28 GHz mmWave Measurements for Joint Sensing and Communications

Timothy Wang[1], David Chen[2], Eliot S.F. Portillo[3], Abhishek Adhikari[3],
Rodolfo Feick[4], Jinfeng Du[5], Dmitry Chizhik[5], Gil Zussman[1]

[1]University of Michigan, [2]Stuyvesant High School, [3]Columbia University, [4]Universidad Técnica Federico Santa María, [5]Nokia Bell Labs

Abstract

- Within Beyond-5G and 6G wireless networks, Joint Communications and Sensing (JCAS) will allow small cells to to perform sensing in addition to their traditional communication responsibilities.
- We model indoor and outdoor clutter using a portable 28 GHz mmWave channel sounder traditionally used for propagation modeling in communication [1-3].
- We collect 2,872,800 individual backscatter measurements in NYC and show preliminary results for JCAS clutter modeling and vehicle detection.
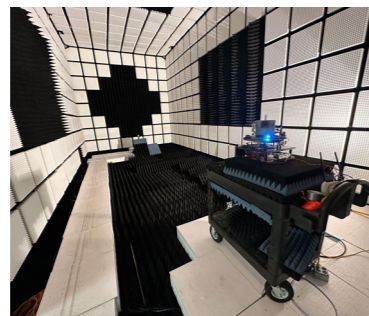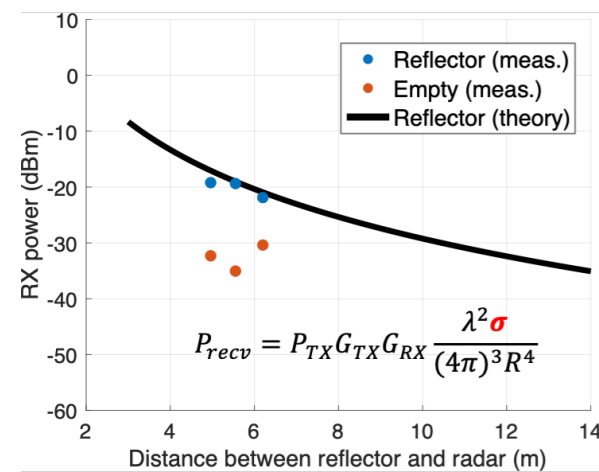
JCAS Measurement Platform

- We use a portable 28 GHz omni antenna transmitter and 10-degree receiver developed by Nokia Bell Labs and Universidad Técnica Federico Santa María.

TX   RX
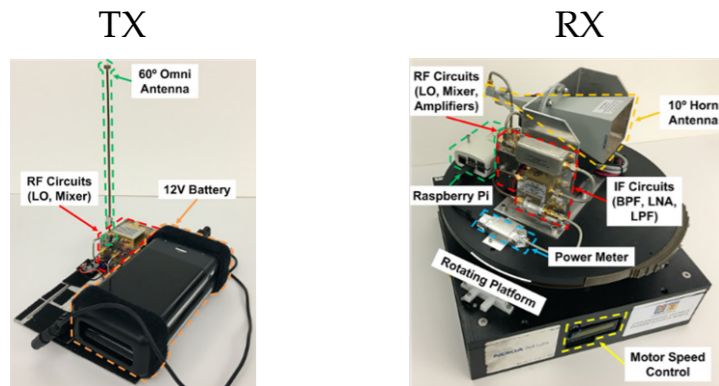
Rigorous Calibration

- Reflector (meas.) is within 1.4 dB of reflector (theory).
- Known reflector RCS of 0.13 m^2 at 28 GHz [4].

$$P_{recv} = P_{TX} G_{TX} G_{RX} \frac{\lambda^2 \sigma}{(4\pi)^3 R^4}$$

Static Clutter Statistical Model

- Obtain directional backscattered power across 360 degrees from several street intersections and calculate the statistical average.
- Representation of power variation across azimuth.

