



Major Areas of Research

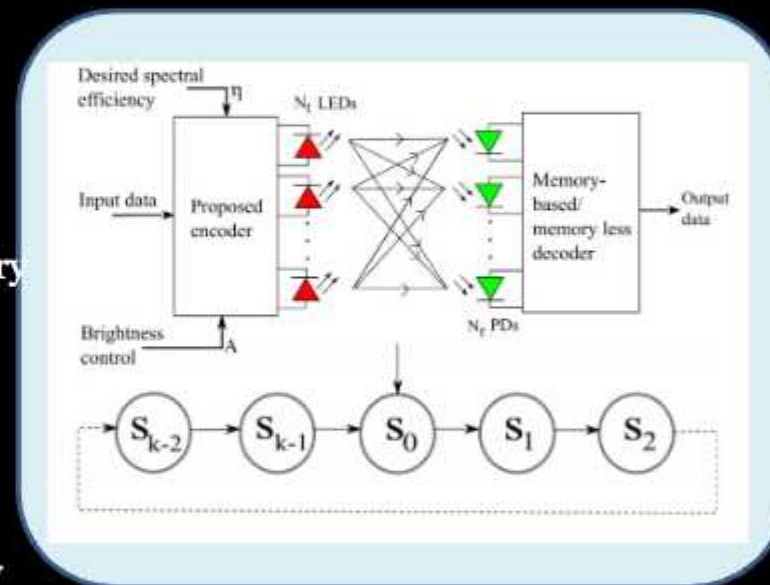
1. Resource allocation, scheduling, optimization in 5G and Beyond networks including Cellular networks, V2X, IoT, etc.
2. Machine Learning for communications, smart mobility, electric mobility, UAV, batteries.
3. Security and Privacy in Wireless Networks

Major Research Facilities in the Group

1. USRP based testing, development, and validation of Physical and MAC layer techniques/protocols/algorithms for 5G and Beyond Wireless Networks
2. Machine learning based solutions for detection, classification, and estimation of various targets/objects in RADAR, Vehicular environment, EV, LiON battery
3. Vehicle-to-vehicle and vehicle-to-infra communications, vehicular networks inside a vehicle.

Most Significant Publications

1. N. S. Mouni, et al., "Adaptive User Pairing for NOMA Systems With Imperfect SIC,"
in IEEE Wireless Communications Letters, vol. 10, no. 7, pp. 1547-1551, July 2021, doi: 10.1109/LWC.2021.3074036.
2. N. Eswara et al., "Streaming Video QoE Modeling and Prediction: A Long Short-Term Memory Approach,"
in IEEE Transactions on Circuits and Systems for Video Technology, vol. 30, no. 3, pp. 661-673, March 2020,
doi: 10.1109/TCSVT.2019.2895223.
3. S. Gupta et al., "Target Classification by mmWave FMCW Radars Using Machine Learning on Range-Angle Images,"
in IEEE Sensors Journal, vol. 21, no. 18, pp. 19993-20001, 15 Sept.15, 2021,
doi: 10.1109/JSEN.2021.3092583.





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Major Areas of Research

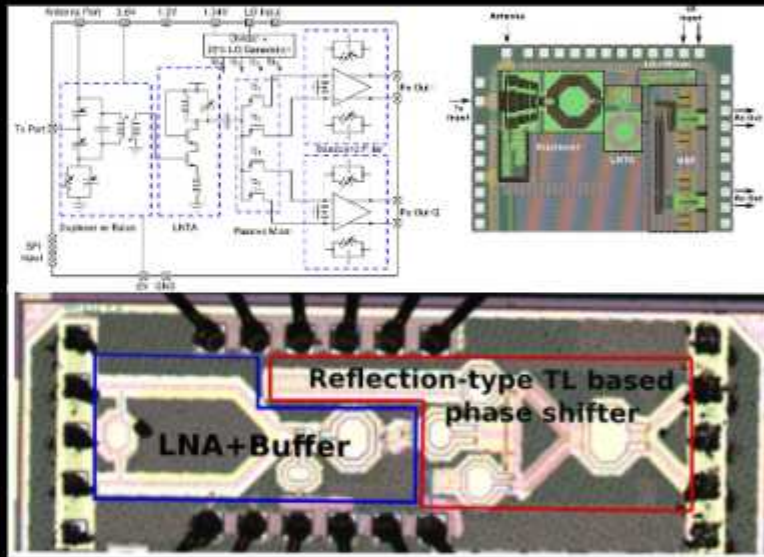
- mmWave beamforming front-ends
- Mixed-mode transceivers
- On-chip self-interference cancellation

Major Research Facilities in the Group

- RF probe station
- mmWave 4-port VNA
- Cadence and Mentor Graphics IC design suite

Technology/Product Developed/Up to 3 most significant Publications

- “Sampler in a full-duplex system and method of sampling received signal,” US11303320B2, Apr. 12, 2022
- “Method and system for interference cancellation in MIMO wireless system,” US11239878B2, Feb. 01, 2022
- “A 28GHz Reflective-Type Transmission-Line-Based Phase Shifter,” IEEE Transactions on Circuits and Systems I: Regular Papers, 2020.



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Major Areas of Research

Signal Processing

Fourier Analysis

Convex and Combinatorial Optimization

Machine Learning

Research Methodologies

Our group primarily works on algorithm design and analysis for signal processing problems. We draw from multiple fields in mathematics, including linear algebra, probability, number theory, additive combinatorics, convex optimization, duality and submodularity.

