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Ish Kumar Jain

Education

2018 - 2023 **University of California San Diego**, *CA*.
PhD Candidate, Electrical and Computer Engineering, *GPA: 4.0*
Advisor: Prof. Dinesh Bharadia

2016 - 2018 **New York University, Tandon School of Engineering**, *NY*.
MS, Electrical and Computer Engineering, *GPA: 3.96*
Advisor: Prof. Shiv Panwar

2012 - 2016 **Indian Institute of Technology (IIT Kanpur)**, *India*.
Bachelors of Technology (B.Tech.), Electrical Engineering

Research Interests

My research drives the next generation of wireless networks by providing a new perspective on optimizing these networks not only by throughput but also with other metrics such as reliability, sustainability, and practical deployability.

Research Experience

Mar 2022– Ongoing **Sustainable Multi-user Millimeter-Wave systems**, *with Prof. Dinesh Bharadia*.
- Developing a multi-user beam management scheme leveraging channel sparsity to ensure link reliability, avoid interference and guarantee high per-user throughput with power-efficient mmWave systems.

Mar 2022– Ongoing **High Mobility Communication with Doppler estimation and prediction**, *with Prof. Dinesh Bharadia*.
- Working towards low latency open radio access networks that efficiently support highly mobile users by taking insights from an analogous channel representation in the delay-Doppler domain.

Aug 2021– Mar 2022 **Flexible and resource-efficient multi-user mmWave networks**, *with Prof. Dinesh Bharadia*.
- Identified a vulnerability in today's mmWave system that they cannot perform frequency multiplexing to support many simultaneous users because the directional 'laser-like' beam can illuminate only one user direction at a time.
- Designed a new power-efficient front-end architecture that can split the frequency bands into multiple concurrent directions, enabling flexible frequency multiplexing for a tenfold higher number of connected users.

Sep 2018– Aug 2020 **[Sigcomm'21] Reliable mmWave Links using Multi-beamforming**, *with Prof. Dinesh Bharadia*.
- Developed beam management scheme that ensures multiple diverse paths are available to mmWave devices to maintain 100% reliable packet transfer even under random and unpredictable link blockage events.
- Prototyped a 5G standard-compliant mmWave network using USRP X310/X410 and off the shelf phased arrays and demonstrated the effectiveness of our scheme.

Jul 2018– Aug 2021 **Wireless Virtual Reality**, *with Prof. Dinesh Bharadia, Prof. Pamela Cosman*.
- Developed a viewport-aware Truncated Square Pyramid (TSP) scheme for 3D to 2D transformation of 360^o videos.
- Analysed trade-off between video quality and bandwidth and developed algorithms to tune a truncation parameter for optimal performance.

Jan–June 2018 **[MS Thesis] Millimeter Wave Blockage Analysis**, *with Prof. Shivendra Panwar*.
- Analyzed the impact of occlusions by mobile blockers on mmWave link reliability in an outdoor mmWave environment with macro-diversity (connectivity with multiple base stations).
- Our results indicate that the minimum density of BS required to satisfy the QoS for URLLC applications is mainly driven by reliability and latency constraints rather than coverage or capacity requirements.

Selected Publications

Hotmobile 2023 **IK Jain**, et al "Delay Phased Arrays: Towards programmable beam-bandwidth for 5G networks", *Under submission to HotMobile 2023*.

Conf. 2023 **IK Jain**, et al "Spoofing Attacks on Automotive Radars using Millimeter-wave Reflect Array", *Under submission to a Security conference 2023*.

Conf. 2023 **IK Jain**, et al "Flexible and resource efficient multi-user mmWave system", *Under submission to a Tier-1 networking conference 2023*.

WPMC 2022 T Qiu, **IK Jain**, R Wu, P Cosman, D Bharadia, "Streaming 360-degree video with Viewport-adaptive Truncation", *International Symposium on Wireless Personal Multimedia Communications (WPMC) 2022*.

HotCarbon 2022 A Gupta, **IK Jain**, D Bharadia "Multiple smaller base stations are greener than a single powerful one: Densification of Wireless Cellular Networks.", *ACM HotCarbon Workshop 2022*.

S3 2021 **IK Jain**, R Subbaraman, D Bharadia "Demo and dataset for mmWave multi-beam tracking using mMobile 28 GHz testbed", *ACM Mobicom S3 Workshop 2021*.

Sigcomm 2021 **IK Jain**, R Subbaraman, D Bharadia "Two beams are better than one: Towards Reliable and High Throughput mmWave Links", *ACM SIGCOMM 2021*.

mmNets 2020 **IK Jain**, R Subbaraman, TH Sadarahalli, X Shao, H Lin, D Bharadia, "mMobile: Building a mmWave Testbed to Evaluate and Address Mobility Effects", *4th ACM Workshop on Millimeter-Wave Networks and Sensing Systems (Mobicom Workshop - mmNets)*, 2020.

