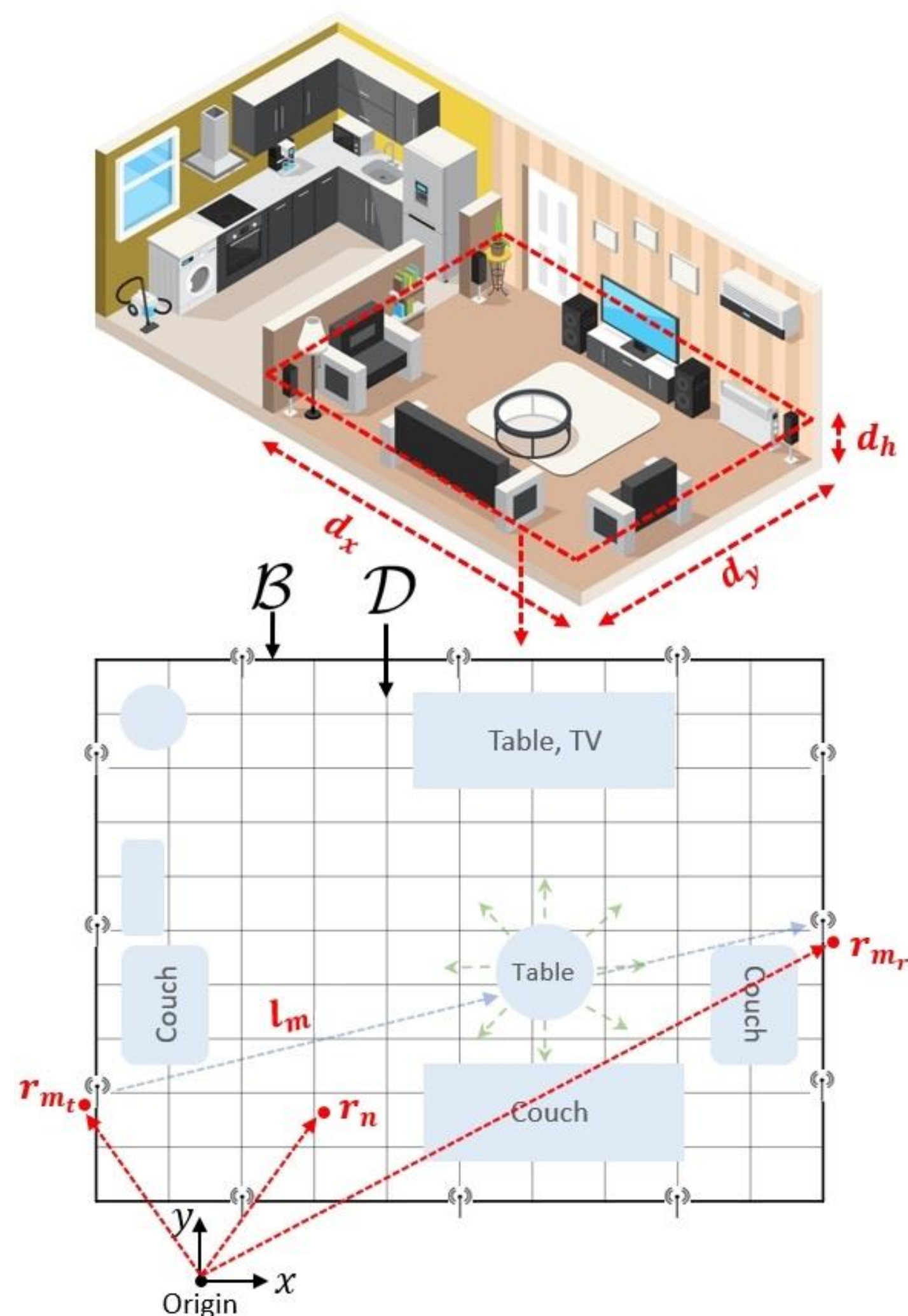


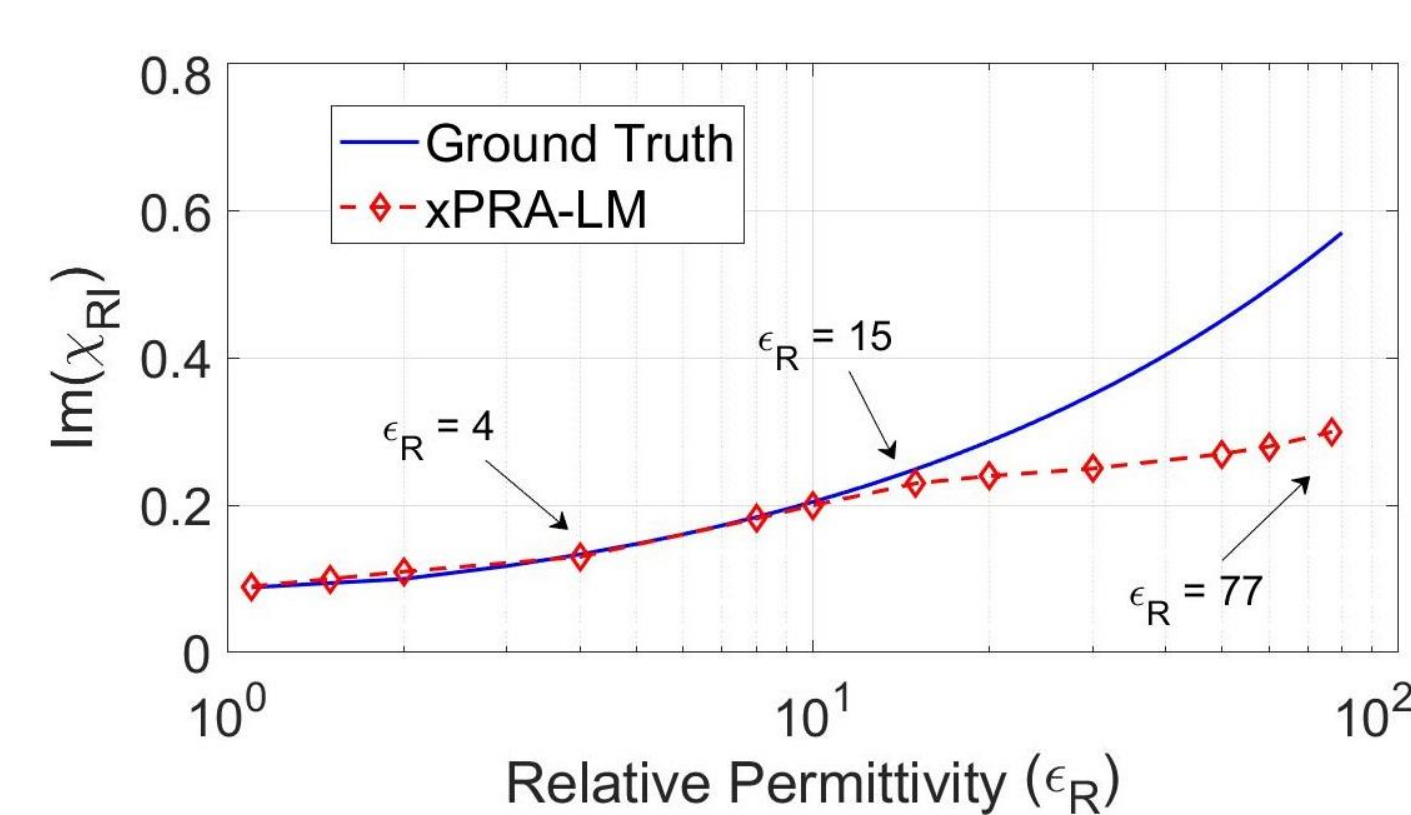
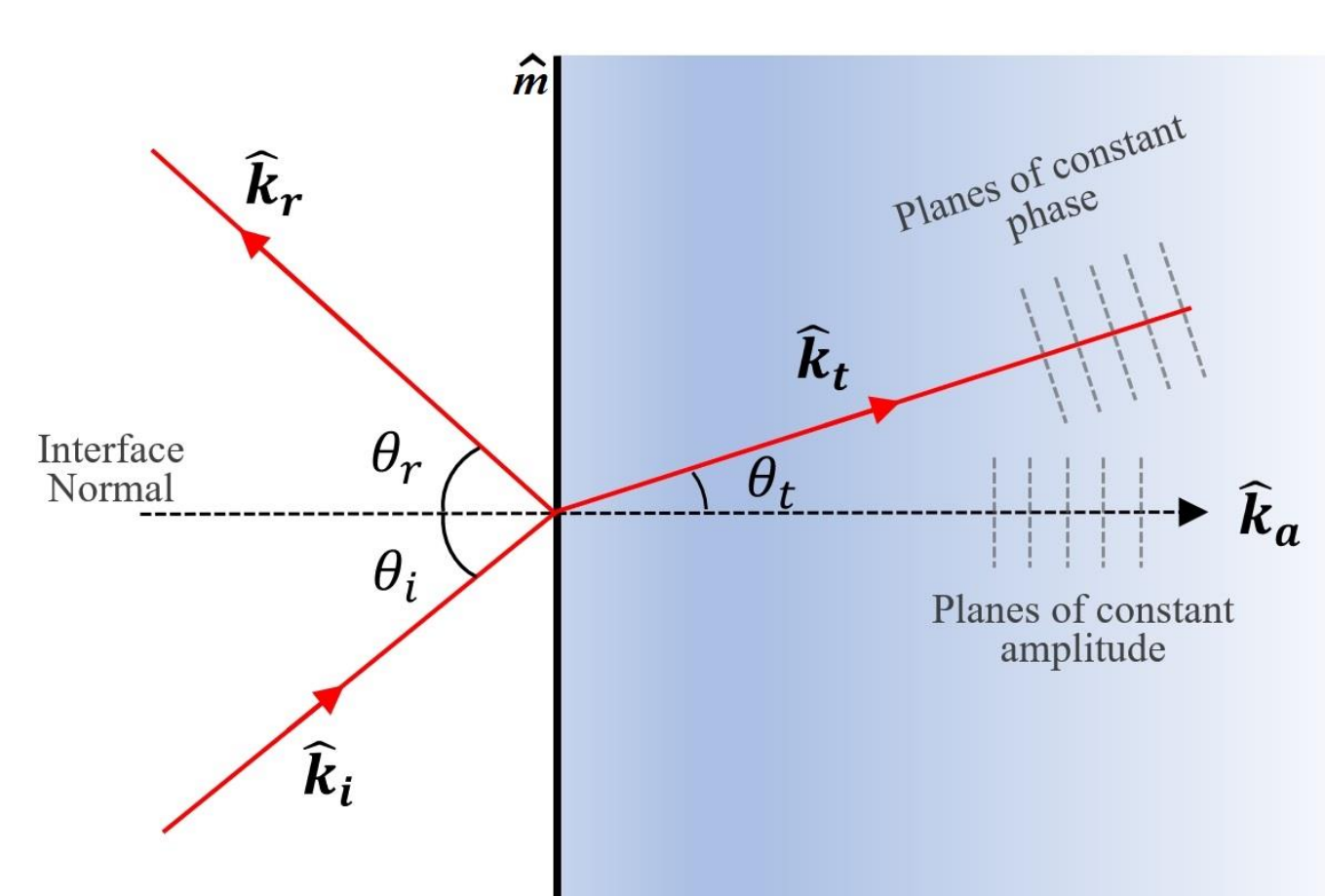
