you for being a part of this vibrant department. I look forward to witnessing the many ways in which we will grow and thrive together.

Warm regards,

Dr. Pradeep Kumar Rathore, Head of Department

Department of Electronics & Communication Engineering, National Institute of Technology Meghalaya





LETTER FROM THE EDITOR



Welcome you all,

“ The first edition of Electronics and Communication Engineering Department Magazine for July-August (volume-I) 2024, provides a platform for sharing news, updates, and important announcements relevant to the Department of Electronics and Communication, National Institute of Technology Meghalaya. The magazine aims to foster a sense of community among faculty, staff, and students by highlighting contributions and participation in departmental activities. The magazine offers opportunities for members to contribute research articles, promoting creativity and engagement. This platform will help us highlight faculty and student research projects, encouraging interdisciplinary collaboration, innovation, and development of the department”,

I wanted to express my heartfelt gratitude to all the stakeholders for making it successful.

Shuleenda
29/10/2024 .

Warm regards,

Dr. Salam Shuleenda Devi, Assistant Professor





LETTER FROM THE CO-EDITOR



Welcome to this inaugural edition of the ECE Department Magazine!

The field of Electronics and Communication Engineering continues to evolve rapidly, and our department stands at the forefront of this transformation. From groundbreaking research to creative projects and industry collaborations, I am proud to highlight the hardwork and dedication of everyone in the EC community.

This issue brings you a collection of articles highlighting our recent accomplishments and events, cutting-edge research published in journals, ongoing projects, and an overview of the state-of-the-art lab facilities available in the department. Further, insights from faculty members on emerging technologies and their potential to shape the future are included.

I would like to thank all contributors for their invaluable input and for sharing their experiences, ideas, and successes. Your dedication makes this magazine reflect the vibrant and innovative spirit of the ECE department.

I hope you enjoy reading this edition and that it sparks new ideas and conversations within our community.

Warm regards,

Dr. Jagritee Talukdar, Assistant Professor





TECHNICAL
Articles



Electronics and Communication Department

The Future of Computation

M.A. SEENIVASAN, Research Scholar, ECE

Neuromorphic vs. Quantum computing

Neuromorphic computation and quantum computing are two emerging technologies that are transforming the path to Artificial Intelligence. Neuromorphic computation mimics the human brain's workings, aiming to create devices that learn, retain information, and make logical deductions. It is less demanding than quantum computing, which requires temperatures close to absolute zero. Neuromorphic computers can work in normal conditions, increasing their practicality and potential integration in various devices. Quantum computing, on the other hand, deals with the world of atoms and subatomic particles, working on the principle of quantum entanglement. Although more complex than traditional computing, quantum computing can solve large and complex computational problems, potentially upgrading machine learning and artificial intelligence. However, it will require the support of traditional computers for their specialized abilities.

Meet the Future of AI

Artificial intelligence (AI) is often viewed as the defining technology of today, with experts stating that we are living in the AI era. The promise of AI's potential to reshape industries, introduce new products and services, and redefine our lives is undeniable. However, the reality is that AI is not as sophisticated as we think. The main problem lies in the underlying approach of current AI algorithms, which rely heavily on training phases. This leads to a complicated balance between overfitting and underfitting, and the seemingly impossible autonomy that these algorithms can achieve. Instead, they adapt their "knowledge" from training sessions to new contexts, which is a limiting aspect of AI.

Neuromorphic engineering aims to create computing hardware that mimics biological nervous systems, potentially revolutionizing the future of computing. Neuromorphic chips would function more like brains than current chips, offering a more efficient and cost-effective solution to the von Neumann bottleneck in traditional personal computers. These chips could have broad and impactful real-world applications by replicating the intricate behavior of brain neurons. While both quantum computing and neuromorphic systems have been proposed, neuromorphic computing or brain-inspired computing is more likely to be commercialized due to the fragile nature of qubits



To truly embrace AI as the tech of the future, AI engineers need to change how they build algorithms, which they are doing through neuromorphic computation. This approach allows AI to adapt to new situations and achieve the benefits of AI in various aspects of life.

The Future of AI is analogue:

The human brain is smaller and more complex than supercomputers, which are smaller and more energy-efficient. The human brain uses around 20 watts of energy, while the Fugaku, the world's fastest supercomputer, requires 28 megawatts. The brain is housed in a bone casing that maintains a constant temperature of 37°C. Supercomputers can perform calculations faster but lack the creative thinking and adaptability of the human brain. Neuromorphic computing, harnessing the techniques of the human brain, aims to address this gap.

How will neuromorphic computing solve AI's energy usage problem?

The talk around AI is often hyperbolic and speculative, overlooking the fact that our attempts to recreate our own intelligence using conventional computers have led to energy-inefficient and over-engineered systems. To create intelligent machines as efficient as our brains, we must mimic their computation. Jonathan Peters argues that the future of AI will be analog, reflecting recent developments in architecture and learning. The rapid advancements have transformed global understanding and perspectives on AI from ignorance to curiosity and fear.

Neuromorphic computing, tomorrow's technology:

Neuromorphic computing is an intersection of diverse disciplines, including neuroscience, machine learning, microelectronics, and computer architecture. Gartner predicts that traditional computer systems will face a digital wall by 2025, necessitating the adoption of neuromorphic computing. Emergen Research predicts that the world-wide neuromorphic processing market will be worth USD 11.29 billion by 2027. Neuromorphic computing mimics the physics of the human brain and the central nervous system's information-processing architecture, blending neuroscience, machine learning, microelectronics, and computer architecture.

Neuromorphic Technologies Current Status, and Future

As the demand for high computing power increases, it is crucial to explore alternative solutions, such as neuromorphic computing. Mammalian brains are known for their low power and energy efficiency, making them ideal for future machines. Researchers and the industry should explore bio-inspired neuromorphic structures to address sustainability issues. Neuromorphic computing can remove existing bottlenecks, such as the von Neumann bottleneck, which limits throughput in traditional personal computers. While quantum computing and neuromorphic systems have been proposed, considering the fragile nature of qubits in quantum computing, neuromorphic or brain-inspired computing is more likely to be commercialized. As power consumption decreases, devices can run for years on a tiny battery, paving the way for using chips in machines that need computationally complex deep learning operations, such as autonomous vehicles, facial recognition security cameras, and military drones. The neuromorphic computing field emerged as a response to the challenges faced by standard computing architecture, particularly the "von Neumann" architecture. This architecture consisted of a memory storage component, a central processing unit (CPU), and a digital bus connecting the two. As modern computing tasks demand larger amounts of data to be processed at increasingly faster speeds, two key limitations have become apparent in that standard format: the bottleneck effect of the digital bus and the physical limitations of transistor-based technology. Neuromorphic systems address these challenges by adhering closely to brain-like structures and functions, though the precise form of that technology is currently the subject of extensive discussion and active development.

