# ECE NEWSLETTER

NOVEMBER 2019

## Inside the Issue

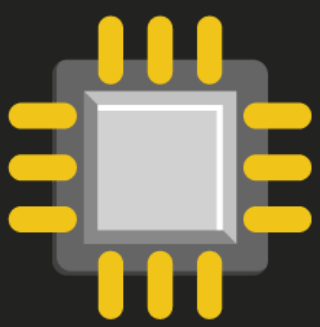


## RESEARCH HIGLIGHTS

Our ECE department carries out research activities in diverse domains including VLSI, Communication, Radar, Signal Processing, Control & Robotics etc. A few samples of research outcomes of the department in each of these sub-domains are subsequently described.

## STUDENT INTERVIEWEES

Anushka Bhandari
Feroz Husain
Kunwar Zaid



# HOD'S MESSAGE

SUJAY DEB

On behalf of the ECE Department, it is our pleasure to share with you the latest edition of ECE newsletter. It has been our intention to use the newsletter for highlighting the on-going activities in the department and like always this edition captures it succinctly.

**We as department have achieved following key milestones in the last six months.**

- NBA team visited to evaluate BTech ECE program
- We have successfully organized 2nd ECE Get-together with Alumni, faculty and current students
- Delhi student congress organized by IEEE student chapter at IIIT Delhi was hosted in IIIT Delhi this year. We had a very successful student congress with more than 400 participants.
- Computer Organization has been introduced as a core course in ECE BTech Curriculum.
- From this edition of newsletter we are creating an 'ECE Roll of Honor' where we are highlighting all the students who scored 'A+' in their courses.

A subset of the different research areas pursued by different groups is highlighted in this edition, we promise to bring more in the subsequent editions. We are looking forward to receiving lot of feedback as well as involvement of every stake holder in every upcoming event. We hope that you will enjoy the content and also get new ideas and most importantly feel proud of being part of the vibrant ECE community. This newsletter strives to provide a unique and effective platform for ECE community at IIITD to remain updated and connected. Have a great time reading this newsletter and beyond.

# RESEARCH HIGHLIGHTS

Our ECE department carries out research activities in diverse domains including VLSI, Communication, Radar, Signal Processing, Control & Robotics etc. A few samples of research outcomes of the department in each of these sub-domains are subsequently described.

# PUBLICATIONS

A. Manoharan, R. Sharma, and P.B. Sujit, “Nonlinear Model Predictive Control to Aid Cooperative Localization”, International Conference on Unmanned Aircraft Systems, Atlanta, 2019

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A. Manoharan, M. Singh, A. Alessandretti, J.G. Manathara, S.C. Prusty, N. Mohanty, I.S. Kumar,A. Sahoo, and P.B. Sujit, “NMPC Based Approach for Cooperative Target Defence”, American Control Conference, Philadelphia, 2019.3) M. Singh, A. Manoharan, A. Ratnoo, and P.B. Sujit, “Three Dimensional UAV Path Following UsingSDRE Guidance”, International Conference on Unmanned Aircraft Systems, Atlanta, 2019.Screen reader support enabled.

# PUBLICATIONS

Antra Saxena, Deepayan Banerjee, Mohammad Hashmi and Medet Auyenur, "A Dual-Band Impedance Transfomer for Matching Frequency Dependent Complex Source and Load Impedances", Proceedings of 2019 15th Conference on Ph.D Research in Microelectronics and Electronics (PRIME), 15-18 July, Laussane, Switzerland

# GNSS-R: AN EMERGING REMOTE SENSING TECHNIQUE

The advancement in Global Navigation Satellite System (GNSS) has given rise to a new re- mote sensing technique i.e. GNSS reflectometry (GNSS-R), besides its application for positioning and navigation. GNSS-R involves the study of GNSS signals reflected from the Earth’s surface. Moreover, the GNSS signals are accessible/present throughout the day, globally. Therefore, GNSS signals can potentially be used for estimating soil moisture, sea-height determination, wind-speed measurement and vegetation cover study. The GNSS constellation mainly includes the US Global Positioning System (GPS), GLONASS by Russia, China’s BeiDou and Galileo by Europe. India has established its own RNSS known as Navigation using Indian Constellation (NavIC), an initiative taken by ISRO. The NavIC is now fully operational, with a constellation of 7 satellites in geosynchronous and geostationary orbits. The primary service area covers the Indian landmass with the total coverage of 1500km beyond Indian geopolitical boundary. The major research here is focused on the development of software-defined receivers for receiving NavIC signals. Perform reflectometry analysis using the NavIC signals and extending its application for soil moisture estimation. Moreover, to develop an algorithm to efficiently acquire and modify received NavIC signals to measures of soil water content. Then finally the constellation of NavIC satellite system could routinely be used to measure soil moisture variations with the help of as many satellites in view.