Department of Electronic and Computer Engineering

A Real-Time Radio Tomographic Indoor Imaging System using Inverse Scattering

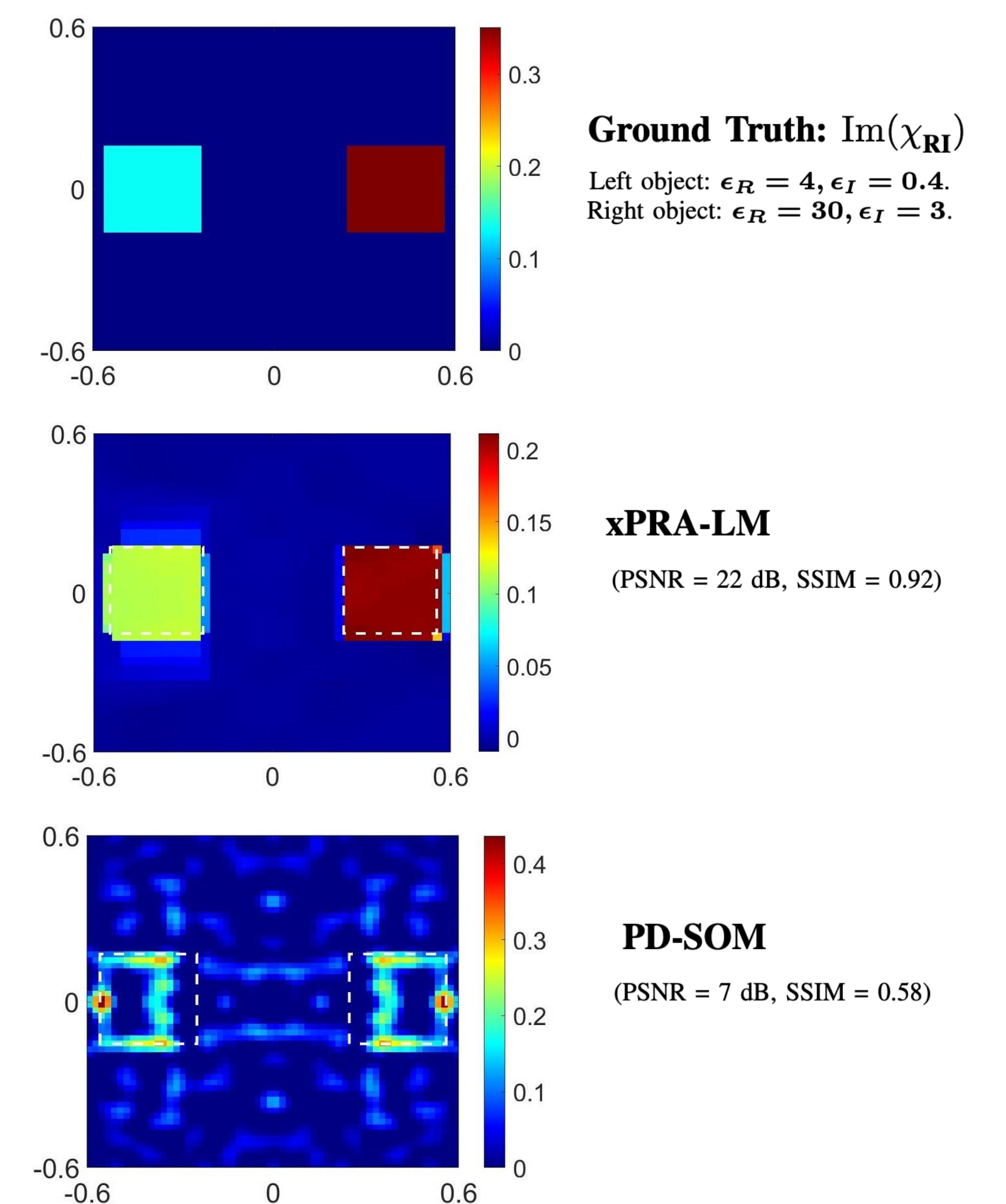
Prof. Ross Murch's Research Group



Radio Tomographic Imaging can be used for Indoor Imaging by utilizing path loss measurements between sensor nodes. No phase information or duplexers are required and is therefore ideal for unsynchronized distributed systems.