Technology/Product Developed/Up to 3 most significant Publications

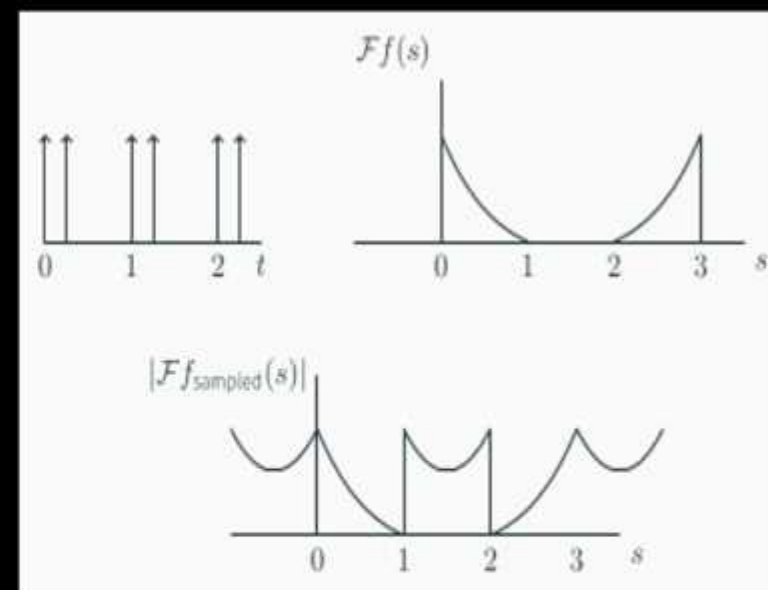
Fast and Efficient DFT Computation for Signals with Structured Support (project completed as part of Qualcomm Innovation Fellowship 2021) [preprint](#)

Convolution idempotents with a given zero-set; A Siripuram, B Osgood; IEEE Transactions on Signal Processing 68, 4773-4781

Discrete sampling: A graph theoretic approach to orthogonal interpolation; A Siripuram, WD Wu, B Osgood; IEEE Transactions on Information Theory 65 (12), 8119-8130

Discrete sampling and interpolation: Universal sampling sets for discrete bandlimited spaces; B Osgood, A Siripuram, W Wu

IEEE transactions on information theory 58 (7), 4176-4200



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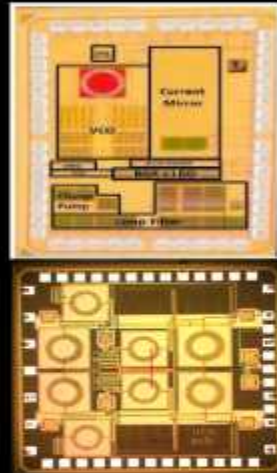


Major Areas of Research/Up to 3 major sponsored projects

- 1) VLSI circuit design for Radio Frequency Transceiver Frontend (Meity project)
- 2) Energy Harvesting System and Circuits (Start-up)
- 3) GaN (III-V) Radio Frequency Power Amplifier (DRDO project)
- 4) Biomedical Circuits and System (Start-Up)

Major Research Facilities in the Group

- 1) EDA software tools for Analog, RF and Mixed signal circuit Design
- 2) High performance IC characterization Lab (VNA, Spectrum Analyzer, Signal generator etc)



Technology/Product Developed/Up to 3 most significant Publications

- 1) Sesha Sairam Regulagadda, S. Nagaveni, A. Dutta, "A Package Aware QLMVF Receiver Front End", IEEE Trans. Of Circuits and Systems-II, 2020
- 2.)S. Nagaveni;Pramod Kaddi;Ashwini Khandekar, A Dutta, "Resistance Compression Dual-Band Differential CMOS RF Energy Harvester Under Modulated Signal Excitation" IEEE Transactions on Circuits and Systems -I: 2020
- 3) Pankaj Kumar Jha; Murali Krishna Rajendran; Prakash Kumar Lenka; Amit Acharyya;Ashudeb Dutta, "A Fully Analog Autonomous QRS Complex Detection and Low-Complexity Asystole, Extreme Bradycardia, and Tachycardia Classification System", " IEEE Transactions on Instrumentation and Measurement-2022





CH Gajendranath

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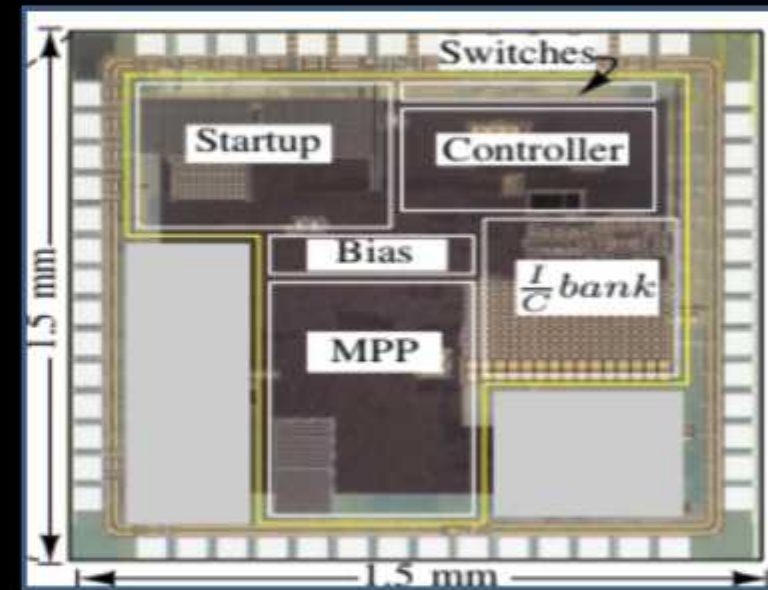
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Major Areas of Research/Up to 3 major sponsored project

1. Analog and Mixed Signal Circuit Design
2. Power Management IC Design
3. Sensor Interface Electronic Design

Major Research Facilities in the Group

1. Analog and Mixed Signal Circuit Design
2. Power Management IC Design
3. Sensor Interface Electronic Design



Technology/Product Developed/Up to 3 most significant Publications

1. Priya, et. al. *IEEE JSSC*, 57, 10, (2022). [[doi](#)]
2. G chowdary, et. al. *IEEE SSCL*, 1, 2, (2018). [[doi](#)]
3. G Chowdary et. al. *IEEE JSSC*, 51, 21, (2016). [[doi](#)]



