Agrim Gupta

Ph.D. Candidate, WCSNG Lab, Electrical & Computer Engineering (ECE), UCSD

📍 San Diego, USA @ agg003@eng.ucsd.edu ✉ 8530 Costa Verde Blvd ⚅ 9th May, 1996

🔗 agrim9.github.io 🐦 @Agrim_G9 in linkedin.com/in/agrimg ⌨ github.com/Agrim9

EDUCATION

Ph.D.	GPA: **4.0/4.0**, Thesis title: **Sustainable Wireless Communications & Sensing**	2019 - present, **UC San Diego**
B.Tech + M. Tech	GPA: **9.42/10.00**, Thesis title: **Limited Feedback MIMO -OFDM Precoding**	2014-19, **IIT Bombay**

ONGOING RESEARCH

Achieving Greener Wireless Networks — Guides: **Dinesh Bharadia, Alireza Vahid** (2020-Ongoing)	• **Conceptualized & Implemented** a new Massive MIMO architecture with a single RF chain • **Key Idea:** The single 'physical' RF chain has digitally-adaptable bandwidth to fit-in optimal number of 'virtual RF chains' dependent on user load and channel conditions • **Key Result:** Potentially 50% power savings in existing 5G Massive MIMO implementations. Breaking the tradeoff between spectral and energy efficiency in today's architectures for efficiently scaling of Massive MIMO to more than 64 antennas • **Future Work:** Demonstrating GreenMO with open-RAN stacks (srsRAN, OAI), integrating channel estimation, power amplifier modelling and designing university-wide testbed for MIMO power optimization • **Publications**: Mobicom'23, IEEE Transactions on Wireless Comm., Hotcarbon'22
Batteryless Wireless Force Sensors — Guides: **Dinesh Bharadia, Tania Morimoto** (2019-Ongoing)	• **Conceptualized & Implemented** backscatter based batteryless+wireless analog force sensors • **Key Idea:** The designed sensors couple the applied force with analog phase changes in digitally identifiable backscattered RF signals, subsiding the need of ADCs for battery-free operation • **Key Result:** Generalized the force-RF phase change coupling effect to successfully miniaturize the sensors by at least 1000x as compared to previous knowledge on phase transduction • **Future Work:** Exploring multiple applications of the designed new technology: force-sensor backed orthopaedic implants, ubiquitous weight sensing, batteryless attachments for AR/VR, measuring baby tongue-forces with sensor backed baby pacifier • **Publications**: NSDI'21, ACM GetMobile, UbiComp'23, IEEE RA-L, IEEE Sensors Journal • **Commercialization Efforts**: Working with a team of 5 people (MedWiForce). Completed NSF I-Corps Regionals and IGE MedTech Accelerator Programs.

MY RESEARCH

Wireless systems have evolved to send in more and more bits across, and faster. However, the push now is to be greener and consume fewer joules, and as well utilize wireless signals not just to send bits across, but use them to sense the environments they propagate in. Thus, my research is driven towards greener growth of wireless networks, and creating batteryless sensors which can be read simply via wireless signal propagation.

WORK EXPERIENCE

• **Keysight Technologies, Santa Rosa (Summer '23 Internship):** Aerospace & Defence Govt. Solutions (ADGS) team Worked on FPGA interfacing, beam nulling techniques, power efficiency & linearity trends for large phased arrays (1024 antennas) for SATCOMS

• **IIT-B Mars Rover Team ('15-'19):** Served as Team Head ('18), spearheaded development of rover's ROS software chain, presented the rover to dignitaries like Indian PM and Defense minister.

• **Microsoft India (Summer '17):** Software Engineering internship, with Business Intelligence (BI) team. Worked on graph recommendation systems to reduce search lookup times.