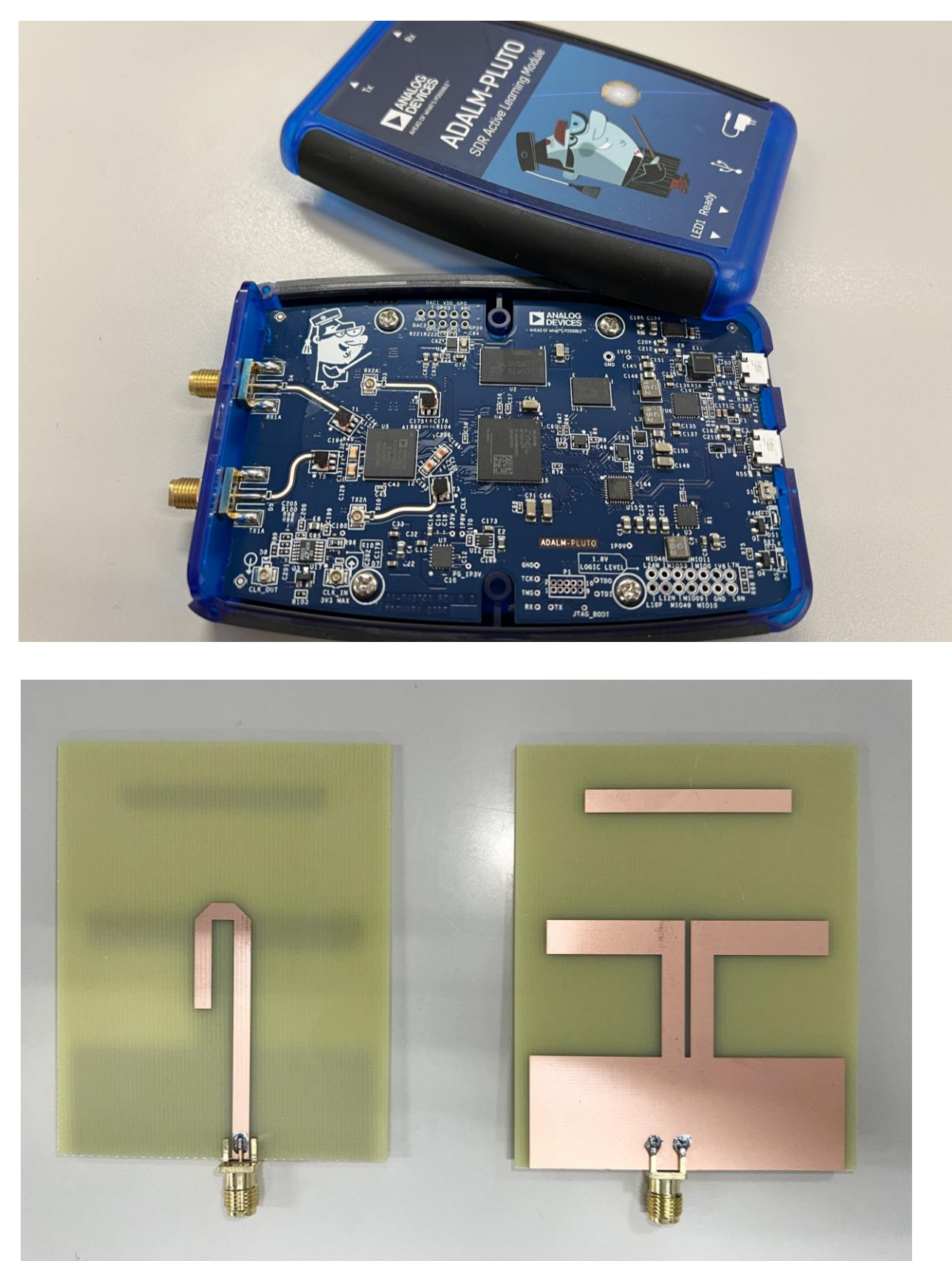


The significant advantage of our extended phaseless Rytov Approximation for loss-less media (xPRA-LM) is its ability to accurately image permittivity and distinguish between different materials [1]. Our extension is based on propagation through lossy materials.