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Major Areas of Research/Up to 3 major sponsored projects

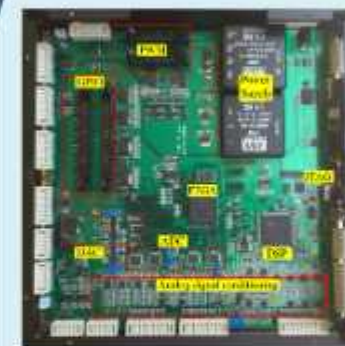
- SiC based current source inverters for traction drives (SERB project)
- Medium voltage high-power converter designs
- Control techniques for multi-phase drives
- Finite element design of electric machines

Major Research Facilities in the Group

- Test setups for induction and PMSM drives
- High performance DSP and FPGA control boards
- Test setups for grid connected renewable energy systems
- Voltage source and current source inverters

Technology/Product Developed/Up to 3 most significant Publications

- R. Ram Bharadwaj Vemparala and J. Titus, "Performance Evaluation of an Si+SiC based Hybrid VSI using a Modified Space Vector Switching Pattern in a Grid Connected Inverter Application," IECON 2022 – 48th Annual Conference of the IEEE Industrial Electronics Society, 2022, pp. 1-6.
- J. Titus and K. Hatua, "Design Considerations for an Active-Reactive Induction Motor for Medium-Voltage Applications," in IEEE Transactions on Industry Applications, vol. 56, no. 3, pp. 2531-2540, May-June 2020.
- J. Titus and K. Hatua, "An Asymmetric Nine-Phase Induction Motor for LCI-Fed Medium Voltage Drive Applications," in IEEE Transactions on Power Electronics, vol. 35, no. 5, pp. 5047-5056, May 2020.



DSP+FPGA control board designed for sophisticated motor control applications



Cascaded H-Bridge Inverter Drive



Major Areas of Research/Up to 3 major sponsored projects

Research area: IC Design, CMOS Image sensors, 2D/3D Vision Sensors, LiDAR, Event Bases Cameras

1. A low-latency, high dynamic range, bio-inspired event-based Dynamic and Pixel Vision Sensor (DAVIS).
2. A Direct Time-of-Flight sensor based System-on-a-chip LiDAR
- 3/ Low noise Noise CMOS Image Sensors

Major Research Facilities in the Group:

IC Design and characterization Lab, CMOS Image Sensor Design and characterization Lab

Technology/Product Developed/Up to 3 most significant Publications:

Technology Developed -Low-Noise and HDR CMOS Image Sensor, Time-of-Flight Pixels for LiDAR, Bio-inspired Event based CMOS Pixels

Publications -

1. P. Philip, **K. Jainwal**, A. van Schaik and C. S. Thakur, "Tau-Cell-Based Analog Silicon Retina With Spatio-Temporal Filtering and Contrast Gain Control," in *IEEE Transactions on Biomedical Circuits and Systems*, vol. 18, no. 2, pp. 423-437, April 2024, doi: [10.1109/TBCAS.2023.3332117](https://doi.org/10.1109/TBCAS.2023.3332117)
2. K. Jainwal and M. Sarkar, "A 280- μ V Temporal Noise, 76-dB Dynamic Range CMOS Image Sensor With an In-Pixel Chopping-Based Low-Frequency Noise Reduction Technique," in *IEEE Transactions on Electron Devices*, vol. 70, no. 3, pp. 1134-1142, March 2023, doi: [10.1109/TED.2023.3236911](https://doi.org/10.1109/TED.2023.3236911).
3. Kapil Jainwal, Chandani Anand, Mukul Sarkar, "1/f Noise Reduction using In-Pixel Chopping in CMOS Image Sensors," *IEEE Solid-State Circuits Letters*, vol. 1, no. 6, pp. 146-149, Jul. 2018

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Major Areas of Research/Up to 3 major sponsored projects

- Coding and Signal Processing for 6G
- Theory of Cyber Physical Systems
- Commensal Radar
- mMIMO and RIS

Major Research Facilities in the Group

- USRP SDRs
- 5G/6G Commsense BTS and receiver

Technology/Product Developed/Up to 3 most significant Publications

- MRMC diversity protocols
- Low complexity decoding for mmWave
- Low complexity diversity decoding for Block codes
- 5G/6G Commsense BTS and receiver

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Major Areas of Research/Up to 3 major sponsored projects

- 1) Multilevel Inverters
- 2) Induction Motor Drives
- 3) PWM Converters
- 4) Pole-Phase Modulated Machines

Major Research Facilities in the Group

- 1) Essential Power electronic Equipment's including Power Analyzer, Function Generator, Programmable DC Source/Load and oscilloscopes.
- 2) Multiphase Induction Motors
- 3) Modular Power Electronic Converters

Technology/Product Developed/Up to 3 most significant Publications

1. B. P. Reddy, A. Iqbal, S. Rahman, M. Meraj and S. Keerthipati, "Dynamic Modeling and Control of Pole-Phase Modulation-Based Multiphase Induction Motor Drives," in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 10, no. 3, pp. 3383-3394, June 2022, doi: 10.1109/JESTPE.2021.3062216.
2. M. R. A and K. Sivakumar, "A Fault-Tolerant Single-Phase Five-Level Inverter for Grid-Independent PV Systems," in IEEE Transactions on Industrial Electronics, vol. 62, no. 12, pp. 7569-7577, Dec. 2015, doi: 10.1109/TIE.2015.2455523.



