IEEE Signal Processing Society - Gujarat Section

NewsLetter Volume 1 | Issue 1

March 2021

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IEEE Signal Processing Society™

GUJARAT CHAPTER

SIGNAL PROCESSING is the enabling technology for the generation, transformation, extraction, and interpretation of information. It comprises theory, algorithms with associated architectures and implementations, and applications related to processing information contained in many different formats broadly designated as signals. Signal processing uses mathematical, statistical, computational, heuristic, and/or linguistic representations, formalisms, modeling techniques and algorithms for generating, transforming, transmitting, and learning from signals.

Mission - IEEE SPS

The Signal Processing Society is an international organization whose purpose is to: advance and disseminate state-of-the-art scientific information and resources; educate the signal processing community; and provide a venue for people to interact and exchange ideas.

Vision - IEEE SPS

The Signal Processing Society is a dynamic organization that is the preeminent source of signal processing information and resources to a global community. We do this by: being a one-stop source of signal processing resources; providing a variety of high quality resources to a variety of users in formats customized to their interests; adapting to a rapidly changing technical community; and being intimately involved in the education of signal processing professionals at all levels.
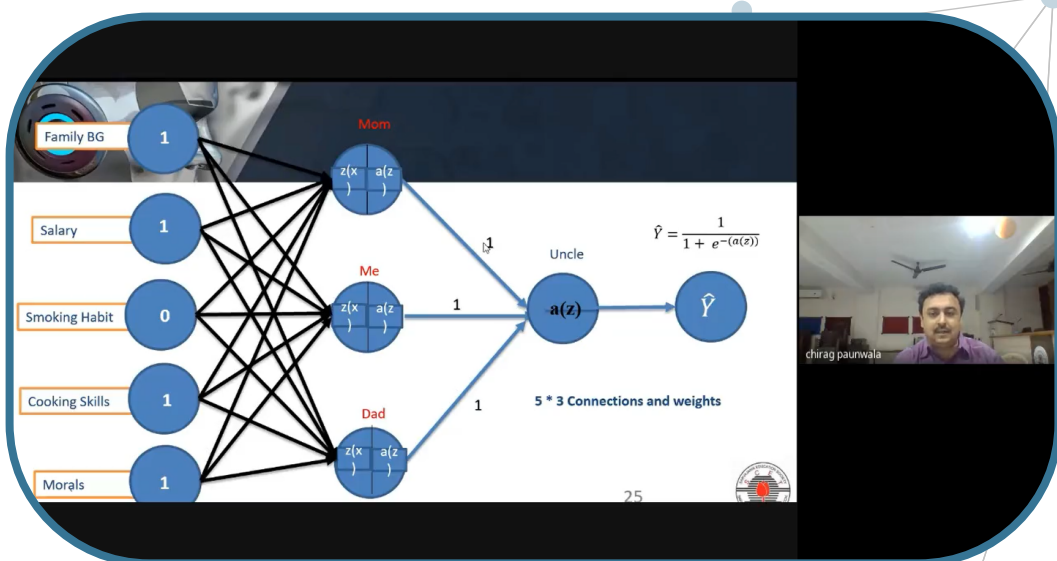
Welcome to IEEE Gujarat Section!

It is indeed a matter of great pleasure to note that the Signal Processing Society Chapter of Gujarat Section is bringing out its Newsletter that can exhibit the achievements and various activities of the Chapter under the Section. The SPS Chapter is a dynamic and vibrant community in the section, equipped with experienced professionals and dedicated student volunteers. The Chapter has accomplished many milestones in recent years and many more to come in the days ahead. It is a very welcome move and I sincerely congratulate the Chair, Office Bearers and all the volunteers of this Chapter. I wish all the very best to all our volunteers!