# HIGH SPEED ELECTRONICS

The last decade has seen a huge upsurge in the applications and usage of wireless communications. With the implementation of modern wireless standards, it has become a necessity to design devices that are compatible with the same. High Frequency Wireless Communication has a wide arena of usage which includes, but are not limited to cellular communications (both voice and data), military applications, bio-medical usage etc. High Speed Electronics Lab. at IIITD focuses on designing multi- band/mode RF/ Microwave devices aligning with the conventional IEEE Wireless Standards. The intrinsic component behind multi-band (more than one frequency) operation is a multi-band impedance matching network. Over the years, the lab has successfully proposed many dual-/tri-/quad-band impedance matching network architectures that have been gracefully accepted by the Microwave Community. Work is also going on in RF Passive Components like multi-band baluns, power dividers and couplers. Since the last year, High Speed Electronics lab. has also collaborated with the iRadio lab. At the University of Calgary, Canada. They are working on Efficiency Enhanced Amplifier architectures on L/S/C/K and Ka-Bands. This has also facilitated research on MMIC based Power Amplifiers. Novel Architectures based on Mutual Harmonic Injection, Parasitic Compensation and Switched-Mode based Dual-band Output 2-Port Networks have been proposed. The lab happens to be one of the few labs in India (after IIT Roorkee and IIT Delhi) that are working on MMIC based power amplifiers. Extensive work is also going on Wireless Body Area Networks, materials and antennae.

Various antenna architectures have been proposed over the years that have obtained national and international recognition. Besides, research is also going on in Wireless Power Transfer (WPT)- a “hot topic” of modern research. Technology giants like Apple, Google, Samsung, Huawei etc. are actively working on WPT and have patents related to wireless charging sets indicating that the lab’s research interests target real life problems. Modern Security has also a lot to do with Radio Frequency Identification (RFID). The lab shows research interests in Chip-less RFID tag design and have significant contributions in the domain.

# PUBLICATIONS


Charul, U. Bhatt, P. Biyani and K. Rajawat, "Online Variational Bayesian Subspace Filtering," IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2019, pp. 5057-5061.

Charul, P. Biyani, “To each route its own ETA: A generative modeling framework for ETA prediction”, IEEE Intelligent Transportation Systems Conference (ITSC), 2019.

S. Jain, P. Biyani, “Improved Real Time Ride Sharing via Graph Coloring”, IEEE Intelligent Transportation Systems Conference (ITSC), 2019.


# SUSTAINABLE MOBILITY

The quality of any public transport system is crucially dependent on its reliability. One of the primary metrics that measure the reliability of a public transit is the predictability of its vehicles in reaching specific pre-determined locations (bus stops in case of a bus-based transit). A predictable and reliable public transportation also attracts more users, thereby increasing the economic viability of the transit as well as reducing congestion on the road, a huge urban challenge, especially in the developing world. From the point of view of the transit operators, predictability is key to maintaining its efficiency. For instance, predicting bus-bunching in real-time also helps in avoiding it. From the passengers perspective, predictability is generally measured by the accurate determination of the expected time of arrival (ETA) of a vehicle on a route. Our lab works in providing solutions to reliable public transportation. In the context of Indian road network traffic state estimation and prediction continues to be a challenging research problem. Thanks to the randomness in road traffic, non homogeneous infrastructure and the presence of multi modal transport, the traffic state at a given time is not even same for various transportation modes. In the absence of structure in the network, this problem is ill posed. However, in realistic settings, the traffic states exhibit spatial and temporal correlations across edges in the network. In other words, the degree of freedom available in the network is far less than the total ambient variables. We revisit the traffic state estimation and prediction problem for Indian road networks under various unique conditions. A variational Bayesian subspace filtering (VBSF) approach is proposed, where the traffic matrix is modeled as comprising of an underlying low-rank subspace evolving according to a linear dynamical model. The proposed method is capable of automatically assessing the relevance of each parameter. Also, we propose a novel ETA prediction algorithm based on a generative autoregressive model that integrates both traffic speed corresponding to the bus as well as the stopping time in one framework. Further, we propose a fast and sustainable solution to the ride-sharing problem that benefits both riders and taxi operators. The work incorporates efficient resource utilization by assigning shared rides to only vehicles that are available in a given fleet of vehicles and does not restrict itself in terms of the number of riders per shared vehicle. For monitoring, we seek solutions from “drive-by-sensing”. OTD data (otd.delhi.gov.in) is one such initiative from our lab which provides publicly accessible data for static and real-time location of public buses run by Department of Transport (Govt of NCT of Delhi) in Delhi NCR. We are also planning on sensing air quality for providing reliable air quality measures. Long and short term exposure to air borne pollutant results in adverse health effects. Therefore monitoring and prediction of air quality can be used to determine if the air of the region meets the regulatory standards. This will in turn impact people’s decision making and government’s policy making.

