



# Women in Engineering Workshop

27<sup>th</sup> National Conference on Communications

**W1: Women in Engineering Workshop Program for NCC 2021**

<b>Start Time (IST)</b>	<b>End Time (IST)</b>	<b>TOPIC</b>	<b>SPEAKERS</b>
0900	1000	<b>Plenary Talk</b> Active Hypothesis Testing for Fast Decision Making with applications to SARS-CoV-2 testing	Prof. Urbashi Mitra, University of Southern California
1000	1030	Assessing Oral Reading Skills with Speech Processing	Prof. Preeti Rao, IIT Bombay
1030	1100	Technology Frontiers: Designing 5G chips in New Technology nodes	Ms. Mamta Bansal
1100	1130	Particle Filter based Nonlinear Data Detection in Hybrid Mmwave Massive MIMO Systems	Prof. Debarati Sen, IIT Kharagpur
1130	1200	Privacy Preserving Inference in Medical Imaging	Dr. Divya Gupta, Microsoft Research, Bangalore



**Active Hypothesis Testing for Fast Decision Making with applications to SARS-CoV-2 testing**

**by**

**Prof. Urbashi Mitra**

**Date & Time: 28th July 2021 (0900-1000 hours) Indian Standard Time**

**Abstract:** Many modern (machine) learning strategies depend on the intelligent acquisition of informative samples. Such sampling methods can be viewed as an instantiation of the exploration-exploitation problem. Initially, one is unclear about the state of the environment and the goal is to take observations that refine the understanding of the state. If one has a series of “experiments” (or queries), each of which provide information about the state, an important question is how to design that sequence of experiments to enable a decision about the environmental state as quickly as possible. Exploration-exploitation problems abound in applications such as anomaly detection, target localization, dynamical system tracking, medical diagnosis, wireless body area sensor networks etc. The problem of experiment design for classification (hypothesis testing) has been persistently studied since the 1940s. Then and now, there has been an emphasis on the design of asymptotically optimal methods. Herein, we will provide new analysis which enables the design of strategies for the finite sample regime. In key cases, our methods are also asymptotically optimal, but provide significantly improved finite sample performance. We specialize our analysis to the problem of anomaly detection for which we can determine asymptotically tight upper and lower bounds on the misclassification error and provide an experiment design strategy with excellent finite sample performance. We further consider the application of our approach to group-testing, wherein different experiments call for the pooling of samples which can dramatically reduce the number of experiments needed. Finally, we consider the problem of testing of populations to provide good spatial estimates of the incidence of an anomaly, such as SARS-CoV-2 positivity. We have preliminary analysis of SARS-CoV-2 serological tests based on randomized testing undertaken

by a colleague at USC's School of Public Policy. Our proposed strategy suggests that uniform allocation for randomized testing over heterogeneous regions may not yield the best estimates of positivity rates and offers a method by which active hypothesis testing can be used to improve such estimates.

**Bio:**

**Urbashi Mitra** received the B.S. and the M.S. degrees from the University of California at Berkeley and her Ph.D. from Princeton University. Dr. Mitra is currently the Gordon S. Marshall Professor in Engineering at the University of Southern California with appointments in Electrical & Computer Engineering and Computer Science. She was the inaugural Editor-in-Chief for the IEEE Transactions on Molecular, Biological and Multi-scale Communications. She has been a member of the IEEE Information Theory Society's Board of Governors (2002-2007, 2012-2017), the IEEE Communications Society's Board of Governors (2018-2020), the IEEE Signal Processing Society's Technical Committee on Signal Processing for Communications and Networks (2012-2016), the IEEE Signal Processing Society's Awards Board (2017-2018), and the Chair/Vice-Chair of the IEEE Communication Theory Technical Committee (2017-2020). Dr. Mitra is a Fellow of the IEEE. She is the recipient of: the 2021 USC Viterbi School of Engineering Senior Research Award, the 2017 IEEE Women in Communications Engineering Technical Achievement Award, a 2015 UK Royal Academy of Engineering Distinguished Visiting Professorship, a 2015 US Fulbright Scholar Award, a 2015-2016 UK Leverhulme Trust Visiting Professorship, IEEE Communications Society Distinguished Lecturer, 2012 Globecom Signal Processing for Communications Symposium Best Paper Award, 2012 US National Academy of Engineering Lillian Gilbreth Lectureship, the 2009 DCOSS Applications & Systems Best Paper Award, 2001 Okawa Foundation Award, 2000 Ohio State University's College of Engineering Lumley Award for Research, and a 1996 National Science Foundation CAREER Award. She has been an Associate Editor for the following IEEE publications: Transactions on Signal Processing, Transactions on Information Theory, Journal of Oceanic Engineering, and Transactions on Communications. Dr. Mitra has held visiting appointments at: King's College, London, Imperial College, the Delft University of Technology, Stanford University, Rice University, and the Eurecom Institute. Her research interests are in: wireless communications, communication and sensor networks, biological communication systems, detection and estimation and the interface of communication, sensing and control.