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Major Areas of Research/Up to 3 major sponsored projects

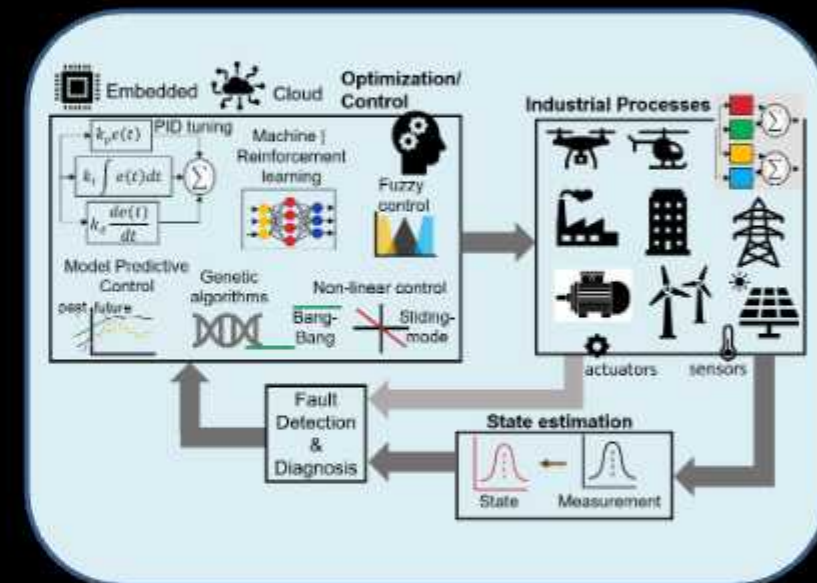
- AI/ML for Control of Multivariable systems
- Co-acting State Estimation
- Fault Detection and Diagnosis

Major Research Facilities in the Group

- Dynamics and Control Lab
- Various control experiments
- Software simulation tools

Technology/Product Developed/Up to 3 most significant Publications

- The optimal detuning approach based centralized control design for MIMO processes, Journal of Process Control
- Distributed State Estimation through Co-acting Kalman Filters, Asian Journal of Control
- Optimal design of energy sources and reverse osmosis desalination plant, Desalination



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Major Areas of Research/Up to 3 major sponsored projects

1. 5G+/6G Converged Terrestrial and Satellite IoT (5G+/6G-sIoT); 2. Next Generation Wireless Research and Standardization on 5G and Beyond; 3. 5G Advance ORAN Massive MIMO Base Station; and 4. 6G End-to-End Communication System

Major Research Facilities in the Group

Indigenous 5G Test Bed setup with the following testing equipments:

- 5G NR gNB and UE - Interoperability testing of sub systems such as PHY, stack, Core, NAS or RF;
- End-to-End testing facility of 5G NR gNB and UE is operational for the users;
- IITH NB-IoT UE ; and
- IITH NB-IoT UE and NB-IoT test base station – NB-IOT App testing Extreme Massive MIMO Lab



Figure 4a: Extremely large circular/cylindrical antenna array that serve up to 48 users (demonstrated in the IITH campus)

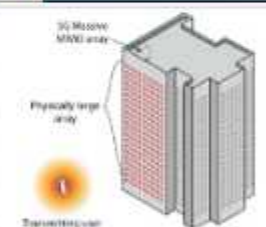


Figure 4b: Extremely large antenna array printed on the walls of a high-rise building

Extreme Massive MIMO

Introduced wireless Standards Essential Patents (SEPs) in 5G and has contributed towards the creation of the 3GPP 5G standard. An introduction of a new waveform “ $\pi/2$ BPSK with spectrum shaping” which has low PAPR (almost constant OFDM signal).

Incubated a start-up company WiSig Networks at the IITH Tech incubator. The aim is provide cutting-edge products such as ORAN compliant 5G base station and NB-IoT SoC (System-On-Chip). WiSig's PHY/MAC algorithms have already made their mark in the 5G industry in a short time.



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Major Areas of Research/Up to 3 major sponsored projects

- Codes for next generation communication
- Coding for distributed computing and learning algorithms

Major Research Facilities in the Group

- Workstation with GPUs
- In-lab library of advanced mathematical and engineering texts

Technology/Product Developed/Up to 3 most significant Publications

- Digital Address Codes for India
- “Berman Codes: A Generalization of Reed-Muller Codes that Achieve BEC Capacity,” IEEE ISIT 2022
- “Lattice Index Coding,” IEEE Transactions on Information Theory, 2015.

Berman Codes: A Generalization of Reed-Muller Codes that Achieve BEC Capacity

Lakshmi Prasad Natarajan and Prasad Krishnan

Abstract—We identify a family of binary codes whose structure is similar to Reed-Muller (RM) codes and which include RM codes as a strict subclass. The codes in this family are denoted as $\mathcal{C}_n(r, m)$, and their duals are denoted as $\mathcal{B}_n(r, m)$. The length of these codes is n^m , where $n \geq 2$, and r is their ‘order’. When $n = 2$, $\mathcal{C}_2(r, m)$ is the RM code of order r and length 2^m . The special case of these codes corresponding to n being an odd prime was studied by Berman (1967) and Blackmore and Norton (2001). Following the terminology introduced by Blackmore and Norton, we refer to $\mathcal{B}_n(r, m)$ as the Berman code and $\mathcal{C}_n(r, m)$ as the dual Berman code. We identify these codes using a recursive Plotkin-like construction, and we show that these codes have a rich automorphism group. Applying a result of Kumar et al. (2016) to this set of automorphisms, we show that these codes achieve the capacity of the binary erasure channel (BEC) under bit-MAP decoding.

The dual code $\mathcal{B}_n(r, m)$ has code parameters

$$[n^m, \sum_{i=0}^m \binom{m}{i} (n-1)^i, 2^{m+1}]. \quad (2)$$

If we substitute $n = 2$ in (1) and (2) we obtain the parameters of the r th order RM code of length 2^m , i.e., $\text{RM}(r, m)$, and its dual $\text{RM}(r, m)^\perp = \text{RM}(m-r-1, m)$. Indeed, we will see that the code $\mathcal{C}_2(r, m)$ is identical to $\text{RM}(r, m)$, and by duality $\mathcal{B}_2(r, m) = \text{RM}(m-r-1, m)$.