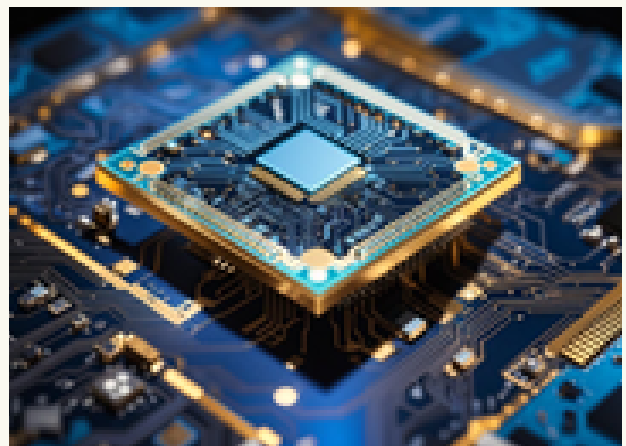
Most neuromorphic hardware operates in a spiking paradigm, where units are only active when they receive or emit information, making them purely event-driven and considerably more efficient than standard systems. Neuromorphic hardware also uses analog computation, representing data in physical quantities versus the binary digits used by digital hardware, making it both more efficient and accurate. However, these systems still use digital signals, allowing them to enjoy a form of "best of both worlds" between the two signal types. Multiple technologies operating under these principles are currently in development, with the major contenders being neuromorphic chips and photonic systems, particularly in the form of laser systems.

Challenges:

While it is unclear what technology will form the backbone of the neuromorphic field in the future, it is clear that the innovations of this field and others like it will be vital to usher in a much-needed new computing era that can meet modern society's ever-growing needs. A fundamental next step will be proving neuromorphic technologies in key tasks, such as image classification, but many remain largely untested in practical applications. Collaboration across the field will be vital in demonstrating that these technologies are viable in application and theory. Exploring mixed technologies that could harness the advantages of multiple subfields is also recommended.

Ultimately, neuromorphic systems offer a brain-based solution to the modern computing crisis. This news article summarizes where we are now, what got us here, and where we might go next, providing a theoretical and contextual unity critical to further collaboration and innovation.

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Recent Trends in Antennas for Biomedical Applications, 5G, and Beyond

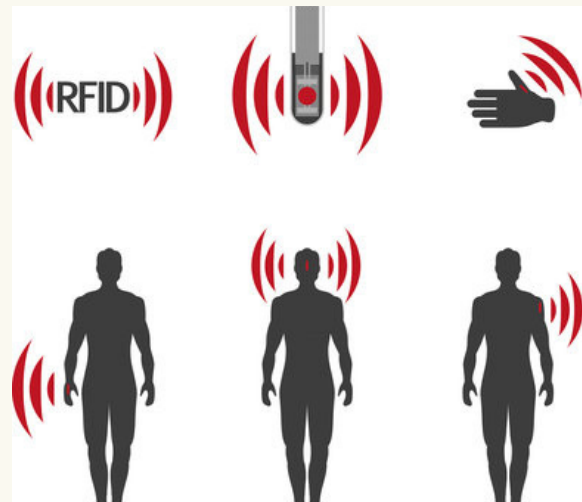
Dr. Moirangthem Santoshkumar Singh
(The author is Alumnus of NIT Meghalaya)

Antennas are critical enablers of modern wireless technologies, playing pivotal roles in fields ranging from healthcare to next-generation communication networks like 5G and beyond. In recent years, significant research has focused on designing antennas that meet the unique demands of biomedical applications and advanced 5G networks, as well as paving the way for beyond-5G (B5G) and 6G technologies. The key trends in antenna design and development for these applications includes

Antennas for Biomedical Applications:

Biomedical applications require antennas that operate reliably within and around the human body. A key focus of recent research has been designing compact, wearable, and implantable antennas for diagnostics, monitoring, and therapeutic purposes. Some of the most significant trends include:

- **Ultra-Wideband (UWB) Antennas:** UWB antennas are essential for medical imaging applications, such as breast cancer detection, due to their high resolution and ability to penetrate biological tissues. UWB antennas offer the advantage of operating over a wide frequency range, which is critical for capturing detailed images with high fidelity. Researchers are working to optimize UWB antenna designs to minimize signal loss and improve penetration depth without causing tissue damage.
- **Wearable and Implantable Antennas:** Wearable antennas are increasingly being used for health monitoring systems, where they can be embedded in clothing or attached to the skin. For implantable devices, antennas need to be biocompatible and capable of operating reliably within the body's tissue environment. These antennas often employ flexible materials and designs like microstrip patches to ensure comfort and minimize interference with body tissues.
- **Nanoscale Antennas:** Another exciting development is the emergence of nanoscale antennas, which are small enough to interact with individual cells or molecules. These antennas can be used for precise drug delivery, biosensing, and nanoscale imaging. They operate on different principles than conventional antennas due to quantum effects, which allow them to manipulate electromagnetic fields at extremely small scales. This has opened up new possibilities in minimally invasive medical treatments.



5G Antennas, Enabling Next-Generation Connectivity:

As the 5G rollout progresses, antenna designs have had to evolve to meet the specific needs of high-speed, low-latency communication. Several trends have emerged in this domain:

- **Massive MIMO (Multiple Input Multiple Output) Antennas:** A major innovation for 5G networks is the use of massive MIMO technology, which allows multiple antennas to transmit and receive signals simultaneously, boosting network capacity and data rates. These antennas are vital for handling the increased traffic and high data demands in densely populated urban areas. Research has focused on enhancing the efficiency of massive MIMO antennas while reducing power consumption, which remains a significant challenge for wide-scale 5G deployment.
- **Millimeter-Wave (mmWave) Antennas:** Another key feature of 5G is the use of millimeter-wave frequencies (24–100 GHz) for higher bandwidth and faster data rates. These frequencies enable ultra-fast wireless communication but come with challenges such as shorter range and susceptibility to physical obstructions. To address these, researchers are developing highly directional antennas with beamforming capabilities that can dynamically adjust to changes in the environment.
- **Reconfigurable Antennas:** Flexibility in frequency and bandwidth is crucial for 5G and beyond. Reconfigurable antennas are designed to adapt to different operating environments by altering their frequency response, bandwidth, or radiation pattern in real-time. This adaptability helps overcome the spectrum scarcity issue by enabling antennas to switch between different frequency bands as needed.