Dr. Maniklal Das
(Chair – IEEE Gujarat Section)

A year like the last one gets created once in history. Never before that had the entire world halted together. It is time to let the fresh air come in and begin the year with full potential. The world has united and is now striving together to serve the community. The IEEE Signal Processing Society Chapter, Gujarat Section Newsletter has been started with this intention and has its mission and vision to serve the community at large. To promote Women in Signal Processing (WISP), an equal opportunity is given to form the Executive Committee of the Chapter. The younger generation, i.e. the students, has also been given stakes in the chapter's working by promoting various student branches. I firmly believe that a team full of zealous and enthusiastic members will embark on a silver lining for the IEEE Signal Processing Society, Gujarat Section, making it one of the finest amalgamations of community service and outreach.

Dr. Chirag Paunwala
(Chair - IEEE Signal Processing Society, Gujarat Chapter)

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Technically Sponsored Events

2 Days Online Workshop on Deep Learning: Recent Trends and Applications

Deep learning is getting a lot of attention lately and for a good reason. It's achieving results that were not possible before. Deep learning becomes important as many organizations, both public and private, have been collecting massive amounts of domain-specific information, which can contain useful information about problems such as national intelligence, cyber security, fraud detection, marketing, and medical informatics. Companies such as Google and Microsoft are analyzing large volumes of data for business analysis and decisions, impacting existing and future technology. A 2 Days Online Workshop on Deep Learning: Recent Trends and Applications was organized by the Electronics and Communication Department of SN Patel Institute Of Technology and Research Centre, Umrakh, Bardoli on 7th and 8th November 2020.

Topics like Artificial Intelligence, Machine Learning, Deep Learning, Supervised, Unsupervised Learning, Reinforcement Learning, Neural Networks, Logistic Regression, Gradient Descent and its variations, ROI methods and depth wise separable convolution were exemplified. Along with these, special refined topics like COVID-19 detection by using AI, Ornithology, Bird identification system based on Neural Networks and AI, Generative Adversarial Networks and NADAM Optimizer were also discussed by experts.

One Week STTP on LMS Enabled Teaching and Learning

One week Short Term Training Program on "LMS Enabled Teaching and Learning" was conducted by the Electronics and Communication Engineering Department of C. K. Pithawala College of Engineering & Technology, Surat in Collaboration with DST, GUJCOST, Government of Gujarat and IEEE Signal Processing Society Gujarat Section during 1st to 5th December 2020. STTP helped in developing the skills of an instructor/tutor for creating a supportive learning environment for engaging the students online. Also, using a learning tool for better management. Total 60 teachers/tutors/industrial persons from different colleges/organizations of India got benefited from the STTP.

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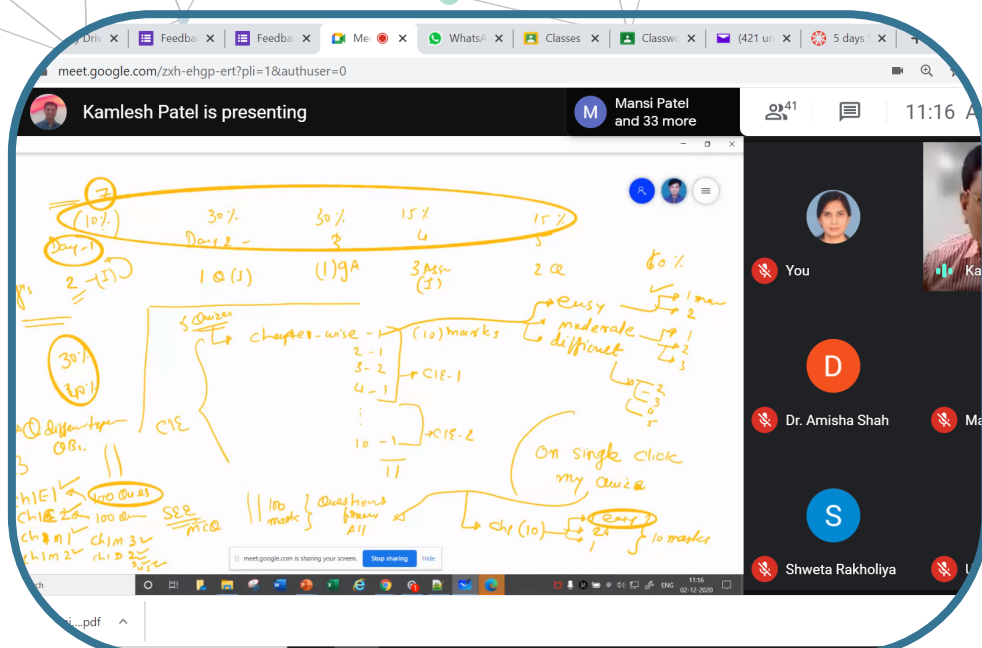
Technically Sponsored Events