## **Assessing Oral Reading Skills with Speech Processing**

**by**

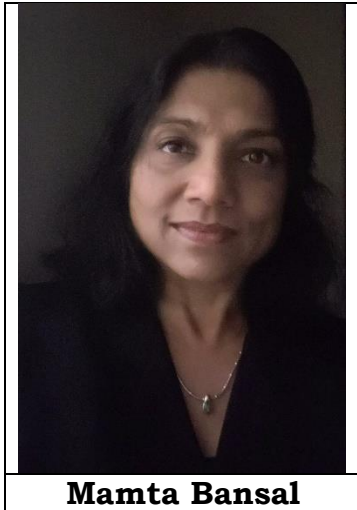
**Prof Preeti Rao**

**Date & Time: 28th July 2021 (1000-1030 hours) Indian Standard Time**

**Abstract:** Education policies, both nationally and globally, accord the highest importance to achieving foundational literacy in the early school years. However, the regular assessment of progress, critical to the effectiveness of education interventions, tends to be expensive in terms of time and human resources. With oral reading being one of the important means of evaluating literacy and language competence, we present an automatic system for the objective evaluation of reading skill from audio recordings. Established reading rubrics that incorporate aspects of word accuracy, speed and fluency are modeled using speech recognition and prosody detection trained on expert ratings of field-collected data. We present the challenges posed by the task and research related to finding effective solutions.

### **Bio:**

**Preeti Rao** is on the faculty of Electrical Engineering at I.I.T. Bombay, in the area of signal processing for speech and audio. She received her Ph.D. from the University of Florida in Gainesville in 1990. Her research interests include speech recognition, speech prosody and music information retrieval. She has been involved in the development of technology for Indian music and spoken language learning applications. She co-founded SensiBol Audio Technologies, a start-up incubated by I.I.T. Bombay, with her Ph.D. and Masters students in 2011. She is a recipient of the Abdul Kalam Technology Innovation National Fellowship for 2020.



**Technology Frontiers : Designing 5G chips in New Technology nodes**

**by**

**Mamta Bansal**

**Date & Time: 28th July 2021 (1030-1100 hours) Indian Standard Time**

**Abstract:**

5G wireless innovation is transforming how the world connects, computes and communicates. A walk through the Technology and Innovations in development of leading 5G SoCs. New architecture trends are driving methodologies and design flow changes. We discuss the trends and opportunities of practical research in Concept to Silicon design solutions.

**Bio:**

**Mamta Bansal** is Sr. Director of Engineering at Qualcomm Technologies Inc., where she leads the Global CAD chip Implementation solutions at Qualcomm Technologies Inc. She has over 25 years of experience in the semiconductor industry. Mamta joined Qualcomm in 2010 and has lead worldwide engineering teams responsible for RTL2GDS design flow for Qualcomm SoCs in cutting-edge advance process nodes. Prior, she held IP design manager, technology access manager and Director- EDA positions at PMC-Sierra Inc. Mamta received her education in Electrical Engineering from Indian Institute of Technology.



**Prof. Debarati Sen**

## **Particle Filter based Nonlinear Data Detection in Hybrid Mmwave Massive MIMO Systems**

**by**

**Prof. Debarati Sen**

**Date & Time: 28th July 2021 (1100-1130 hours) Indian Standard Time**

**Abstract:** The nonlinear distortions attributed by the radio frequency (RF) power amplifier (PA) and other RF circuits from the enormous bandwidth of millimeter wave (mmWave) and high frequency design limitations of the integrated circuits involved, degrade the performance of the hybrid mmWave MIMO-OFDM systems. These distortions cause nonlinear coupling of the hybrid precoder with the data signals. Further, it induces intercarrier interference (ICI) in the OFDM systems, which also involves the interference from the precoders of other subcarriers. These difficulties in collusion with frequency selective channel and carrier frequency offset (CFO) may pose great challenges to the estimation accuracy of these parameters (channel gains and CFO) and signal detection. The nonlinearity causes the target posterior distribution for data detection as non-Gaussian and analytically intractable.