# PUBLICATIONS

A. Singh, A. Srivastava, V.A. Bohara et al., Performance of hybrid cellular-VLC link for indoor environments under dynamic user movement, Physical Communication (2019) 100816, https://doi.org/10.1016/j.phycom.2019.100816.

A. Singh, A. Srivastava, V.A. Bohara et al., Performance of Indoor Visible Light Communication System Under Random A. Placement of LEDs, ICTON, Angers, 2019.

# LI-COMM

Most of the current wireless networks are radio frequency (RF) based; however, these networks are regularly confronted with the growing demand for higher data rates. Cellular networks and indoor wireless networks (such as Wi-Fi) are becoming the predominant choice of wireless access. Watching high definition live stream videos and accessing cloud-based services are the main user activities that rapidly consume the data capacity. Visible light communication (VLC) in conjunction with RF communication, can provide potential solutions to address the issues faced by the RF communication in the indoor environment. VLC is considered to be a complementary technology for conventional RF wireless networks. License-free deployment of services makes it an attractive and inexpensive choice for service providers. Moreover, in VLC features of illumination and communication can be merged; hence, for indoor optical wireless networks, VLC is a preferred choice over infra-red communication. In addition, VLC can also be employed in environments which are sensitive to RF waves, for example, in airplanes, hospitals, refineries, chemical industries, gas installations, etc., as it does not interfere with other modes of communication.

In this lab, we are working on the following areas.

1. Indoor Visible light communication.
2. Co-existence of Li-Fi and Wi-Fi.
3. Color-shift-keying (CSK) based modulation schemes in VLC.
4. VLC based Vehicular Communication.
5. Elastic Optical Network.
6. Fiber Wireless (Fi-Wi) for NOFN.

We are also implementing the hardware VLC testbed setup, Indoor smart VLC transmitter for experimental analysis of the VLC based application.

# SEMINARS&EVENTS

**18-23 Dec'18** — FDP Workshop on Hardware-Software Co-design on Zynq SoC

**26 Nov'18** — IEEE SPS Distinguished Lecture by Prof. Vivek Goyal, Fellow IEEE, Associate Professor, Boston University

**31 Jan'19** — Enterprise Grid Computing in Environment Problems, Scale and Solutions Seminar by Srinivasan Viswanatha

**24 Jan'19** — ECE seminar series on Future of Learning by Amit Goyal

**6 Feb'19**

Seminar series on "Greedy Pursuit algorithms for Sparse Signal Processing" By Prof. K.V.S.Hari

**14 Feb'19**

Seminar series on "Toolbox for Inventive Problem Solving - A brief Introduction" by Dr. Anuj Grover

**8-9 Mar'19**

International Workshop on Next Generation Wireless Networks

**11 Mar'19**

Talk on Brainstorming in silicon by Honorary Institute Professor, Dr. Rajiv Joshi

**28 Mar'19**

Seminar series on "Towards Explainable Deep Learning: Adding Why to What" by Vineeth N Balasubramanian

**29 Mar'19**

Talk on Basics and Applications of Guidance for Autonomous Vehicles by Dr. Satadal Ghosh

**5 Apr'19**

Talk on "Cooperative UAV Localization in Partially GNSS Denied Environments" By Dr. Salil Goel

**11 Apr'19**

Seminar on "Path to 5G – A Review from Energy Consumption perspective" by Mr. Ramakrishna Sethuraman

**1 Jul'19**

ECE Seminar series on "Optimally Compressed Nonparametric Online Learning" by Dr. Amrit Singh Bedi

**1-5 Jul'19**

Summer School on EEG analysis and Allied technologies

**10-11 Jul'19**

Workshop on Deep Learning

**27 Jul'19**

Workshop on vehicular communication on advanced road safety

**27 Jul'19**

Hardware Security Workshop

# STUDENTINTERVIEWS

## FERAJHUSAIN

**What motivated you to pursue your masters in VLSI over others?**
I have a keen interest in digital circuits and design. Additionally, basic transistor operations and different types of transistor devices always inspired me to pursue my master's in VLSI domain.