2 Days Workshop on Data Science Using Python (Online Mode)

Data Science is a multidisciplinary field that uses methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data. This means that data science helps Artificial Intelligence figure out solutions to problems by linking similar data for future use. Evolved from the study of pattern recognition and computational learning theory in artificial intelligence, machine learning explores the study and construction of algorithms that can learn from and make predictions on data. These analytical models allow researchers, data scientists, engineers, and analysts to "produce reliable, repeatable decisions and results" and uncover "hidden insights" through learning from historical relationships and trends in the data. MCA Department of Sarvajanik College of Engineering and Technology, Surat, organized a workshop on Data Science using Python for the benefit of the interested students and faculties on 18th and 19th December 2020.
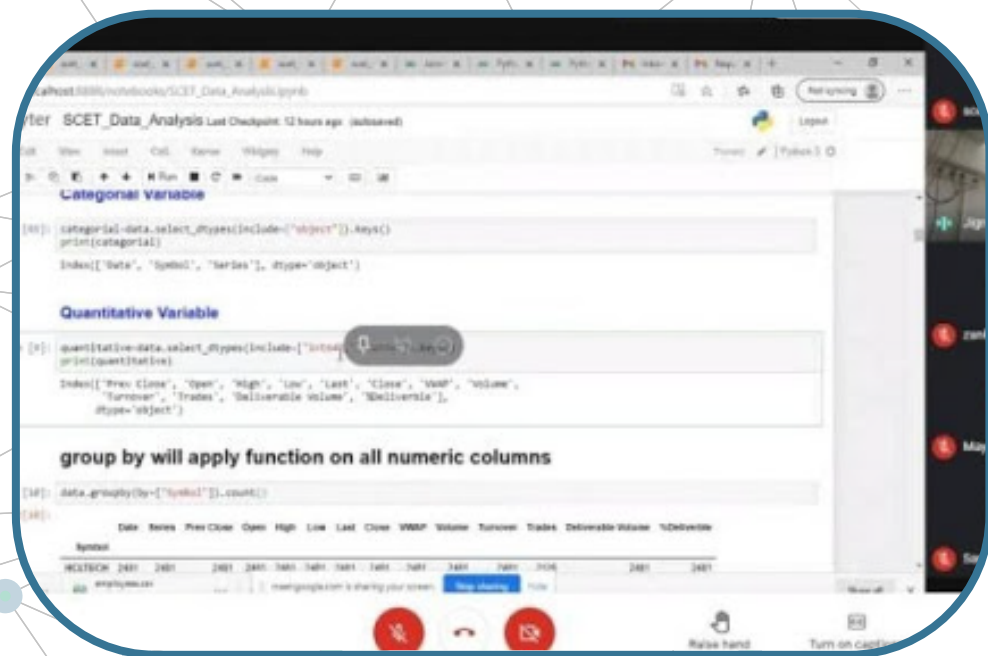
Short Term Training Program (STTP) on Artificial Intelligence for Signal Processing Applications (AISPA 2020)