We study various basic properties of $\mathcal{C}_n(r, m)$ and $\mathcal{B}_n(r, m)$ in this work. A sub-class of these codes, corresponding to the case $n = p$ with p being an odd prime, was studied by Berman [5], and Blackmore and Norton [6] using a group algebra framework. To the best of our knowledge, Berman [5] introduced and investigated the code $\mathcal{B}_p(r, m)$ and showed



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Major Areas of Research/Up to 3 major sponsored projects

1. Nanophotonics
2. Semiconductor Optoelectronics
3. Plasmonics and Metamaterials

Major Research Facilities in the Group

1. Confocal Fluorescence Lifetime Imaging System
2. Mid-IR Quantum Cascade Laser
3. Portable UV-VIS-NIR Spectrometer



Technology/Product Developed/Up to 3 most significant Publications

1. Saurabh Kishen, et. al. *Nanoscale Advances*, 4, 17, (2022). [[doi](#)]
2. Jinal Kiran Tapar, et. al. *Journal of Optics*, 24, 3, (2022). [[doi](#)]
3. Jinal Kiran Tapar et. al. *ACS Photonics* (2021). [[doi](#)]



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Major Areas of Research

Modelling and simulation nanoelectronic devices

Computational Nanoelectronics

TCAD tool development

Major Research Facilities in the Group

6 high end Dell workstations

Inhouse TCAD tool for modelling of nano-electronic devices

Technology/Product Developed/Up to 3 most significant Publications

2D in-house TCAD tool for modelling

G. A. Gauhar *et al.* “Study of gate current in advanced MOS architectures”,
Solid State Electronics, 2022.



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Major Areas of Research/Up to 3 major sponsored projects

Major Areas of Research:

Autonomous Navigation Technologies: Aerial/Terrestrial, Autonomous Navigation Testbed/Living Lab, Drone Based Sensing, Cyber Physical Systems (CPS)/Internet of Things (IoT), Wireless Sensor Networks, Embedded Systems.

Application Areas: Smart Transportation – Terrestrial and Air-Borne, Agriculture, Healthcare, Environmental, Sensors like LIDAR, Hyperspectral/Multi-spectral/RGB Imaging are being used for these applications.

Major Ongoing sponsored projects:

'ADAS for point-to-point navigation system for autonomous car adaptable to Indian scenarios,' by Suzuki Motor Corporations, Japan, Rs. 3.976 Crores, September 2021 – August 2024.

'Real-Time Edge Computing Architectures for LiDAR-based Intelligent Transportation System,' by MeITY, Rs.1.989655 Crores, February 2021 – February 2024.

'Technology Innovation HUB TIH on Autonomous Navigation and Data Acquisition Systems (UAV, RoV..),' under DST's NM-ICPS, March 2020 – March 2025.



Major Research Facilities in the Group

Wireless Network Lab (WiNET Lab) – IoT technologies, Drones, High end sensors – RGB, Multispectral, Hyperspectral, Lidars, GNSS Systems

Testbed/Living Lab for Autonomous Navigation (Aerial and Terrestrial) at IITH campus: Facility includes proving grounds, test tracks, connected vehicle (V2X) environments, signalized and unsignalized intersections, rain-fall emulators, smart poles, mechanical integration facilities, UAV testing, and developmental facilities, edge compute and networking infrastructure.



Technology/Product Developed/Up to 3 most significant Publications

IoT Motes, Drones with Hyperspectral Multispectral RGB cameras for agriculture phenotyping applications, GPS Based Autonomous Navigation of Campus Shuttle Vehicle, Map based Navigation, GPS denied navigation – Sensor based, Sensor aided accurate landing of Unmanned Aerial Vehicles (UAVs), Swarm of Network Connected Unmanned Aerial Vehicles (UAVs), Flapping wing – bio inspired drones, Heavy Payload Drones, Autonomous E-Bike – First/Last mile connectivity



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Major Areas of Research/Up to 3 major sponsored projects

- 1) Power System Protection
- 2) Grid Connected Renewable Energy Systems
- 3) Wide Area Protection and Control
- 4) Microgrids



Major Research Facilities in the Group

- 1) MicroLab Box-dSpace Controller for testing Control Algorithms, microcontroller development boards
- 2) 5kW Roof-top Solar PV, Inverter modules and 8-Channel oscilloscope
- 3) Power System Simulation Softwares (PSCAD and PSS/E)



Technology/Product Developed/Up to 3 most significant Publications

- 1) Prototype on "Virtual Synchronous Generator Concept" realization for grid connected renewable energy sources
- 2) G. S. Kumar and R. Bhimasingu, "Optimal Sector-Based Sequential Model Predictive Control for Current Source Rectifier," in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 10, no. 5, pp. 5833-5843, Oct. 2022, doi: 10.1109/JESTPE.2022.3186242.
- 3) Purushotham Reddy Chegireddy, Ravikumar Bhimasingu, "Synchrophasor based fault location algorithm for three terminal homogeneous transmission lines, Electric Power Systems Research, Volume 191, 2021, 106889,



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Major Areas of Research: Power Electronics, Electric Drives, Renewable Energy Sources, Distributed Energy Generation.