Beyond 5G (B5G) and 6G Antennas:

Looking beyond 5G, antenna research is increasingly focused on supporting emerging B5G and 6G technologies, which are expected to offer even higher data rates, ultra-low latency, and massive connectivity for the Internet of Things (IoT), autonomous vehicles, and smart cities. Key research areas include:

- Terahertz (THz) Communication: One of the main challenges for B5G and 6G is the use of terahertz frequencies (0.1–10 THz). These frequencies offer enormous bandwidth but require entirely new antenna designs. Terahertz antennas are still in the experimental phase, but they show great promise for enabling ultra-fast wireless communication and ultra-high-resolution sensing applications.
- Nanoscale and Metamaterial Antennas: B5G and 6G systems will rely heavily on nanoscale antennas for applications in quantum communication, Nano-sensors, and Nano-imaging. These antennas are engineered using materials with unique properties that allow them to manipulate electromagnetic waves in ways that conventional antennas cannot. Metamaterials, for instance, offer the potential to control the antenna's response at the atomic scale, making them ideal for future high-frequency communication systems.

Challenges and Future Directions

While substantial progress has been made in antenna technology for both biomedical and communication applications, several challenges remain. In biomedical applications, key challenges include ensuring biocompatibility, minimizing interference from surrounding tissues, and achieving long-term stability for implantable antennas. For 5G and beyond, the challenge lies in managing the trade-offs between antenna size, bandwidth, efficiency, and power consumption.

Moreover, the deployment of terahertz and nanoscale antennas requires breakthroughs in material science and fabrication techniques

Career Opportunities in Antenna Engineering

The development of antennas for biomedical and communication applications has led to an increasing demand for professionals with expertise in this field. Careers in antenna engineering span across various industries including telecommunications, healthcare, aerospace, and consumer electronics. The potential career paths and opportunities for antenna engineers are outlined as:

Biomedical Applications: Antenna engineers focusing on biomedical applications can work on designing and improving antennas for medical devices, diagnostic tools, and wearables. Key roles include:

- Biomedical RF Engineer: Specializes in designing antennas for healthcare devices like implants, diagnostic systems, and monitoring equipment. Expertise in low power and small-form-factor antennas is critical.
- Antenna Designer for Medical Wearables: Focuses on developing antennas for continuous health monitoring systems such as smartwatches and other wearable devices.
- Research Scientist in Biomedical Electromagnetics: Conducts research on how electromagnetic fields interact with biological tissues, aiming to improve imaging techniques and treatment delivery systems.

Telecommunications and 5G: With the rollout of 5G and preparation for B5G and 6G networks, telecommunications companies are heavily investing in antenna research and development. The demand for engineers skilled in millimeter-wave, MIMO, and reconfigurable antennas is high.

- 5G RF Engineer: Works on optimizing antennas for 5G networks, including base stations and mobile devices. Engineers must understand mmWave technology and massive MIMO.
- Antenna Integration Engineer: Focuses on embedding advanced antennas into smartphones, tablets, and IoT devices, ensuring that they meet both size and performance requirements
- Research and Development Engineer for B5G/6G: Works on next-gen antenna technologies, including terahertz and nanoscale antennas for high-frequency communication systems.

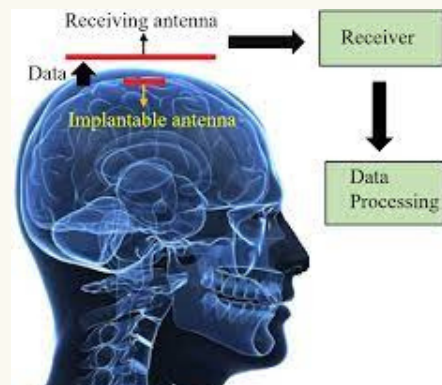
Aerospace and Defense: The aerospace and defense sectors often require antennas for satellite communication, radar, and autonomous systems. Engineers in this field develop high-performance antennas capable of operating under extreme conditions.

- Antenna Engineer for Aerospace: Designs antennas for aircraft, spacecraft, and satellites, often focusing on durability, high-frequency operation, and long-range communication.
- Defense Contractor for Antenna Systems: Works with defense organizations to develop radar and communication systems, including phased-array antennas for military applications.

Emerging Technologies: IoT, AI, and Nanoscale Systems: With the expansion of the Internet of Things (IoT) and AI, antenna engineers are increasingly tasked with developing systems for smart homes, autonomous vehicles, and wearables. Nanoscale antennas offer potential for highly miniaturized devices, leading to roles in cutting-edge fields like:

- IoT Antenna Engineer: Designs antennas for smart devices, including sensors, connected vehicles, and smart city infrastructure. These engineers need to focus on low-power, compact antennas that offer wide-area coverage.
- AI-Enhanced Antenna Systems Developer: Engineers who integrate AI with antenna systems for real-time optimization, beamforming, and interference reduction.
- Nanotechnology Engineer for Antennas: Develops antennas at the nanoscale for applications in sensing, communication, and medicine. Expertise in quantum effects and nanoscale electromagnetic properties is essential.

The antenna research for biomedical applications, 5G, and beyond is at the forefront of technological innovation. Whether it's improving healthcare outcomes through advanced imaging and monitoring systems or enabling the next generation of wireless communication, antennas are an integral part of our increasingly connected world. As research continues, it is expecting even more sophisticated designs that push the boundaries of size, performance, and functionality.



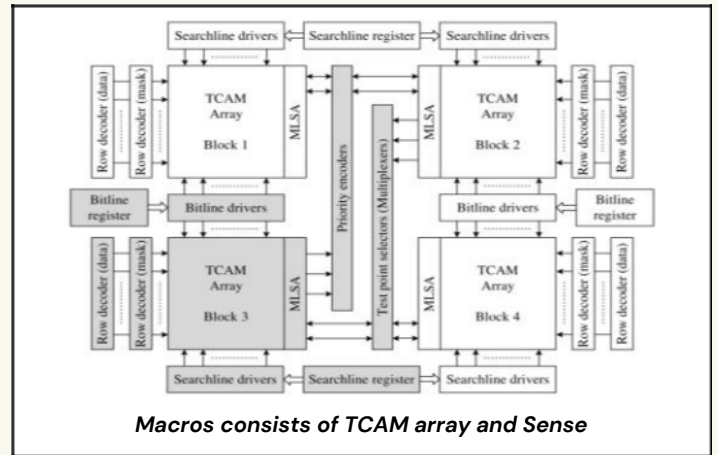
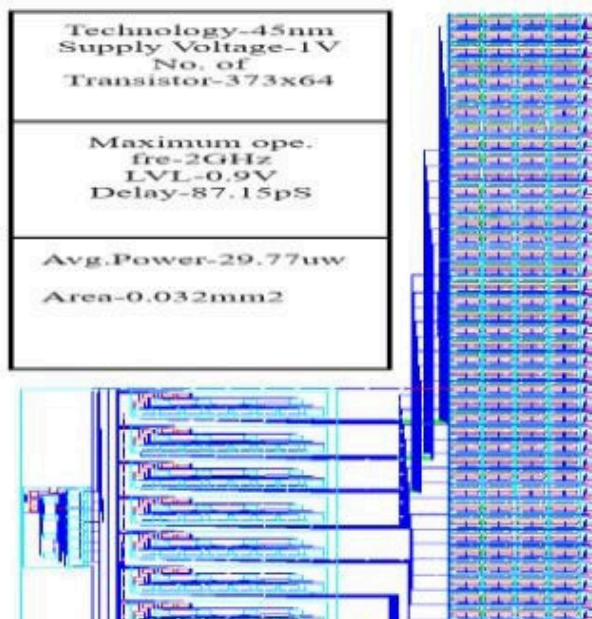
ASSOCIATIVE MEMORY FOR IN-PROCESSOR COMPUTING