The STTP aimed at cooperative use of two disciplines namely Artificial Intelligence (AI) and signal processing (SP) from later one's (i.e. signal processing) perspective. AI has been visualized as the science of building computational models that exhibit intelligent problem solving behaviour and signal processing can be termed as science of playing with and /or manipulating numeric signals / data to extract meaningful information out of input signals. Looking at the experience of the last decade, the domain of signal processing (SP) has been benefited and enriched by the emergence of artificial intelligence (AI) and machine learning (ML). These advances have made new tools availability in sub domains like signal estimation, manipulation, classification and prediction. In data analytics, it is possible for further research in dimensionality and data size with the help of layer by layer signal representations, function approximation and signal prediction for nonlinearity as well. These enhancements have led the research community to significant improvements in a wide variety of long standing problem domains (e.g., speech processing, vision/video based systems.

The One-Week STTP from 22nd to 26th December 2020 was organized by the Electronics and Communication Department of Sarvajanik College of Engineering and Technology, Surat. Topics like Neural networks and deep learning, Bayesian Learning and modelling, Sequential learning and decision methods, Independent Component Analysis, Signal detection, Pattern Recognition, Classification Dictionary learning, Subspace and manifold learning, Active and Reinforcement learning, Learning from multimodal data, Resource-efficient machine learning, Cognitive Information Processing, Biomedical applications and neural engineering, Speech and audio processing applications, Communications applications were discussed in the one week STTP.

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Technically Sponsored Events

International e-Conference on Intelligent Systems and Signal Processing (e-ISSP 2020)

The International e-Conference on Intelligent Systems and Signal Processing (e-ISSP 2020) aimed to spread awareness in the research and academic community regarding the cutting-edge technological advancements revolutionizing the world. The emphasis of this conference was on the dissemination of information, experience and research results on the current topics of interest through in-depth discussions and participation of researchers from all over the world. The Conference provided a platform to the scientists, research scholars and industrialists to interact and exchange ideas in a number of research areas. The Conference was organized by Department of Electronics & Communication Engineering of G. H. Patel College of Engineering & Technology, Vallabh Vidyanagar on 28th and 29th December 2020.

e-ISSP 2020 received an overwhelming response of about 140 research papers including 38 papers from foreign authors. Out of the received papers, 68 papers were accepted (including 19 foreign papers) which makes an acceptance rate of just under 50%. All the accepted papers, presented during the conference, are published by Springer's Advances in Intelligent Systems and Computing (AISC) in the form of proceedings. The conference was an amalgamation of four keynote speeches, preconference workshops/ tutorials and poster session in addition to the regular paper presentation.

CODEMANIA

CodeChef SCET Chapter from the Computer Department of SCET, Surat organized CODEMANIA , an online Competitive Coding Competition on 20th February 2021. Students from 93 colleges/universities/institutes participated in the competition. Novice coders also participated where they got a chance to learn and start with competitive coding whereas it was a battle for the experienced coders to solve all the problems in the least amount of time and top the leaderboard. With all the problem statements comprising different logics and programming concepts, along with free will to choose any programming language, it was a learning event as well as a competition that benefitted the students.

- Total Users/ Teams who have made a submission: **380**

- Total Submission : **2080**

- Number of Distinct users/ teams with correct submissions: **1156**

CODECHEF

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Technical Talk Series

1. Recent Developments in the Field of Quantum Machine Learning

Quantum machine learning is the integration of quantum algorithms within machine learning programs thereby improving and often expediting the classical machine learning techniques.

The Expert for the first Expert Talk Series organized by IEEE Gujarat Section was **Mr. Srinjoy Ganguly, Founder & CEO, AdroitERA, EdTech firm, UK.**

The talk was organized on 30th January 2021 at 4:00 P.M. IST

2. How do Self-Driving Vehicles Work

A self-driving car, also known as Autonomous Vehicle (AV) is a vehicle that is capable of sensing its environment and moving safely with little or no human input. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage.