Sponsor Projects: (1) Design and development of a hybrid DC bus power supply with the high voltage ride through capability, SERB, 29.52Lakhs, 2019-21

(2) Design of power converter for 3-phase grid integration of Hydrogen fed PME Fuel cell, DST and Kinetica Solar, 51.69Lakhs, 2022-25

(3) Hybrid bridge isolated DC-DC converter with ZVS suitable for auxiliary supply in EV, Meity and Kinetica Solar, 37,54Lakhs, 2022-24

Major Research Facilities in the Group

(1) Solar Array Simulators 600V, 25Amp, Ametek, TerraSAS,

(2) Multimachine common shaft setup, 10KVA, Synchronous, DC, Induction, spare shaft for PMSM

Technology/Product Developed

(1) Hybrid DC bus power supply using PV, UC and battery: TRL-4



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भारतीय प्रौद्योगिकी संस्थान हैदराबाद
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Major Areas of Research/Up to 3 major sponsored projects

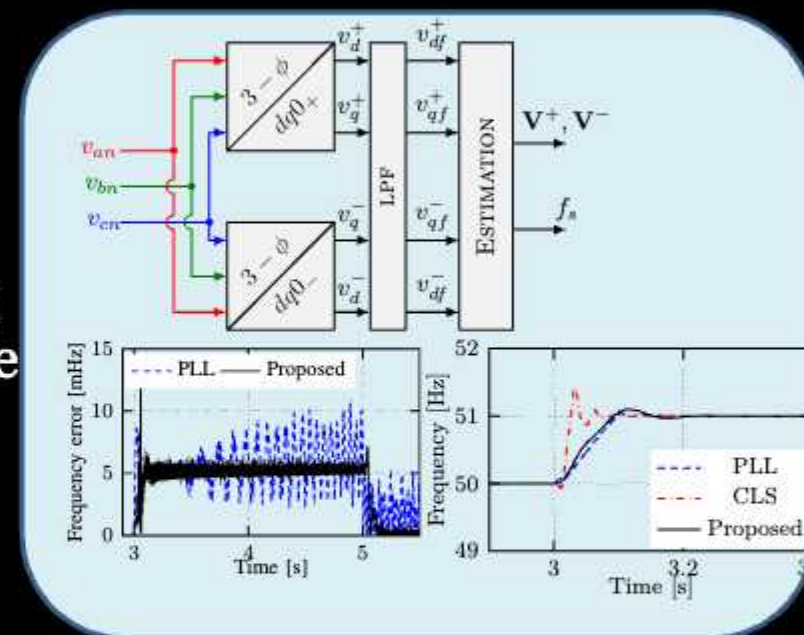
- 1) Power Engineering
- 2) Applied Mathematics
- 3) Wide Area Monitoring and Control
- 4) Grid Connected Renewable Energy Systems

Major Research Facilities in the Group

- 1) Essential Power electronic Equipment's including Power Analyzer, Function Generator, Programmable DC Source/Load and oscilloscopes.
- 2) Appropriate Microcontrollers for testing Digital Algorithms
- 3) Computational Facilities for Testing Algorithms developed for Power Networks.

Technology/Product Developed/Up to 3 most significant Publications

- 1) C V S Anirudh and V. Seshadri Sravan Kumar, "Estimation of Symmetrical Component Phasors and Frequency of Three-phase Voltage Signals using Transformations," *IEEE Trans. in Power Del.*, 2022.
- 2) P Naresh and V. Seshadri Sravan Kumar, "Control of an Ultracapacitor-based Energy Storage System for Source and Load Support Applications," *IEEE Transactions on Energy Conversion*, Sep 2021.
- 3) C V S Anirudh and V. Seshadri Sravan Kumar, "Enhanced Modeling of Doubly Fed Induction Generator in Load Flow Analysis of Distribution Systems," *IET Renewable Power Generation*, 2021



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Major Areas of Research/Up to 3 major sponsored projects

Research interests: Information Theory, Error Correcting Codes, Statistical Inference

Recent work: Data compression with random access, Privacy and distributed compression

Distributed inference and learning with limited communication

List decoding

Major Research Facilities in the Group

Fusionstor Invento Server, workstations

Representative Publications

“Random access in distributed source coding,” with Venkat Chandar and Aslan Tchamkerten, accepted, IEEE Journal on Selected areas in Information Theory, 2023

“List Decoding Random Euclidean Codes and Infinite Constellations,” with Yihan Zhang, IEEE Transactions on Information Theory, 2022

“Local Decode and Update for Big Data Compression,” with Aslan Tchamkerten, IEEE Transactions on Information Theory, 2020



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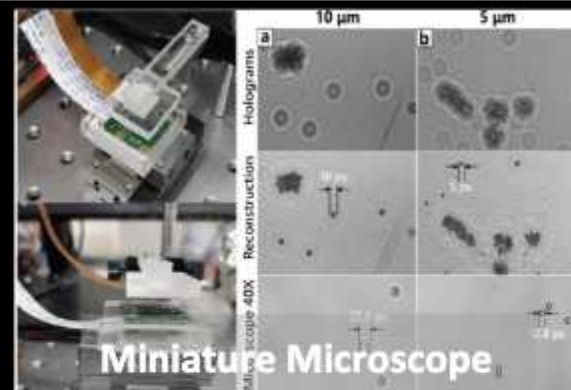


Major Areas of Research

- Large Scale Microfluidics (LSM) for automated & scalable lab-on-chip
- Computational Microscopy and Machine Learning for biology
- Applications of Nanopores and Nanochannels made of 2D materials

Major Research Facilities in the Group

- High resolution inverted optical microscope (Nikon Eclipse 2)
- Semi-automated chemical vapour deposition (CVD) machine for 2D materials (home built)
- Confocal Raman Spectroscopy (Witec Alpha 300)
- Vacuum/Pneumatic/Optical/Mechanical/Electronic components
- GPU equipped mid-level machine for machine learning



Technology/Product Developed

- Miniature Microscope (Muscope, patented)
- A microfluidic connector (applied for patent)
- Semi-automated CVD setup
- Midway development: Handheld microscope for digital pathology, automated linear stage, miniature imaging flow cytometer.