• **TU Braunschweig (Summer '16):** Research intern under Prof. Thomas Kürner. Worked on simulating diffraction effects for THz backhauls

• **Teaching Assistant Roles**: ECE-157A, "Comm. Systems Lab", Prof. Dinesh Bharadia, Apr'23-Jun'23 EE-328, "Digital Communications", Prof. Kumar Appaiah, Jan'19-Apr'19

TECHNICAL SKILLS

Python ●●●●○
C++ ●●●○○
Android/Java ●●○○○

Softwares/Platforms: Matlab, Ansys HFSS, Comsol Multiphysics, ADS, Xilinx Vivado, GNURadio, USRP, Kubernetes, Pluto SDR, Android Studio, WARP

PREVIOUS RESEARCH PROJECTS

Limited Feedback MIMO Precoding (2018-2020) **Guides: Kumar Appaiah, Rahul Vaze**	• Formulated algebraic structures of channel matrix (manifolds), and exploited the underlying manifold structure to utilize temporal & freq. correlations combinedly, for reduced quantization error • **Publications**: IEEE Transactions on Communications, IEEE Wireless Communications Letters, IEEE ICC 2019 • Received **Undergraduate Research Award** from IIT-B for this work
BLE Proximity Social Distancing (Summer'20) **Guide: Dinesh Bharadia**	• Implemented an Android App to provide classification of <6ft proximity using BLE beacons' RSSI levels, to aid in social distancing during COVID-19 • **Publications**: Sensys'20 poster, **News Releases:** SD Union Tribune ⧉

KEY COURSES UNDERTAKEN

UCSD	Principles of Wireless Networks, Modern Communication Networks, RF Circuit Design, Antenna Theory, Medical Devices & Circuits, Optimizing Platforms on FPGAs, Flexible Electronics
IIT-B	Network Information Theory, Communications Systems+Lab, Control Systems+Lab, Fiber Optic Communications, Quantum Information & Computing, Lie Groups & Lie Algebras

PUBLICATIONS

📄 Conferences

• **Gupta A.**, Nassirpour S., Patamasing E., Dunna M., Vahid A., Bharadia D. "**GreenMO: Enabling Virtualized, Sustainable Massive MIMO with a Single RF Chain**", ACM Mobicom'23⧉

• Park D., **Gupta A.**, Bashar S., Girerd C., Bharadia D., Morimoto T. "**Design and Evaluation of a Miniaturized Force Sensor Based on Wave Backscattering**", *IEEE RA-L/IROS* ⧉

• **Gupta A.**, Girerd C., Dunna M., Zhang Q., Subarraman R., Morimoto T., Bharadia D. "**WiForce: Wireless Sensing and Localization of Contact Forces on a Space Continuum**", NSDI '21 ⧉
Invited for publication in ACM GetMobile magazine for being one of the top papers in NSDI'21, GetMobile article ⧉

• **Gupta A.**, Appaiah K., Vaze R. "**Predictive Quantization and Joint Time-Frequency interpolation technique for MIMO-OFDM precoding**", IEEE ICC 2019 ⧉

📖 Journals

• **Gupta A.**, Park D., Bashar S., Girerd C., Morimoto T., Bharadia D. "**ForceSticker: Batteryless, Thin Sticker-like Flexible Force Sensor**", , *ACM IMWUT 23* ⧉, *Ubicomp'23 Video Teaser, Demo* ⧉

• Nassirpour S., **Gupta A.**, Bharadia D., Vahid A. "**Power-Efficient Analog Front-End Interference Suppression with Binary Antennas**" *IEEE Transactions on Wireless Communications* ⧉

• Zhang Q., Girerd C., **Gupta A.**, Dunna M., Bharadia D., Morimoto T. "**Towards a Wireless Force Sensor Based on Wave Backscattering for Medical Applications**", *IEEE Sensors Journal* ⧉

• Nijhawan S., **Gupta A.**, Appaiah K., Vaze R., Karamchandani N. "**Flag manifold based precoder interpolation techniques for MIMO-OFDM systems**", *IEEE Transactions on Communications* ⧉

• Madan M., **Gupta A.**, Appaiah K. "**Scalar Feedback-Based Joint Time-Frequency Precoder Interpolation for MIMO-OFDM Systems**", *IEEE Wireless Communications Letters* ⧉

🔧 Workshops/Posters

• **Gupta A.**, Jain I., Bharadia D. "**Multiple smaller base stations are greener than a single powerful one: Densification of Wireless Cellular Networks**" *HotCarbon'22* ⧉, *Soon to be in ACM e-Energy Special Issue*

• Arun A., **Gupta A.**, Bhatka S., Komatineni S., Bharadia D. "**BluBLE, space-time social distancing to monitor the spread of COVID-19**" *Sensys'20* ⧉