Shyamosree Goswami, Anup Dandapat

Extended Abstract

Associative memory technology represents a significant departure from traditional memory architectures by enabling content-based data retrieval and pattern recognition inspired by biological neural networks. This paper presents an extensive exploration of associative memory principles, advantages over conventional memory systems, and the practical challenges encountered in its implementation.

Advantages of Associative Memory: Associative memory, exemplified by Content Addressable Memory (CAM), offers unique advantages including parallel searching capabilities, enhanced performance, and suitability for real-time applications. By accessing data based on its content rather than specific addresses, associative memory facilitates rapid retrieval operations, contributing to improved efficiency and responsiveness in diverse computing domains.



PARAMETE	PFCAM	SCPFAM	PPMVT	PROPOSED
Delay(ps)	306	1250	542	163.55
Power (uW)	109	35.96	45.57	29.77
Area (mm ²)	0.740	0.049	0.0016	0.032

A 64x32 bit CAM layout and its performance

Practical Challenges In Memory Fabrication:

Scalability: Scaling is a critical factor in memory fabrication as it allows for the miniaturization of memory cells, increasing memory density and reducing manufacturing costs per unit.

Capacity: The capacity of memory is a factor of memory fabrication as it is influenced by the size and density of memory cells, which are determined by the fabrication process.

Safety and Reliability of Silicon: The safety and reliability of silicon are crucial factors in memory fabrication, ensuring the integrity and longevity of memory devices. Design & Fabrication of High Density and High reliable memory is of primary concern.

Significance Of Associate Memory In Memory Fabrication:

In-memory computing utilizes RAM for data storage and processing, offering speed and efficiency benefits over disk-based retrieval. In-memory computation in Content Addressable Memory (CAM) occurs through the inherent architecture and operation of CAM itself. Memory stacking, or 3D stacking, can also be done in associate memory which can increase the memory density. The masking of bits which can easily done in TCAM (Ternary CAM) can be very helpful in high speed networking application.

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- S. P. Levitan, D. M. Chiarulli, A. Katsuri, J. Kettering, P. U. PA, Associative memory study: Architectures and technology (2002).



FACULTIES & STAFF

ELECTRONICS AND COMMUNICATION ENGINEERING



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Research Interest:

Low power VLSI design, Cyclic combinational circuits, Content Addressable Memory (CAM), Memristor based memory Design, In-memory Computing.

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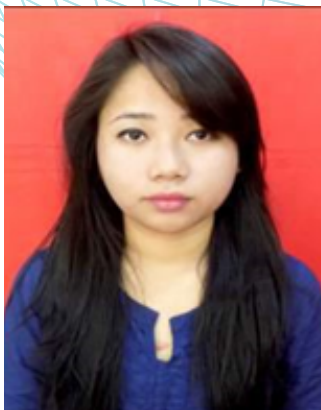
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<https://scholar.google.co.in/citations?user=TzNf01cAAAAJ&hl=en>



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Ms. Pubalee Podder
Technical Assistant
M.Tech, Tezpur University

Joined on 31st December, 2021
Email: pubalee.podder@nitm.ac.in

DEPARTMENTAL PROGRAM

○ **B.Tech**

○ **M.Tech**

○ **Ph.D.**

○ 2021-2025 Batch: 35

○ 2022-2026 Batch: 29

○ 2023-2027 Batch: 37

○ 2024-2028 Batch: 32

○ 2023-2025 Batch: 02

○ 2024-2026 Batch: 12

○ Total: 30 (Full Time)



**STUDENT
DETAILS**



Ph.D. Scholars & M.Tech

Ph.D. Scholar Details



Dariskhem Pyngrope

Area of Research: VLSI and Power Electronics



Debaraj Rana

Area of Research: Biomedical Image Processing



Jintu Borah

Area of Research: Air quality sensor applications in Machine learning and Deep learning architectures.



Shyamosree Goswami

Area of Research: Semiconductor Memories



Mahima Chaudhary

Area of Research: Wireless Communication

Ph.D. Scholar Details



Menuvolu Tetseo

Area of Research: MEMS cantilever-based mass sensors.



Seenivasan M A

Area of Research: Neuromorphic VLSI



Rabul Saikia

Area of Research: Biomedical Image Processing



Dolly Kumari

Area of Research: Signal Processing



Debarni Sarkar

Area of Research: Wireless Communication

Ph.D. Scholar Details



Amartya Paul

Area of Research: Non-Destructive Testing Using RF Sensors



Risham Doley

Area of Research: Wireless Communication-Waveform Designing.



Hemant Kumari

Area of Research: Computational Theory, Power Amplifier



Jacinta Potsangbam

Area of Research: Biomedical Image Analysis



Sunanda Mukhopadhyay

Area of Research: RF filter design, Programmable metasurface design.

Ph.D. Scholar Details



Kalpana Gogoi

Area of Research: MEMS-based pressure sensors.



Debojyoti Chattapaddhyay

Area of Research: Electromagnetic Metasurface for Stealth and Radome Applications.



Jacinta Jyrwa

Area of Research: Memristor-based Memory Design & In-Memory Computation



Habanaibok Suting

Area of Research: Electromagnetic Metasurface for Satellite Communication and Radar Cross Section



Deibaphira Suchiang

Area of Research: MEMS Flexible Sensors

Ph.D. Scholar Details



Ramkhun Gangmei

Area of Research: Biomedical Image processing



Geetima Kachari

Area of Research: VLSI Design



James L Lyngkhoi

Area of Research: Digital Image Processing, Hyperspectral Image Analysis



Parishmita Goswami

Area of Research: VLSI Design



Marbaremdor Wahlang Pahsyntiew

Area Of Research : Memory Design

Ph.D. Scholar Details



Mandira Biswas

Area of Research: ASM HEMTs, Semiconductor Device and Sensor Modeling, OFET.



Dhiraj Kumar

Area of Research: Fabrication and characterization of perovskites cell with different non-toxic materials.



Soumendu Ghosh

Area of Research: Electromagnetic Metamaterial and Metasurface, Metamaterial inspired Antenna, MIMO Antenna.