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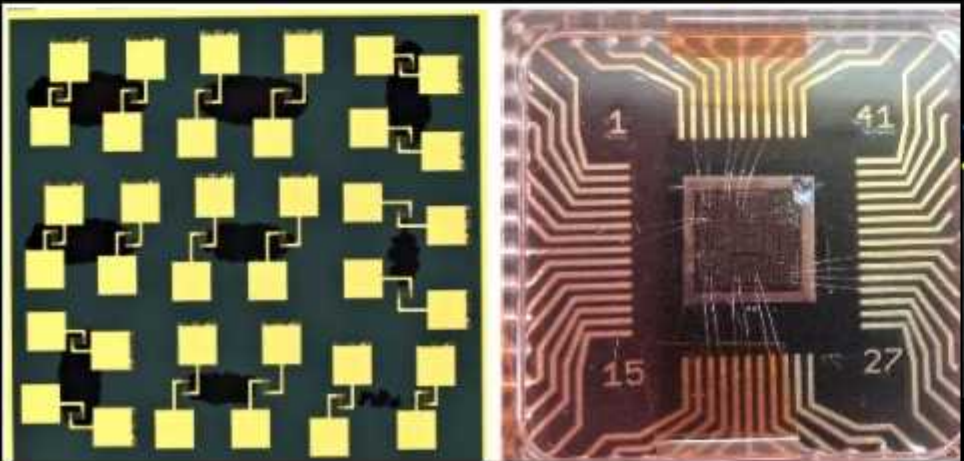
Major Areas of Research

- # Fine pitch W2W and C2W Hybrid Bonding for heterogeneous integration.
- # AI-Powered, Multianalyte Electronic Kit for gas and biomarkers detection (Gas/Bio Sensors)
- # Novel materials and processes for CMOS and MEMS applications

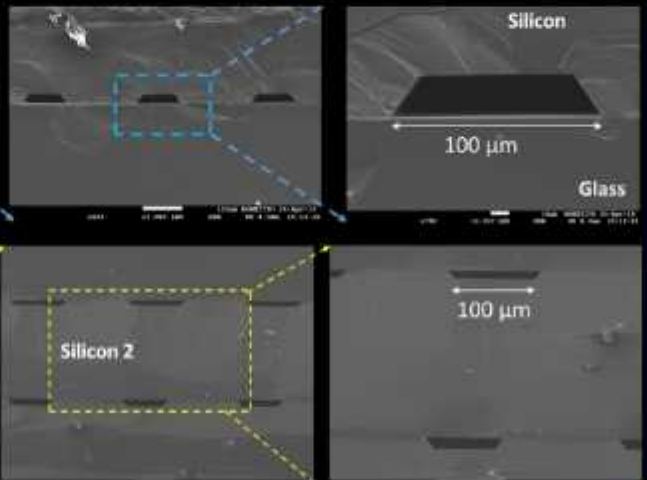
Major Research Facilities in the Group

- # Clean room equipped with microfabrication facility.
- # Customized Gas sensors testing / measurement setup
- # Customized Micro-bolometer sensors testing setup
- # Customized Biosensors development and testing set up.

Technology/Product Developed



Process Single Pixel Fabricated Microbolometer



Technology for fine pitch hybrid bonding



Si Antenna (14 GHz) with 3D IC



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Major Areas of Research/Up to 3 major sponsored projects

Research Area: Physics and Engineering of Nanodevices: Steep-slope transistors, Neuromorphic devices, twisted 2D heterostructures

Sponsored Projects:

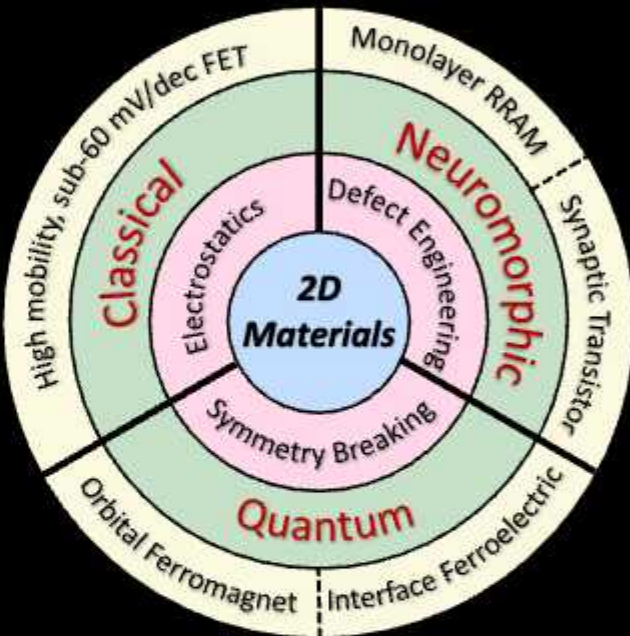
1. (PI) *Tunable synaptic plasticity in MoS₂ transistors for low-power spiking neural networks (SNNs)*, Funding Body: SRG, SERB, GoI, 2 years
2. (PI) *Back-end-of-line (BEOL) compatible MoS₂ devices*, Funding Body: ASCENT, European Nanoelectronics Access, 2 years

Major Research Facilities in the Group

Pulse Measurement System to measure electrical characteristics up to 10 ns – under procurement
Common facility: cleanroom nanofabrication and materials characterisation.