As a part of 2nd Expert Talk Series, IEEE Gujarat Section invited **Mr. Saiman Shetty, Robotics & AI @ Tesla, Lyft, Nuro, San Francisco, USA**

The talk was organized on 6th February 2021 at 9:30 A.M. IST

Distinguished Lecture

Transfer Learning for Image and Video Recognition

Transfer learning makes use of the knowledge gained while solving one problem and applying it to a different but related problem. From the practical standpoint, reusing or transferring information from previously learned tasks for the learning of new tasks has the potential to significantly improve the sample efficiency.

As a part of 3rd Expert Talk Series, IEEE Gujarat Section invited **Dr. Dong Xu, Chair in Computer Engineering and ARC Future Fellow at the School of Electrical and Information Engineering, University of Sydney, Australia.** His talk was intriguing and the audience really benefited from it.

The talk was organized on 5th March 2021 at 12:00 Noon IST

Recent Developments in the Field of Quantum Machine Learning

The term Quantum Machine Learning was originally coined by Lloyd, Mohseni and Rebentrost in their paper titled "Quantum algorithms for supervised and unsupervised machine learning" in 2013 and since then, there has been a lot of research and growth happening in this cutting edge field. Quantum machine learning is the merging of quantum algorithms with the classical machine learning algorithms and this is also termed as quantum enhanced machine learning. There are a lot of developments happening currently regarding various applications of quantum machine learning, where some of them include solving linear systems of equations (HHL algorithm), quantum enhanced reinforcement learning, quantum neural networks and quantum sampling techniques which are used in various finance industries.

On the basis of the type of data and the data processing device, there are mainly 4 categories in which we can classify the quantum machine learning approaches. For the CC approach, we have classical data which is processed by classical computers as we have already seen in the previous section. These are your classical machine learning algorithms. For the QC case, we see the usage of classical machine learning for quantum data such as distinguishing between various quantum states and learning phase transitions in many body quantum systems.

For the cases CQ and QQ, we term them as quantum machine learning because here we deal with quantum computer as the main processing device with both kinds of data – classical and quantum. Primarily we are currently only dealing with the CQ case, where we have large classical data sets and then we are using quantum computers to search for the latent underlying patterns present in the data or to extract useful information from data and make inference from it.

It turns out that when we replace a machine learning model by a quantum circuit (quantum models), these quantum models analyze the data in a higher dimensional Hilbert spaces where only inner products are present which can be accessed through measurements.

The near term quantum computers are subjected to noises and they need to be fault tolerant. This kernel based quantum machine learning method is suitable for both the near term and the fault tolerant quantum computer and the quantum models running on these quantum computers can be replaced with a kernel SVM whose kernel will calculate distance between data-encoded distance quantum states.

When the classical data is encoded into quantum states, these encoded data live in the quantum feature space where the quantum models can be defined as a linear model whose decision boundary can be defined by a measurement. Also it is worth to note that the kernel based training methods are guaranteed to find the best and optimal measurements out of all the other measurements if the loss function is convex in nature. Measurements will have a form of a linear combination of the training data points with some coefficients w.

Variational quantum classifier as the name suggests is a classifier which is composed of quantum circuits with variational parameters or trainable parameters. This is the basis for quantum neural networks. Since you are already familiar with the notion of artificial neural networks, it will be easy for you to appreciate the nature of the variational circuit used for classifiers.

There are many different types of variational circuits available which can be used for quantum classifiers and many of the circuit architectures have been defined in the paper "Expressibility and Entangling Capability of Parameterized Quantum Circuits for Hybrid Quantum-Classical Algorithms" with the proper reasoning about the functioning of those circuits.

Before the variational circuit, we first encode the classical data into quantum states and then we start putting layers of these variational circuits. Each layer of a variational circuit can be thought of as a hidden layer of the classical neural networks which you have already studied.