**What do you find best about the academic culture at IIIT Delhi? Any reform that the ECE department should undergo for betterment (department specific VLSI)?**
Flexibility to take any subject of your personal choice irrespective of your specialization is the best part of IIIT Delhi academic culture. Additionally, I would like to suggest some additional courses like RF design and more faculties for the VLSI domain.

**Can you describe any recent project that you worked on?**
Yes, recently I completed my independent study in SRAM design and testing in which I researched to detect both static and dynamic transition faults completely using linear test algorithms. This project is done under the supervision of Dr. Anuj Grover.

**What opportunities do you think students have in this domain? Or some points to encourage the students for this domain?**
Well, there are a lot of opportunities in the VLSI domain depending on someone's interest. In the current scenario, VLSI has many different design areas like digital design, analog design, FPGA design, and memory design.

## ANUSHKABHANDARI

**Being in ECE how was your experience ?**
The core ECE subjects offered in second year cleared my concepts on the theoretical side.Having strong hold over the fundamentals whenever I take up any project, it's easier to proceed .Through my work in a course project , I got the opportunity to attend VLSID 2019 and the experience of attending the conference gave me a better understanding of the work in industry and the contribution of academia to it.

**Any reform that ECE department should undergo for betterment(Course specific)?**
The fundamental core courses offered can be made more practical. The projects should be aligned with practices in the industry (some collaboration should be taken up).

**Any academic difficulty which you faced during entire stay in college?**
Deadlines of multiple courses tend to come at the same time. Although announced a week or two before it usually is difficult and tiresome to manage them all together.

**Do's and Don't for good placement/ pursuing higher studies?**
Placements: For core ece companies , basic questions covered in BE, DC, CTD, M3 are asked. If the students have clear concepts in the courses, meaning they are consistent and perform well in these core courses , not only it will help in getting good grades but also in placements.And good grades will of course build your profile for higher studies.
Higher studies : Try to be consistent in the courses and get good grades. Take up projects that build your profile and try to get a publication through your BTP or IP.

## KUNWARZAID

**What motivated you to pursue your masters in Signal Processing and Communication area?**
Having opted for Electronics and Communication in my bachelors, I enjoyed the subjects related to Signal Processing and Communication. When I got to know that IIITD, a research focused institute, is offering masters in "Communication and Signal Processing", I decided to pursue my interest and dive deep into the subjects I like the most. With the help of my seniors and some faculty members, I realized the true potential of the branch in real-life problems.

**What do you find best about the academic culture at IIIT Delhi? Do you suggest any improvements?**
Academic culture at IIIT Delhi is excellent; it is very flexible, as it allows students to study the subjects of their choice.Most of the students don't understand what Signal Processing or this specialization does or means. The faculty and student interaction can be increased so that faculties can help the students understand the subjects in depth and choose their courses wisely.

**Can you describe any recent project that you worked on?**
Currently, I am working on a project which is in the domain of wireless communication, namely mmWave communication, also requiring some reinforcement learning algorithms.Previously, I have also worked on a project which analyses the performance of a wireless MIMO system having crosstalk.

# 2019 GRADUATING BATCH

## AWARDS

### BEST B.TECH PROJECT

**RESEARCH**
Ekansh Sareen
(2015139)

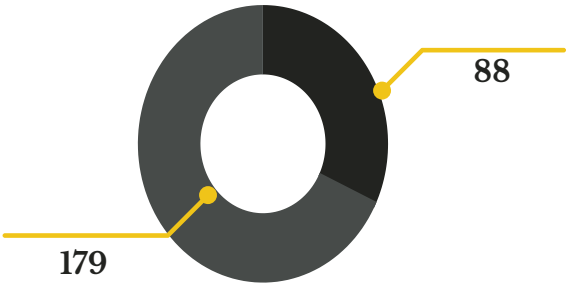
**ENGINEERING**
Parikshit Pruthi
(2015155)
Shubhankar Butta
(2015180)