NSDI 2020 R Ayyalasomayajula, A Arun, C Wu, S Rajagopalan, S Ganesaraman, A Seetharaman, **IK Jain**, D Bharadia, "LocAP: Autonomous Millimeter Accurate Mapping of WiFi Infrastructure", *Usenix NSDI*, 2020.

MDPI 2019 A Choromanska, **IK Jain**, "Extreme Multiclass Classification Criteria", vol 7, issue 1, *MDPI Computation Journal*, 2019.

JSAC 2018 **IK Jain**, R Kumar, S Panwar, "The Impact of Mobile Blockers on Millimeter Wave Cellular Systems", *IEEE Journal on selected areas in communications (JSAC)*, 2018.

ITC 2018 **IK Jain**, R Kumar, S Panwar, "Driven by Capacity or Blockage? A Millimeter-wave Blockage Analysis", *IEEE International Teletraffic Congress (ITC30), invited paper*, 2018.

Patents

US Patent (provisional) D Bharadia, **IK Jain**, R Subbaraman, T Sadarahalli, inventors. Enabling Reliable Mmwave Link Using Multi-Beam Pro-Active Tracking. *Patent pending, contact UC San Diego (innovation@ucsd.edu)*

US Patent (provisional) D Bharadia, R Ayyalasomayajula, A Arun, C Wu, S Rajagopalan, S Ganesaraman, A Seetharaman, **IK Jain**, inventors. Enable Indoor Navigation with Context assisted Localization. *Patent pending, contact UC San Diego (innovation@ucsd.edu)*

Work Experience

June–Sep 2022 **VMware**, *Palo Alto, CA, USA*.

Topic: VMWare RAN Intelligent Controller (RIC), *Mentor: Dr. Rakesh Misra*

- Designed near-real-time applications (xApps) to improve wireless connectivity and reduce inter-cell interference in Open-RAN framework.

June–Aug 2017 **Nokia Bell Labs**, *Murray Hill, NJ, USA*.

Topic: Millimeter Wave Beam Training Algorithm Design, *Mentor: Dr. Özge Kaya*

- Developed an adaptive beam training algorithm for mobile multi-user scenario in outdoor mmWave cellular networks.
- Achieved an average of over 60% reduction in beam-steering delay over a sequential search baseline.

Teaching and Mentoring Experience

Teaching Assistant.

Winter 2021 ECE 257B- Modern Wireless Communication (Graduate).

Spring 2020 ECE 157B- Communication Systems Lab (Undergraduate).

Spring 2018 EEGY 9123- Introduction to Machine Learning (Graduate).

Fall 2017 EEUY 4563- Introduction to Machine Learning (Undergraduate).

Spring 2017 ELGY 6373- Internet Architecture and Protocols Lab (Graduate).

Mentorship, I mentored one PhD student and 10+ BS/MS students at UC San Diego. I particularly help historically underrepresented and underprivileged students.

Leadership

2021–2022 **The Marconi Society**, *Scholar in Residence*.
Served as a student scholar for facilitating the Marconi Society meetings with the chair Vint Cerf and other prominent scientists, engineers, and policymakers.

2021–2022 **Escribamos Ciencia K12 team**, *UC San Diego*.
Developed interesting science modules and videos for K12 students on topics such as electricity, internet, nuclear power, etc., under guidance of Prof. Olivia Graeve.

2020–2022 **Coordinator, Jacobs Undergraduate Mentorship Program**, *UC San Diego*.
Mentored underprivileged students through lab tours, industry talks, panel discussions, technical workshops, etc., and bridged the communication gap between undergraduates and graduate students.

2020–2021 **O.W.L Reading group**, *Inter-continental collaboration*.
Founded in Fall 2020 as a small group of Ph.D. students interested in research talks and discussion on recent conference papers and has grown over 100+ members in a year.

2019–2021 **Vice President, ECE graduate student council**, *UC San Diego*.
Responsible for providing communication between ECE students and the ECE department and organizing weekly events such as seminars and coffee hours.

Services

2019–2022 **Technical Reviews**.
IEEE Trans. Vehicular Technology (TVT) 2019-20
National Conference on Communications (India) 2021
IEEE Globecom 2021
IEEE WCNC 2022
IEEE Access 2021-22
IEEE SPAWC 2022

2021 **Technical Program Committee (TPC)**.
ACM Mobicom S3 Workshop 2021

2019 **Artifact Evaluation Committee**.
ACM CoNEXT 2019

Awards and Honors

- Qualcomm Innovation Fellowship winner 2022-23.
- Winner of 3-minute research talk competition at ACM Mobisys'20, Mobicom'21, Mobicom'22.
- Commencement award for the best graduate student service in ECE, UC San Diego, May 2021.
- Commencement award for the best MS Academic Achievement in ECE, at New York University, 2019.
- Motorola Gold Medalist: Commencement award for the best all-round performance in Electrical Engineering, IIT Kanpur, May 2016.
- Samuel Morse MS Fellowship (full financial support during MS at NYU) 2016–2018.
- Secured All India Rank 390 (amongst 0.5 million students) in IIT–Joint Entrance Exam 2012.