The process for training a variational classifier is the same as that of an artificial neural network. First the classical data is converted into quantum states using encoding and state preparation schemes. Then the variational circuit blocks are run and measurement is taken which predicts one of the class labels (considering classification problem). These predicted class labels are then compared with the true labels with the help of cost function and the optimization algorithm is run to adjust the parameters of the variational circuit and then this process is repeated as an epoch. To include non-linearity in this case we do that into the measurement step as it is the classical step and quantum circuits cannot be nonlinear because they must be always unitary in nature.

Quantum machine learning is also being applied in the area of finance such as portfolio optimization, derivatives pricing, financial risk management and financial modelling. Recently there has been a growing interest for quantum image processing and quantum natural language processing to achieve quantum computing advantage over this classical and cutting edge field. There is active research going on in the field of quantum convolutional neural networks and quantum generative adversarial networks as well as various parameterized quantum circuits which can efficiently work for quantum machine learning algorithms.

If you follow quantum world association (http://quantumwa.org/) and Swiss quantum hub (https://www.swissquantumhub.com/) then you will be able to keep track of the latest developments happening in the field of quantum computing and quantum information processing in general. To keep track of the research happening in the field of quantum machine learning, it will be better to follow PennyLane by Xanadu (https://pennylane.ai/), Cambridge Quantum Computing (https://cambridgequantum.com/) and Zapata Computing (zapatacomputing.com).

Srinjoy Ganguly | Founder & CEO | droitERA (https://twww.aera.academy/)

How Do Self-Driving Vehicles Work

Robotics and Artificial Intelligence are super interesting areas with a lot of evolving opportunities. More and more contribution is continuously made towards the development of self-driving vehicles. But, a vehicle can't be made self-driving overnight! There are different levels of automation for self-driving vehicles from Level 1 to Level 5. Level 0 is no automation, a vehicle fully driven under manual supervision. Level 1 autonomy is defined when there is a one-dimensional autonomy offered to the driver like cruise control. Level 2 is partial automation, for example, acceleration and steering are managed by a computer but the driver must remain engaged at all times. The current Tesla autopilot can be categorized under level 2 automation. Level 3 automation is conditional automation, which means the driver is necessary but not required to monitor the environment at all times but they need to stay ready to take control under any scenario. Level 4 and Level 5 are ideal states, but the major difference is, for Level 4 autonomy the vehicle would be capable of performing all driving functions under certain conditions but the driver will have options to control the vehicle. Whereas Level 5 is completely autonomous, where technically the vehicle doesn't include the steering wheel, brake pedal, and other manual-controlling interfaces. So, these are the five levels of autonomy and most of the companies are at level 2 and level 3. There is still a lot of work that could be done to reach level 4 and 5.

But, how do self-driving vehicles work? We humans have our senses- eyes and ears that help us sense the surroundings and our brain- the central entity which processes all the information and takes the necessary decisions. Similarly, autonomous vehicles have different sensors, like GPS, Video cameras, ultrasonic sensors, LiDARs, RADARs, and high-performance computing modules for processing. Selection from these various sensors depends on the company, as different companies prefer selecting a different combination of sensors. In the case of Tesla, it relies on its RADAR and cameras that detect various objects using neural networks. These neural networks are trained using a high amount of data assisting the self-driving vehicle to detect parts of road, traffic signs, vehicles, pedestrians, and other objects of interest. Apart from detection, the vehicle has to plan its path using lane detection mechanisms, coordinate with GPS to plan the route, should have an emergency braking system, adaptive cruise control mechanism, etc. Tesla has very less number of sensing modalities as it depends only on video cameras and RADARs whereas other vehicles have LiDAR. A LiDAR is a bunch of fast-spinning lasers that the device shoots out to its surroundings and then it receives the rebound from targets and then based on what it receives it draws a point cloud.