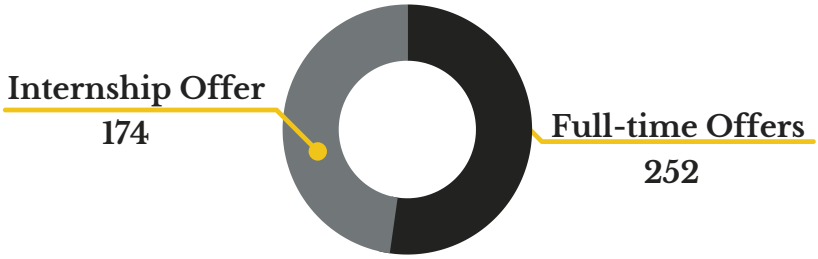
### PERFORMANCE

**ALL ROUND PERFORMANCE MEDAL**
Manasi Malik
(2015146)

**BEST ACADEMIC PERFORMANCE**
Pulkit Goel
(2015158)
CGPA 8.79

## PLACEMENT



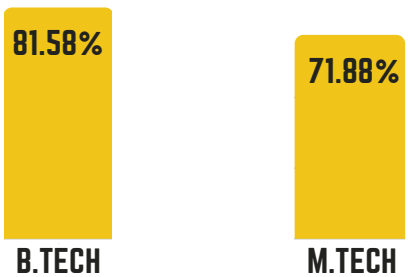




**A+ OFFERS |** CTC >= 10 lpa
**A OFFERS |** 5lpa< CTC <10lpa

**15.91 LAKHS**
*Average ECE B.Tech. Package*

**15.72 LAKHS**
*Average ECE M.Tech. Package*

### PERCENTAGE OF STUDENTS PLACED



# A+ STUDENTS

## 2015

### INDEPENDENT RESEARCH
Ekansh Sareen
(2015139)

### APPLIED ETHICS
Ekansh Sareen
(2015139)

## PHD

### TRANSFORM LEARNING AND APPLICATIONS
Ashutosh
Vaish(PhD17109)

### RADAR SYSTEMS
Bushra
Ansari(PhD18103)

## 2016

### DIGITAL HARDWARE DESIGN
Mayank Rawal
(2016162)

### ANIMATIONS & GRAPHICS
Sahil Yadav
(2016184)

### RADAR SYSTEMS
Munish Thakral
(2016167)

## 2017

### FIELDS AND WAVES
M Badri
(2017164)

### INTEGRATED ELECTRONICS
Samarth Singhal
(2017188)

### MATHS IV
Siripurapu Venkata Sai
(2017197)

## 2018

### FIELDS AND WAVES
Hritik Goel
(2018148)

### INTEGRATED ELECTRONICS
Rohith
Rajesh(2018182)

### MATHS IV
Setu Gupta
(2018190)

# PROFILE OF ECE COMPANY

VLSI Design is the art & science of designing large & complex electronics systems on a small piece of silicon called the chip. The artistic side of an individual takes prominence when he/she is required to come up with circuit design along with geometrical designs for printing on silicon, simultaneously it also involves technology and engineering to implement the designs.Skills & Challenges:Typically, a VLSI verification engineer verifies the functionality and performance compliance of a design with respect to specifications and ensures that designs are correct. A verification engineer is required to develop a verification environment which mimics the real world deployment scenario also known as Verification Intellectual Property (VIP) for the design under test (DUT) and also captures the failure models for the design.
There are two types of verification:
1.Functional Verification – It is the task of ensuring that the design conforms to the specification. It attempts to answer the question "Does the proposed design do what is intended?"
2.Timing Verification – It is the task of verifying if the design is fast enough to run without any errors at the targeted clock time. It can be classified into two categories:
Static Timing Analysis – (STA) is a method of computing the expected timing of a digital circuit without requiring simulation.
Dynamic timing verification – Refers to verifying that an ASIC design is fast enough to run without errors at the targeted clock rate. This is accomplished by simulating the design files used to synthesize the integrated circuit (IC) design. This is in contrast to static timing analysis, which has a similar goal as dynamic timing verification except it does not require simulating the real functionality of the IC.The main challenge of the job is that a VLSI engineer seldom has a choice of being incorrect. The cost of designing, fabrication and testing is extremely high â€“ sometimes amounting to even billions of USD.An error by the engineer will cost an organization dearly. It will not be incorrect to say that there is no room for failure in this profile. This job role is challenging and yet can be rewarding when one directly contributes towards bringing out high performance system for applications like smart-phones, medical instruments, automotive controls and defense applications.

# OPPORTUNITIES FOR ECE STUDENTS

- EADS Innovation Works by Air Bus
- COMSNETS Conference (COMmunication Systems and NETworkS)
- INAE Young Engineer Award
- INAE Innovator Entrepreneur Award
- Conference on Cognitive Radio Oriented
- Wireless Networks (CROWNCOM),
- Marie R. Pistilli Women in Engineering Achievement Award by the Design Automation Conference (DAC)
- National Level Paper Presentation organized by IEEE

# EDITORIAL TEAM

CONTENT

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