Technology/Product Developed/Up to 3 most significant Publications

1. **S. Bhattacharjee**, et.al. “A sub-thermionic MoS₂ FET with tunable transport”, Appl. Phys. Lett. 111, 163501 (2017) **Editor’s Pick article**.
2. **S. Bhattacharjee**, et.al. “Insights into Multilevel Resistive Switching in Monolayer MoS₂” ACS Applied Materials & Interfaces 12 (5), 6022-6029 (2020)
3. A Weston, **S. Bhattacharjee**, et.al. “Interfacial ferroelectricity in marginally twisted 2D semiconductors” Nature Nanotechnology, 17(4), 390-395. (2022)



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Major Areas of Research

Sensors (Bio)
MEMS, 3D IC
Flexible Electronics

Major Research Facilities in the Group

Electrochemical Workstation
Electrospinning Setup
Acoustic Characterization Set up

Technology/Product Developed

Detection of Bacteria
Flexible Silk Substrate
Silk Based Pressure Sensor/PMUT

1 The common thread – Silk



✓ As Transducer



✓ As Substrate



✓ As Nanogenerator

2 Other Core Thread



✓ E-cell Platform



✓ PVDF PMUT

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Major Areas of Research/Up to 3 major sponsored projects

Signal processing

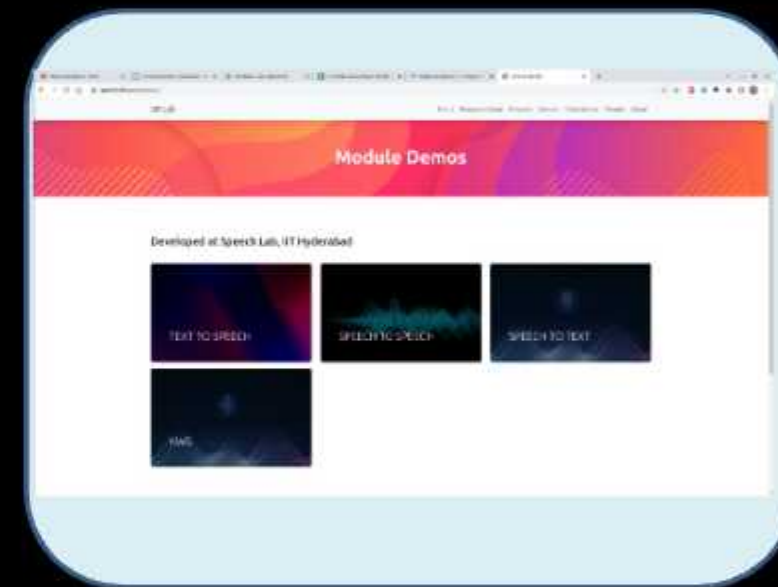
Speech analysis, recognition and synthesis

Pattern recognition and machine learning

Major Research Facilities in the Group

Microphones and speakers for speech data collection

GPU servers for speech data processing



Technology/Product Developed/Up to 3 most significant Publications

Neural combfiltering using sliding window attention network for speech enhancement, Circuits systems and signal processing, 2022

Significance of analytic phase of speech signals in speaker verification, Speech communication, 2016



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Major Areas of Research/Up to 3 major sponsored projects

Research Areas: Image and Video Quality Assessment, Biomedical Image Processing, Machine Learning

Projects: Digital Scene Matching Area Correlation (DSMAC, DRDO), Vision for Autonomous Robots (CARS, DRDO)

Major Research Facilities in the Group

- Stereoscopic display

Technology/Product Developed/Up to 3 most significant Publications

IQA algorithm is a part of MATLAB's image processing toolbox

An Optical Flow-Based Full Reference Video Quality Assessment Algorithm, IEEE Transactions on Image Processing, 2016

No-reference Stereoscopic Image Quality Assessment Using Natural Scene Statistics, Signal Processing: Image Comm. 2016

Streaming Video QoE Modeling and Prediction: A Long Short-Term Memory Approach, IEEE Trans. On CSVT, 2019



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Major Areas of Research/Up to 3 major sponsored projects

- 1) Flexible Nanoelectronics
- 2) Bionanoelectronics
- 3) Supercapacitors

Major Research Facilities in the Group

- 1) Electrochemical Workstation
- 2) Thermal Evaporator
- 3) Electrospinning set-up

Technology/Product Developed/Up to 3 most significant Publications

- 1) S. Veeralingam & S. Badhulika*. Enhanced Carrier separation assisted high performance Piezo-phototronic self-powered photodetector based on core-shell $\text{ZnSnO}_3/\text{In}_2\text{O}_3$ heterojunction, Nano Energy, 2022, 107354
- 2) L. Durai & S. Badhulika*. A wearable PVA film supported TiO_2 nanoparticles decorated NaNbO_3 nanoflakes based SERS sensor for simultaneous detection of metabolites and biomolecules in human sweat samples. Advanced Materials Interfaces, 2022, 2200146
- 3) O.P. Nanda & S. Badhulika*. Biomass derived Nitrogen, Sulphur, and Phosphorus self-doped micro-meso porous carbon for high-energy symmetric supercapacitor – with a detailed study of the effect of different current collectors. Journal of Energy Storage, 2022, 56, 106042

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Major Areas of Research/Up to 3 major sponsored projects

1. Flexible control of the photovoltaic power generation and the microgrid.
2. Stability and control of inverter-dominated power system with low rotational inertia.
3. Real-time WAMS data analytics for the system security improvement.

Major Research Facilities in the Group

1. eMEGASIM Simulator.
2. Solar PV Emulators.
3. CompactRIO and PXI Controllers.
4. Power Stacks.

Technology/Product Developed/Up to 3 most significant Publications

1. M. K. K. Reddy and V. Sarkar, "Designing a generic multi-modality processing adapter for the practical implementation of the photovoltaic regulated power point tracking under the partial shading," *Elect. Power Syst. Res.*, vol. 208, p. 107806, Apr. 2022.
2. G. V. N. Yatendra Babu and V. Sarkar, "Application of recurrent corrective control for the transient instability mitigation in a synchronous interconnection with multiple control areas," *Elect. Power Syst. Res.*, vol. 201, p. 107520, Dec. 2021.
3. S. R. Vaishya, A. R. Abhyankar, and V. Sarkar, "Marginal loss modeling based DCOPF and LMP calculations for an integrated AC and multi-terminal HVDC system," *IEEE Trans. Power Syst.*, vol. 36, no. 3, pp. 1867-1878, May 2021.



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