Different sensors serve different applications. Ultrasonic sensors are used mostly for park-assist as they are low-range but precise. Short and medium range RADARs are used for blind spot detection, collision warning and cross-traffic alerts. Long range RADARs help for adaptive cruise control. Narrow field and wide field cameras are used for traffic light, pedestrian, vehicle, lanes and sign detection. These sensors should also work under different test cases, like dusty environments, low-light and low visibility conditions including rain and night time. Every sensor comes with its own set of advantages and drawbacks. LiDARs are not currently used in Tesla as they are cost inefficient and unreliable primarily as they require huge processing and are susceptible to noise. Whereas illumination cameras show less accuracy in low-light environments where LiDARs might be more efficient. But, under rainy environments, LiDARs are proven inefficient as the light waves reflect from the rain droplets. Hence, it depends on the manufacturer of the vehicle in selection of different sensing mechanisms as different combinations provide different performance and add up to expenses.


All of the major processing and decision making tasks are handled by neural networks. It includes the concept of mapping. There is a base map which is similar to a Google map. Neural networks layer the point cloud data which includes road signs, traffic lights on base map converting it into geometric map which is rendered and then there's a semantic map which includes all the lanes and pathways and then on top of that there's the scenario map that it uses to understand what's in its path or what a certain scenario is right and this is how in general an area is mapped in multi dimensions to make self-driving. When it comes to hardware standpoint and company requirements, there is a development cycle which is followed. It starts from defining the problem, developing the prototype and then the cycle- develop, test, evaluate, research continues. Autonomous vehicles are not just related to self-driving cars. It has a widespread range of applications ranging from autonomous farm vehicles, automated construction site vehicles, autonomous airplanes for effective remote-area delivery, and so on. Self-driving businesses have grown showing a clear sign that we are capable of developing the technology if we work long enough at it and make relevant improvements. We are capable of making it commercially viable.

Mr. Saiman Shetty, Robotics & AI @ Tesla, Lyft, Nuro, San Francisco, USA (Co -Authored by Poojan Dalal, IEEE Student)

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International Women's Day Celebrations 8th March 2021

Inaugural Ceremony of IEEE SPS GS Women Wing
[WiSP-Women in Signal Processing]
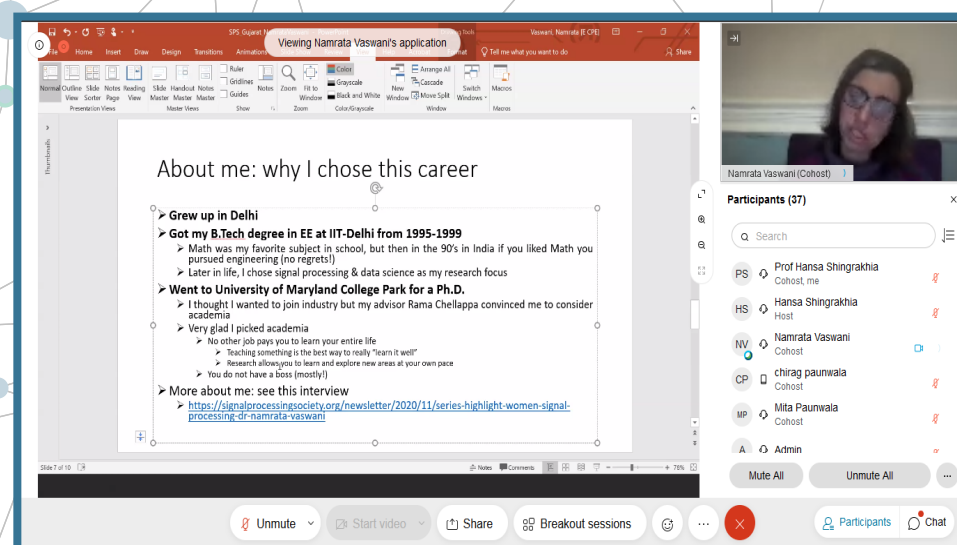
"Balance Between Professional and Personal Life
From The Women Perspective"
by
Prof. Dr. Namrata Vaswami, Iowa State University, USA