Sovan Bhattacharya

Area of Research: Microwave Sensor



Brijmohan Chaurasia

Area of Research: Integrated Sensing and Communications

M.Tech. Student Details



Wanchi Dora M Sangma
T23EC001



Marbud Janai Sun
T24EC006



Prachi
T23EC002



Eugene Daniel Phin
T24EC008



Mohit Raj
T24EC001



Sufanri Fella Lyngkhoi
T24EC009



Shahoj Chakma
T24EC002



Pasli Rasmus
T24EC010



Dasainmiki Diengdoh
T24EC003



Saumy Datt
T24EC011



Shyam Kumar
T24EC004



Risika Kumari
T24EC012





Markdone Well Jyrwa
T24EC005

STUDENT ACHIEVEMENTS

"EXCELLENCE
IS THE
GRADUAL
RESULT OF
ALWAYS
STRIVING
TO DO
BETTER."

- Pat Riley



Debaraj Rana, under the supervision of *Dr. Bunil Kumar Balabantaray* and *Dr. P. Rangababu*, received the Best Paper award at the 13th International Conference on Computing, Communication and Sensor Network (CCSN2024) held at Aliah University, Newtown, Kolkata, West Bengal, India on 27th September 2024 for the research title “CMNV2: Compact MobileNet-V2 towards Hardware Deployment for Colorectal Disease Classification”.

Anjani Kumar, the UG student from the ECE dept. was awarded the Scheme for Promotion of Academic and Research Collaboration by Purdue University USA and IIT Hyderabad from the 24th of June to the 2nd of August 2024.

During the 5th Research conclave held on February 28th & 29th 2024 organized by the National Institute of Technology Meghalaya, the following scholars were awarded with the following prizes from the Department of Electronics and Communication Engineering:

- *Jintu Borah*: 1st prize for “Contributing to NorthEast India”
- *Shyamosree Goswami*: 2nd prize for “Paper Presentation”.
- *Risham Doley*: 2nd Prize for “2-minutes Thesis Presentation”.
- *Dariskhem Pyngrope*: “INUP Best project award”.

ALUMNI ACHIEVEMENTS





JATIN KUMAR SINGH *B.Tech (2019-2023) , ECE*

Former Student General Secretary, SAC Working at Oracle (Associate Consultant). My four years at NIT Meghalaya were truly unforgettable. I'm grateful for the support from faculty and friends who helped me navigate challenges and shape my career.

To the young minds, Balance your classes with exploration, try different things, and explore your passion. Build strong bonds with friends and faculty; they offer invaluable lessons. Enjoy every moment of your college life fully. Wishing you all great success and a fulfilling journey ahead!



DR. SASHI KUMAR

He is currently working as Senior Engineer, Technology Development NAND Flash in Micron Technology, Hyderabad, Telangana, India. He has also worked as a Senior Research Scientist at the Indian Institute of Technology Bombay. He completed his PhD from the National Institute of Technology Meghalaya in 2021. His area of research was CMOS, MEMS & integrated sensors.



DR. SUSHANTA GOGOI

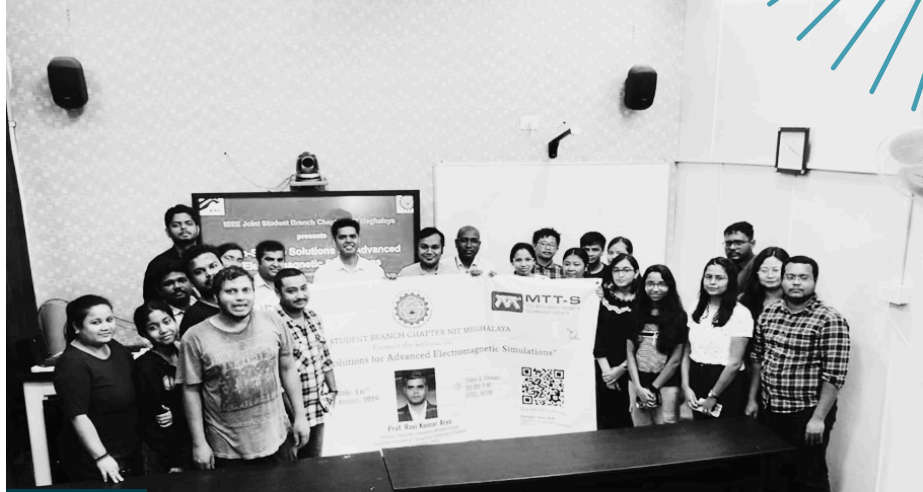
He is presently working as a Senior R&D Engineer at Qualcomm Technologies, Bangalore, India. Message: I hope this message finds you in good health and high spirits. It's been a privilege to witness the achievements of our alumni community since we graduated. The experiences we shared during our time at the university have created bonds that transcend time and distance. Now, as part of this incredible alumni network, we have the chance to stay connected and make a difference. Whether it's sharing career advice, offering internship opportunities, or simply catching up, each of us has something valuable to contribute. Let's continue to build on the foundation we created and support each other in both personal and professional endeavors.

EVENTS

ECE DEPARTMENT



INVITED
LECTURES



AWARENESS
PROGRAMS



IEEE Awareness Program at RKM School, Sohra



Invited Lecture by
**Prof. Kumar Vijay Mishra, Research Scientist at the
University of Maryland, College Park, USA**
Talk Topic : *5G Communication and Beyond*



Invited Lecture by
Prof. Jayanta Mukherjee - IIT Bombay
Talk Topic: *High Efficiency Power Amplifier Design*
using GaN transistors for 5G Communication



Invited Lecture by
Prof. Ravi Kumar Arya- Director, Xiangshan Laboratory
Wireless Group, Xiangshan Laboratory, Zhongshan Institute of
Changchun University of Science and Technology, China,
Talk Topic- *Open-Source Solutions for Advanced*
Electromagnetic Simulations