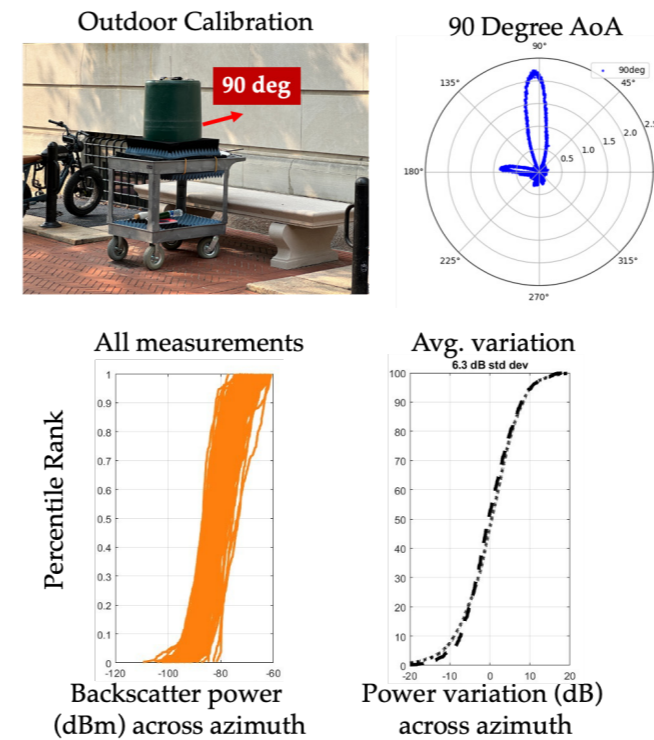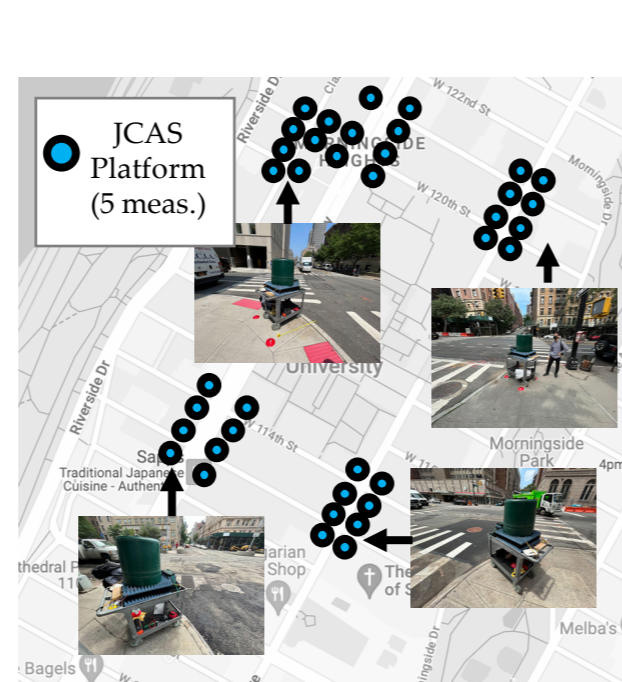★ Sensing Platform
→ Backscatter

Indoor Backscatter Measurements

- Statistical models confirm that higher average backscatter is characteristic of smaller rooms, with larger rooms exhibiting lower backscatter.

MH Office
MH Lab
MH Cafeteria
MH Lobby
MH Game Room
CU Coffee Shop
CU Study Area
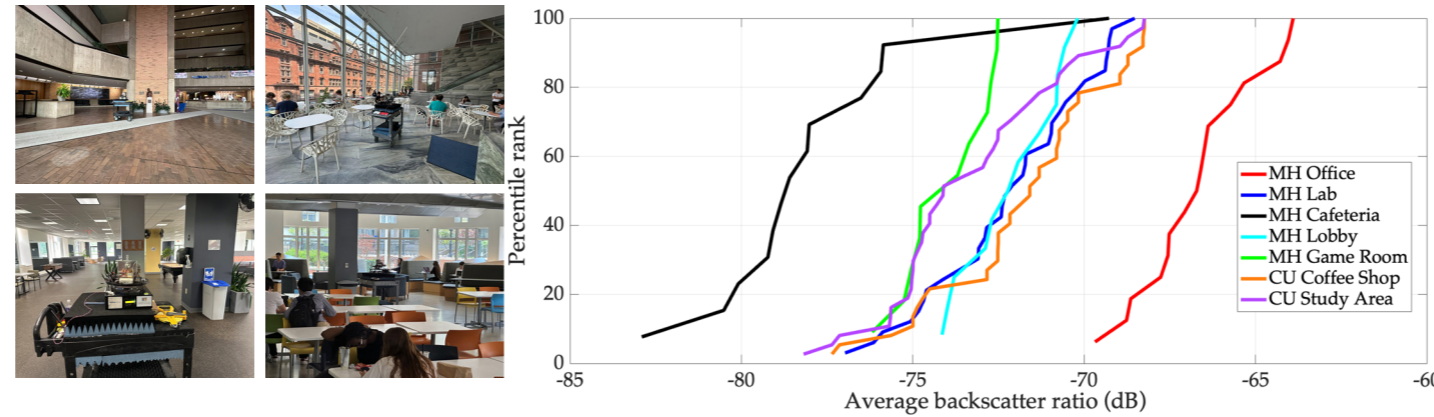
## Outdoor Backscatter Measurements

- Using the COSMOS FCC Innovation Zone [5], we collect 2,872,800 individual backscatter measurements in 190 locations spanning 10 intersections in NYC.
- We obtain a static clutter model for avg. power variation across azimuth.