New Beginnings, New Journey, New Learnings

We Congratulate **Sarvajanik College of Engineering & Technology** and **G H Patel College of Engineering and Technology** for the formation of the **Signal Processing Society Student Branch Chapter**

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Upcoming Events

Technical Talk

Autonomous vehicles (AVs) are appearing everywhere: in the air, on the road, and even underground and underwater. Signal Processing is helping to guide these vehicles more accurately, which ensures their safety and also protects the people who encounter them.

As a part of 4th Expert Talk Series, IEEE Gujarat Section invites **Dr. K.V.S Hari, Indian Institute of Science, Bengaluru** to share his knowledge on **Sensing and Signal Processing for Autonomous Navigation**

The talk will be organized on **13th March 2021 at 10:00 A.M. IST** v

Hackathon for Young Professionals

Google Developer Student Club (DSC) of Gujarat in association with the **IEEE Student Branch of Sarvajanik College of Engineering & Technology, Surat** organized a 24-hour Online Hackathon named HACKBASH. The Online Hackathon will start on **13th and end on 14th March 2021**.

More details of the Hackathon can be found on: https://dsc-hackbash-2021.web.app/

4th National Seminar on New Trends in Signal Processing (NeTSiP – 2021) 19th – 21st March 2021

More Information visit our webpage at: http://ieeespsgs.org/wp-content/uploads/2021/01/NeTSiP_2021.pdf

Symposium on Signal Processing for Nanoelectronics and BioSciences on 26th – 27th March 2021 (Virtual Mode)

To find more about the Symposium, please visit: http://ieeespsgs.org/wp-content/uploads/2021/02/SSPNB.pdf

Do not miss our Upcoming Talk on **MIMO Communication in 5G and Beyond** by **Dr. Emil Bjornson, Visiting Professor, KTH Royal Institute of Technology, Sweden** on **16th April 2021 at 2:00 P.M. IST.**

Register on:
https://docs.google.com/forms/u/0/d/e/1FAIpQLSedk-Pt1YUP43nvgye9x5M-GjQ7e_5NRvvN51sg V3yHgKGzcw/closedform to join the enthralling talk.

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Benefits of SPS Chapter

Membership Benefits

A membership with the IEEE Signal Processing Society (SPS) provides you with dynamic opportunities to collaborate and connect with industry professionals, academics, and students alike working toward the advancement of signal processing and the technology it enables. When you join SPS, you'll have access to conferences and events, employment and professional networking opportunities, award eligibility, and top-ranked educational resources that help build rewarding, lifelong careers in the signal processing fields.

If you're a student looking to learn more about signal processing and careers within the field, a student membership with SPS offers unique benefits, including opportunities for career development, student-focused competitions, Seasonal Schools for graduate students, and travel grants to attend SPS flagship conferences around the world.

With an SPS membership, you can:

1. Broaden your knowledge with complimentary tools and resources
2. Receive exclusive discounts on world-class SPS products and services
3. Connect with our global network to share ideas and opportunities
4. Volunteer with our community and become an asset to society activities

For more information or to join SPS:

https://signalprocessingsociety.org/community-involvement/membership

To stay updated regarding our activities of IEEE Gujarat SPS team, reach us at:
Website: **www.ieeespsgs.org**/ | Facebook: **ieeespsgs** | Telegram: **ieeespsgs** |
YouTube: **IEEE SPS Gujarat Section**

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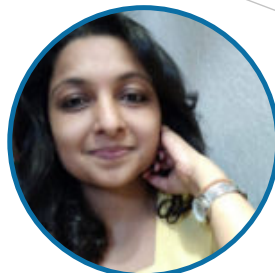**Dr. Manish Khare**
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