ELECTRONICS AND COMMUNICATION



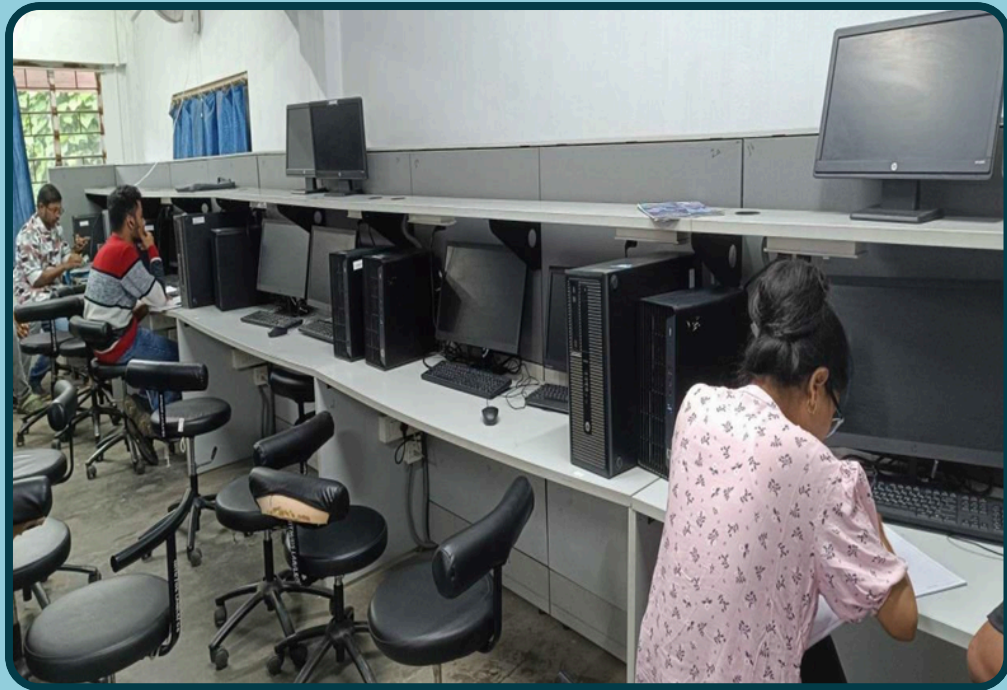
DEPARTMENT LABORATORY



Basic Electronics Lab, Sohra



Digital Signal Processing



Communication Systems Engineering Lab



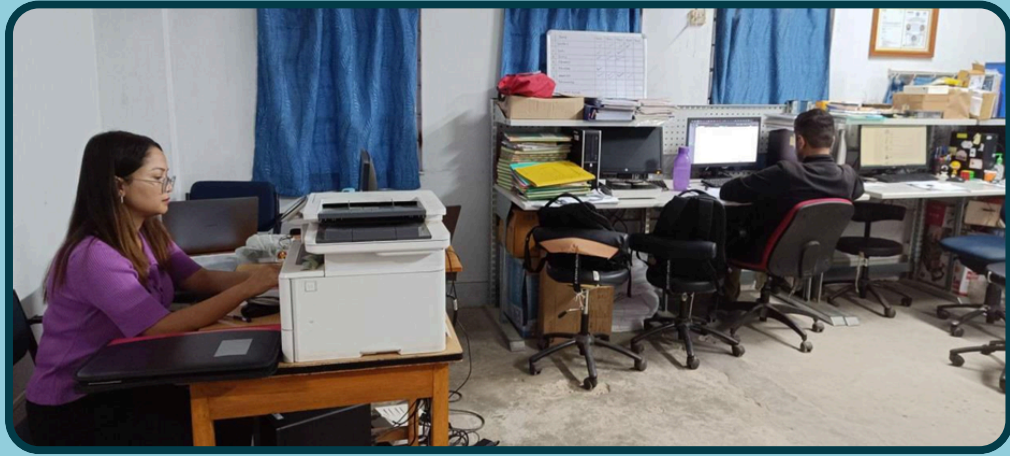
The Communication Systems Engineering Laboratory(CSEL) within the Electronics and Communication Engineering(ECE) Department serves as a critical hub for advancing research and development in modern communication technologies. Equipped with state-of-the-art facilities, the laboratory focuses on a wide array of topics including, but not limited to, digital signal processing (DSP), wireless communications, and network protocols.



The NI USRP 2953R, developed by National Instruments, is a cutting-edge software-defined radio (SDR) platform that stands out for its flexibility and performance in a wide range of applications. This innovative device is particularly well-suited for researchers and engineers working in fields like telecommunications, signal processing, and wireless communications