A novel pilot assisted maximum likelihood (ML) based framework for estimating the CFO with PA impairment in the time domain by formulating a low dimensional equivalent channel matrix is presented here. This channel matrix is composed of hybrid precoders-combiners, high dimensional MIMO channel, and the nonlinearly distorted components from PA. Further, a group-sparse Bayesian learning (G-SBL) based semi-blind channel estimator is proposed in the time domain, which incorporates the CFO and nonlinearity of PA in its estimation process. With the estimated channel, a procedure to obtain the hybrid precoder and combiner matrices for data transmission is developed next. An iterative algorithm based on particle filter (PF) that effectively handles the nonlinear coupling of precoder matrix with data, and ICI is also proposed for data detection. Performance of proposed algorithm is evaluated over (a) synthetic geometric based mmWave channel and (b) realistic mmWave channel for an urban microcell (UMi) environment.

**Bio:**

Debarati Sen is currently an Associate Professor, IIT Kharagpur, India. She was a Post-Doctoral Research Fellow with the Chalmers University of Technology, Sweden, and a Senior Chief Engineer with the Samsung Research, Bangalore, India prior to join IIT Kharagpur in 2013. In 2014, Dr. Sen was a visiting faculty with the Institute for Comm. Engg., TUM, Germany; and in 2019, she was an academic visitor with the Dept. of ECSE, Monash University, Australia. She has about 12 years of R&D experience overall related to the domains of Wireless and Optical Communications including Interdisciplinary Computing, mostly on 5G/6G Communications, AI enabled Wireless, Millimeter

Wave and Terahertz Communications, Green Communications, Large MIMO, Cloud RAN etc. Her research is supported by a variety of Govt. Organizations including MHRD, MeitY, Min. of HI&PE, BEL, HAL, DST, DRDO, SERB, Indian Railways and external collaborators like AIRBUS, Samsung, Qualcomm (USA), Ericsson (Sweden), Rosenberger Technol. (China) etc. She has 13 patents published / applied to her credit including few US Patents, and has published more than 100 papers in Journals and Conferences of repute. She is an Editorial Board Member of two international journals; recipient of Best Paper Awards at Samsung Tech. Conference 2010 and IEEE ANTS 2016; IE(I) Young Engineers Award 2010; IETE N.V.G. Memorial Award 2013; Qualcomm Innovation Fellowship 2017, Faculty Excellence Award IIT Kharagpur 2020. She is a Senior Member of IEEE, Fellow of IE(I) and IETE.





## **Privacy Preserving Inference in Medical Imaging**

**by**

**Dr. Divya Gupta**

**Date & Time: 28th July 2021 (1130-1200 hours) Indian Standard Time**

### **Abstract:**

Fueled by massive data and availability of extensive compute, sophisticated machine learning models have found diverse applications across verticals such as healthcare and finance. This has made the problem of privacy preserving machine learning increasingly important. In this talk, I will focus on two broad scenarios in the healthcare domain, namely secure prediction-as-a-service and secure model testing. In the prediction-as-a-service scenario, a hospital/ML provider has a machine learning model that has been trained on sensitive data, and patients have their private medical records. The goal is to enable the patients to learn the prognosis based on the model without revealing their sensitive medical data while preserving the confidentiality of the model held by the hospital. Secure model testing is a try-before-you-buy scenario where a hospital or a pathology lab wants to evaluate how the machine learning models from different vendors perform on its private data. This needs to be done without the hospital revealing their sensitive test data or the vendors revealing their proprietary models. Our work CryptTFflow provides a programmable, scalable and efficient cryptographic solution for both of these problems. CryptTFflow is a system that automatically compiles TensorFlow/ONNX inference code to secure computation protocols. It has two components. First component is an end-to-end compiler from TensorFlow/ONNX to a variety of secure computation protocols. Second, we build specialized protocols for secure machine learning for two and three party settings that are orders of magnitude more performant than prior works. We demonstrate that CryptTFflow is ready for disruption in secure healthcare by showcasing evaluation on multiple real-world case studies. These include ML models for detecting lung diseases including

Covid19 from chest X-Rays, predicting frequency of doctor visits for Wet-AMD patients, and segmentation models for radiotherapy planning using 3D CT scans.

**Bio:**

**Divya Gupta** is a Senior Researcher at Microsoft Research India. Her research interest is cryptography and its applications to security and privacy. Currently her work at MSR focusses on secure multiparty computation and blockchains, and in particular, making cryptography practical, usable, and performant. She has published several papers in top computer science conferences such as Crypto, Eurocrypt, IEEE S&P, ACM CCS, OSDI, and so on and holds 3 US Patents. Before joining MSR, she was a postdoc at UC Berkeley hosted by Sanjam Garg. She completed her PhD at University of California at Los Angeles with Amit Sahai. Her PhD dissertation was recognized by the Dissertation Fellowship and the Dimitris N. Chorafas Dissertation Award, given for outstanding work in engineering sciences, medicine and the natural sciences. She got her bachelors and masters degree in Computer Science and Engineering from Indian Institute of Technology, Delhi.