JCAS Platform (5 meas.)

Outdoor Calibration
90 deg

90 Degree AoA

All measurements

Avg. variation
6.3 dB std dev

Backscatter power (dBm) across azimuth
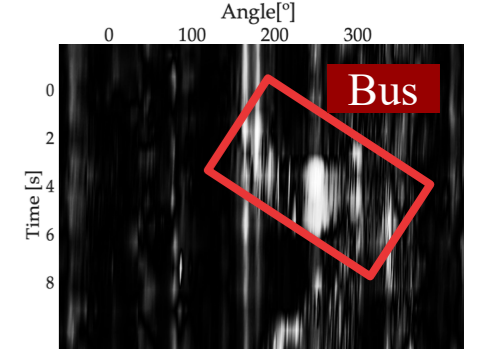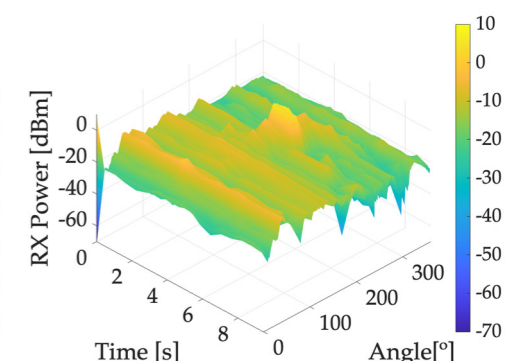
Power variation (dB) across azimuth

Vehicle Detection

- We placed the channel sounder, Tx elevated above the Rx, at street intersection corners. From there, we took a series of 22 10-second measurement samples. We recorded accompanying video footage to compare with the measurements.
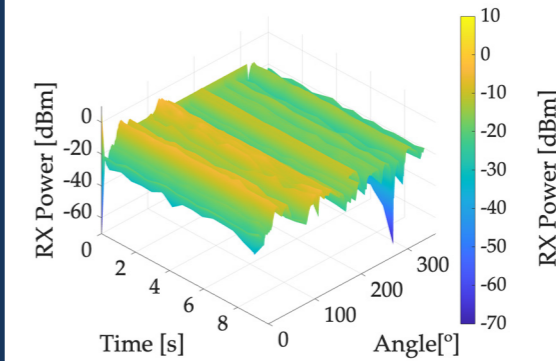
Empty Measurement   Vehicle Measurement

90deg   0deg

Bus

Future Work

- We are beginning work on using the JCAS measurement platform for traffic monitoring, pedestrian detection, and integration with Lidar sensors for multi modal sensing.

Traffic Density Comparison   Pedestrian Detection   Lidar-Informed Modeling

References

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[2] M. Kohli, A. Adhikari, G. Avci, S. Brent, J. Moser, S. Hossain, A. Dash, I. Kadota, R. Feick, D. Chizhik, J. Du, R. Valenzuela, and G. Zussman, "Outdoor-to-Indoor 28GHz Wireless Measurements in Manhattan: Path Loss, Location Impacts, and 90% Coverage," in Proc. ACM MobiHoc'22, Seoul, South Korea, Oct. 2022.
[3] D. Chizhik, J. Du, M. Kohli, A. Adhikari, R. Feick, R. Valenzuela, and G. Zussman, "Accurate urban path loss models including diffuse scatter," in Proc. 17th European Conf. on Antennas and Propagation (EuCAP'23), Florence, Italy, Mar. 2023.
[4] Reflector Datasheet: https://sftp.eravant.com/content/datasheets/SAJ-024-S1.pdf
[5] D. Raychaudhuri, I. Seskar, G. Zussman, T. Korakis, D. Kilper, T. Chen, J. Kolodziejski, M. Sherman, Z. Kostic, X. Gu, H. Krishnaswamy, S. Maheshwari, P. Skrimponis, and C. Gutterman, "Challenge: COSMOS: A city-scale programmable testbed for experimentation with advanced wireless," in Proc. ACM MobiCom'20, 2020.

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