**Spotlight on the NI USRP
2953R: A Versatile Tool
For Modern
Communications**

RF Microwave and Optics Lab



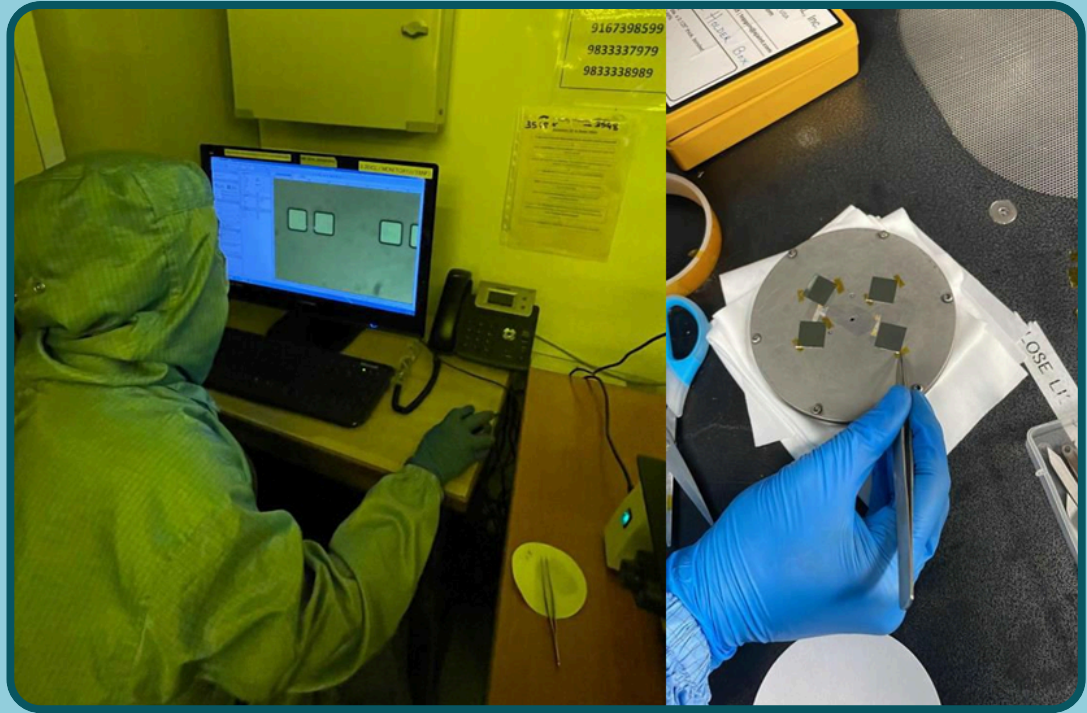
Digital Design Lab



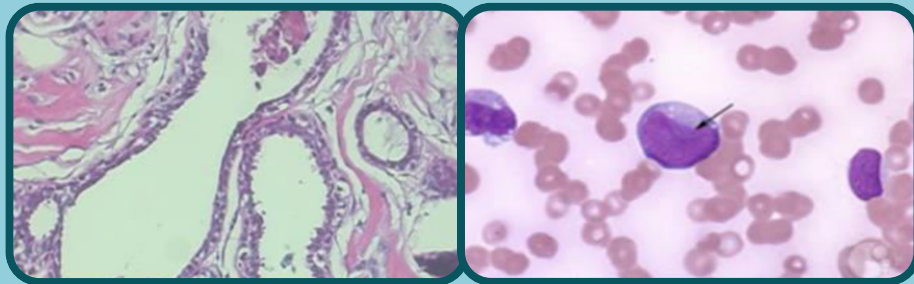
Low Power VLSI Lab



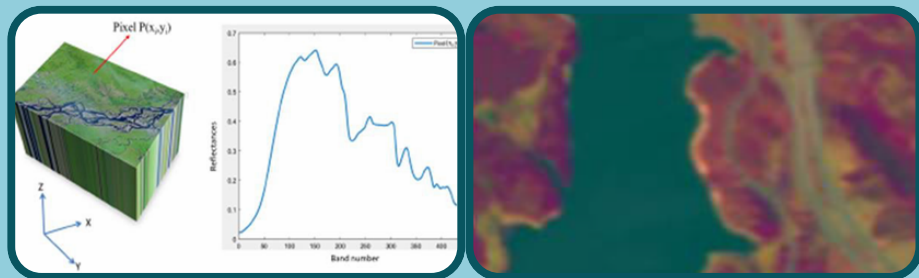
MEMS Computing Lab



Digital Signal & Image Processing Lab



Research on Breast Cancer Detection and Acute Leukemia Detection

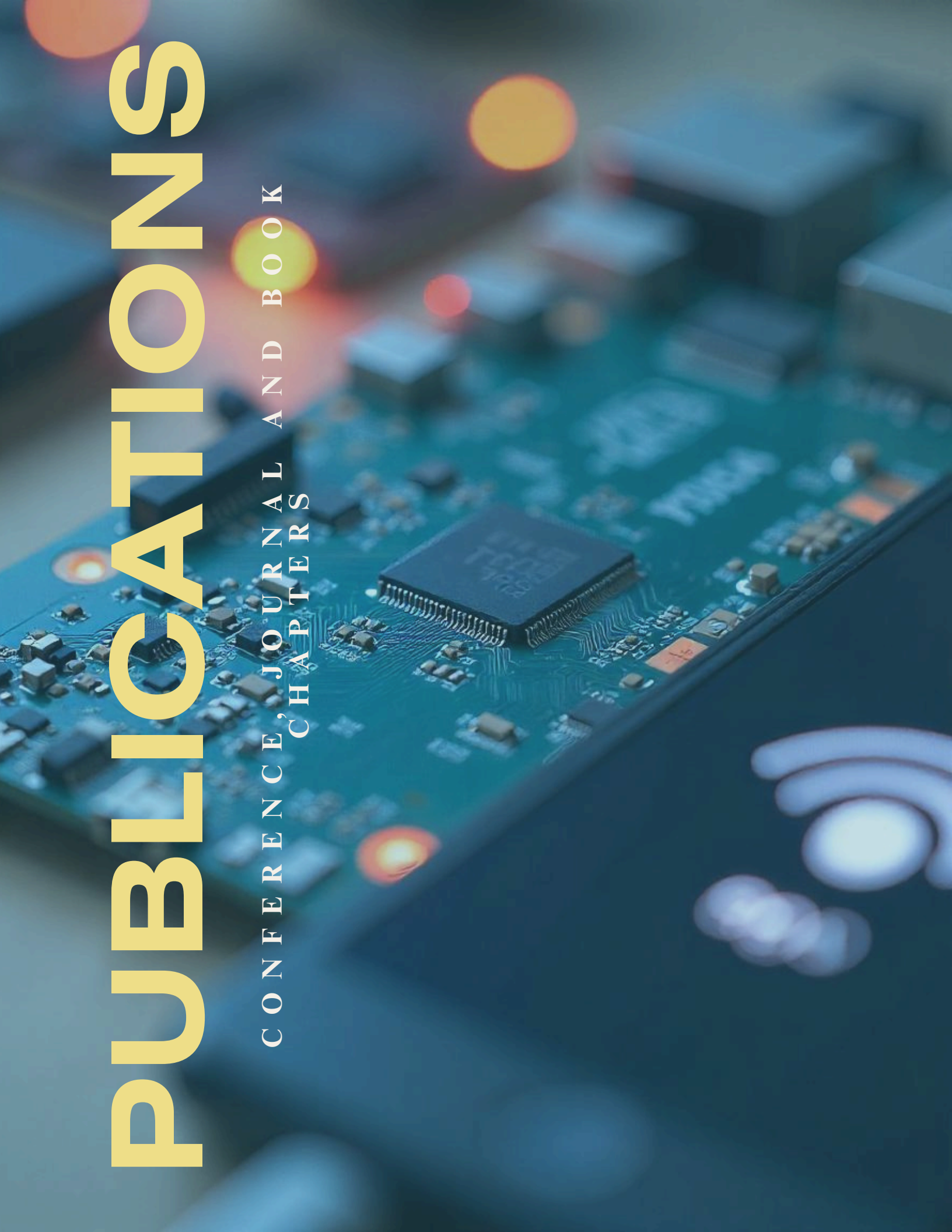


The false-color reconstructed image for the Jasper Ridge Dataset

Signal and Image processing are critical disciplines in electronics and communication engineering. They analyze, interpret, and manipulate visual and audio data. Recent advancements in engineering resources have driven significant progress in these fields. Image processing extracts information from digital images, while signal processing deals with signal analysis and manipulation. These disciplines employ various methodologies, algorithms, and tools to extract insights, enhance data quality, and facilitate decision-making.

PUBLICATIONS

CONFERENCE, JOURNAL AND BOOK
CHAPTERS



- J. Borah, M. S. Mohd. Nadzir, M. G. Cayetano, S. Majumdar, H. Ghayvat and G. Srivastava, "AiCareAir: Hybrid-Ensemble Internet-of-Things Sensing Unit Model for Air Pollutant Control," in IEEE Sensors Journal, pp. 21558-21565, 1 July 2024, doi: 10.1109/JSEN.2024.3397735.
- S. M A and P. Saha, "The Energy-Efficient and Distortion Blocking Leaky Integrate-and-Fire Neuron Model," 2024 6th International Conference on Energy, Power and Environment (ICEPE), Shillong, India, 2024, pp. 1-6, doi: 10.1109/ICEPE63236.2024.10668956.
- R. Saikia, A. Sarma, K. M. Singh and S. S. Devi, "VCaps-Net: Fine-Tuned VGG16 with Capsule Network for Acute Lymphoblastic Leukemia Detection on a Diverse Dataset," 2024 6th International Conference on Energy, Power and Environment (ICEPE), Shillong, India, 2024, pp. 1- 6, doi: 10.1109/ICEPE63236.2024.10668856.
- Chaudhary M, Bandari SK. "A low complex joint optimization model for maximizing sum rate and energy efficiency in an IRS-assisted multi-user communication scenario", Physical Communication. 2024 April, doi: 10.1016/j.phycom.2024.102296
- Tetseo, M., Gogoi, K., Kumar, S. et al. "A conceptual study on novel current mirror integrated cantilever (CMIC) mass sensor for micro-gram (μg) range sensing applications", Microsystem Technologies, pp. 263–275 January 2024. doi: 10.1007/s00542-023-05594-8
- Amartya Paul, Hemant Kumari, Rinaldo Snaitang, PradeepK. Gautam, and Shubhankar Majumdar, "Microwave imaging and non-destructive testing of bituminous mix binder-aggregate behavior using log-periodic feedline-based microstrip filter", NDT, pp. 347–362, August 2024. doi:10.3390/ndt2030021
- Debbarni Sarkar, Vipin Pal, Satyendra Singh Yadav, and Sarat Kumar Patra. "IRS-aided NOMA-based communication architecture for 6G wireless networks: An enhanced error-control and reliable data transmission", Physical Communication, May 2024. 102394. doi: 10.1016/j.phycom.2024.102394
- Amartya Paul, G. Bhargava, D. Adak, S. Dutta, and Shubhankar Majumdar, "Design and validation of a microstrip log-periodic feedline based filter for microwave imaging of rebar," IEEE Transactions on Instrumentation and Measurement, (ACCEPTED).

- *Debbarni, Sarkar, S. S. Yadav, L. R. Cenkeramaddi, O. J Pandey. "TDRA: Transformer Based Deep Recurrent Architecture for Automatic Modulation Classification (AMC) Pertinent to Intelligent Reflecting Surface Assisted Internet of Things (IoT) Networks". IEEE Internet of Things Journal (Accepted).*
- *Biswas, M., Pyngrope, D., Kumar, S., Majumdar, S., & Bag, A. "RF magnetron sputtering of Ga₂O₃ thin films: Analysis of oxygen flow rate impact on stoichiometry, structural, optical characteristics, and energy band alignments", Materials Science in Semiconductor Processing, October 2023. doi: 10.1016/j.mssp.2023.107937*
- *Pyngrope, D., Biswas, M., Kumar, S., Majumdar, S., & Bag, A. "RF magnetron sputtering of Ga₂O₃ thin films: Analysis of thermal annealing induced tuning of structural, optical characteristics, and energy band alignments", Materials Science in Semiconductor Processing, 108243. February 2024. doi:10.1016/j.mssp.2024.108243.*
- *Pyngrope, D., Majumdar, S., & Crupi, G. (2024). "Fractional order capacitance behavior due to hysteresis effect of ferroelectric material on GaN HEMT devices", International Journal of Numerical Modelling: Electronic Networks, Devices and Fields, January 2024, doi: 10.1002/jnm.3206.*
- *S. Ghosh, S. Mukhim, N. Sohtun and A. Sarkhel, "A Multiband Ultrathin Multifunctional Polarization Rotator Metasurface and its Application in RCS Reduction," 2023 IEEE Microwaves, Antennas, and Propagation Conference (MAPCON), Ahmedabad, India, 2023, pp. 1-6, doi: 10.1109/MAPCON58678.2023.10464034.*
- *S. Ghosh, J. Ghosh, M. Santoshkumar Singh and A. Sarkhel, "A Low-Profile Multifunctional Metasurface Reflector for Multiband Polarization Transformation," in IEEE Transactions on Circuits and Systems II: Express Briefs, pp. 76-80, Jan. 2023, doi: 10.1109/TCSII.2022.3202085*
- *S Goswami, V Chandana, A Dandapat."An Approach to Design a Low Power High-Speed Full Adder Circuit Based on Logical Effort," ELECTRONICS, JUNE 2024. doi: 10.53314/ELS2428003G*
- *R. Saikia, R. Deka, A. Sarma and S. S. Devi, "BSNEU-net: Block Feature Map Distortion and Switchable Normalization-Based Enhanced Union-net for Acute Leukemia Detection on Heterogeneous Dataset," in Journal of Imaging Informatics in Medicine, pp 1-28, September 2024, doi: 10.1007/s10278-024-01252-1.*

Research and Development Project

S. No	Name of the faculty member	Title of the Project	Period (From -To)	Sponsoring Organisation	Amount [in Lakhs]
1.	Dr. S. Majumdar	Fully acoustics testing of low velocity impact damage in composite plate using the concept of local defect resonance	2022-25	Aeronautics R and D Board	24,02,800
2.	Dr. P. Rangababu Dr. A. Sarkhel Dr. S. K. Bandari Dr. S. Majumdar Dr. S. S. Yadav Dr. P. K. Rathore Dr. Prabir Saha Dr. A. Dandapat	AI Empowered Advanced Wireless Communication Systems	2021-2026	DST -FIST	80 00000/-
3.		Development of High Sensitivity CMOS-MEMS Integrated Pressure Sensor and System for Space Application	2019 - 2024	Indian Space Research Organisation (ISRO), Department of Space, Government of India	32,46,000/-
4.	Dr. P. K. Rathore	Design and Development of Highly Sensitive Non-Conventional Ring Channel Shaped MOSFET Based Current Mirror Integrated Pressure Sensors	2021 - 2024	Department of Science & Technology, Ministry of Science and Technology, Government of India	44,93,601/-
5.	Dr. S. Majumdar	BRO Project - Sensor Based Big Data Analysis for Prognostics and Health Management of RCC Bridges	2023-2025	BRO	37000000/-
6.	Dr. P. Saha, Dr. P. K. Rathore, Dr. S. Majumdar	SMDP Project - Development of On-chip MEMS Pressure Sensor based Tensiometer for Agriculture.	2023-2028	MIETY	1,10,00000/-
7.	Dr. P. Saha Dr. A. Sarkhel Dr. S. K. Bandari Dr. S. Majumdar Dr. S. S. Yadav	TCIL Project- UAV Assisted Soil Moisture Content Determination through 5G Network	2023-2028	DoT	1,14,00000/-

Editorial Board

Editor's



Dr. Salam Shuleenda Devi



Dr. Jagritee Talukdar

Members



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Roll No. P21EC002



Rabul Saikia
Roll No. P21EC003



Jintu Borah
Roll no. P21EC016



Seenivasan M A
Roll No. P21EC005



Debojyoti
Chattapaddhyay
Roll No. P23EC002



James L Lyngkhoi
Roll NO. P24EC002



Marbaremdor Wahlang
Pahsyntiew
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Electronics and Communication Engineering Department
National Institute of Technology Meghalaya
(An Institute of National Importance)