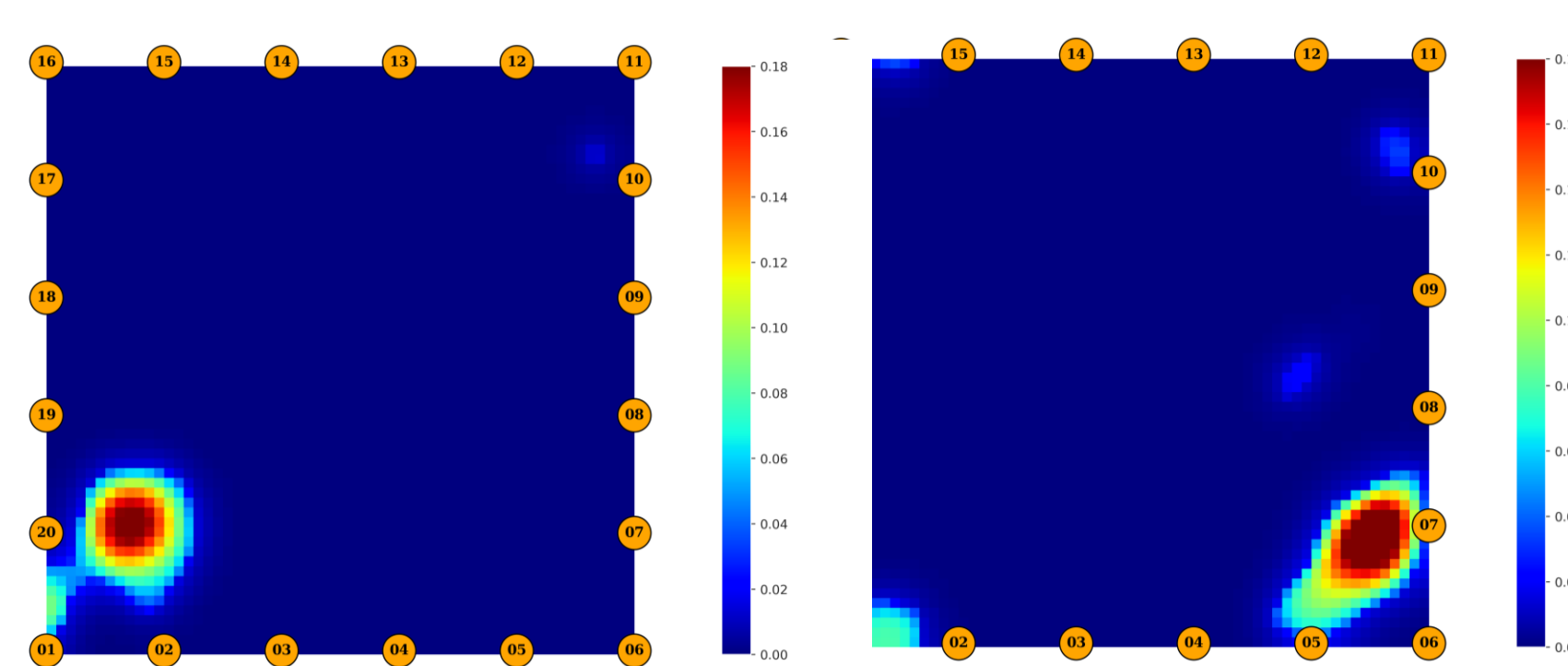
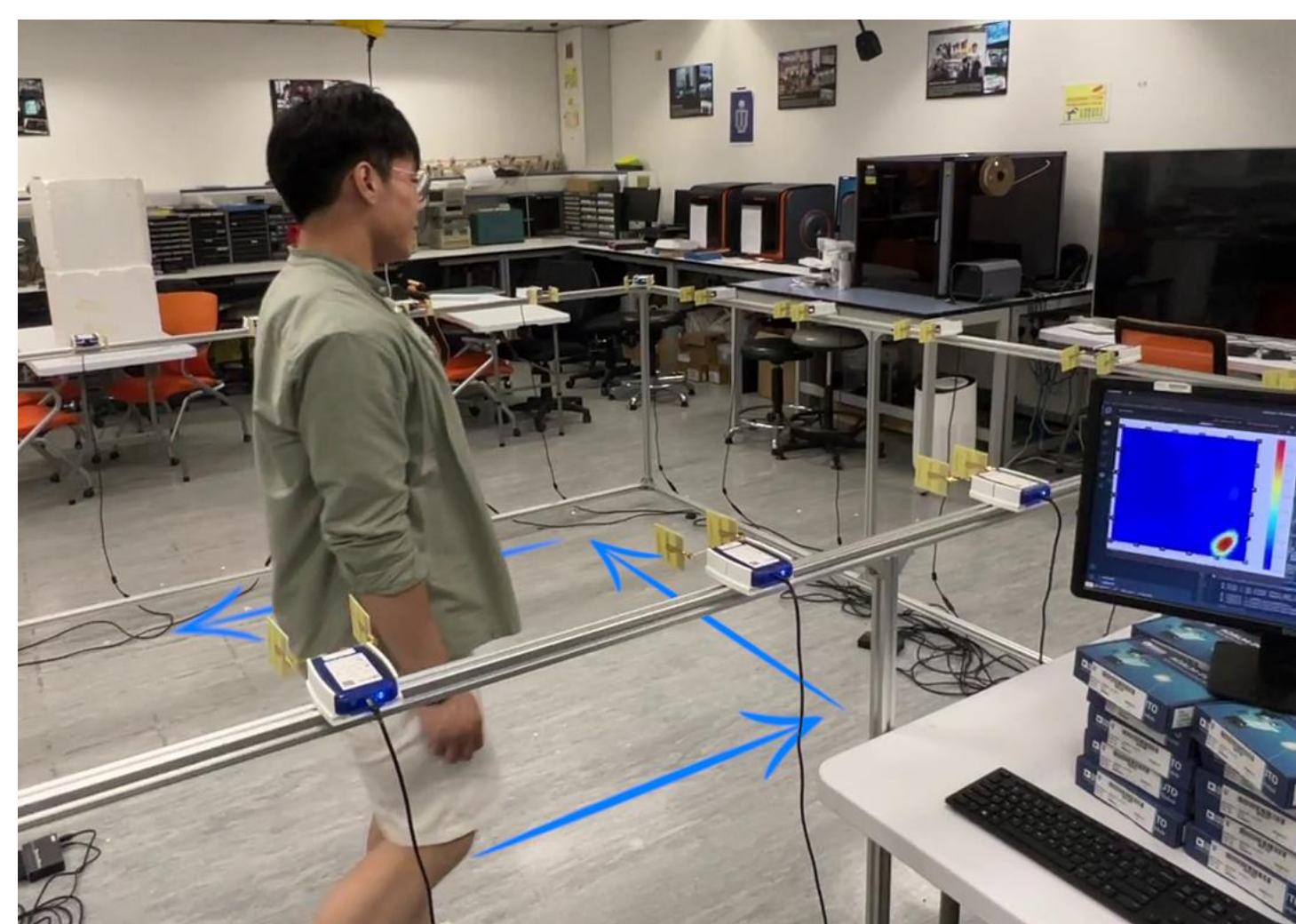


Reconstruction simulation results: From top to bottom: ground truth, our method (xPRA-LM) and a state-of-the-art inverse scattering method (PD-SOM) [1].

Experimental Real-Time Results



We use off-the-shelf FPGA Pluto boards configured with customized Yagi antennas to acquire one measurement sample consisting of 400 measurements in less than 0.5 second.



Real-time measurement system and experimental results of person moving around the imaging area (moving left to right).

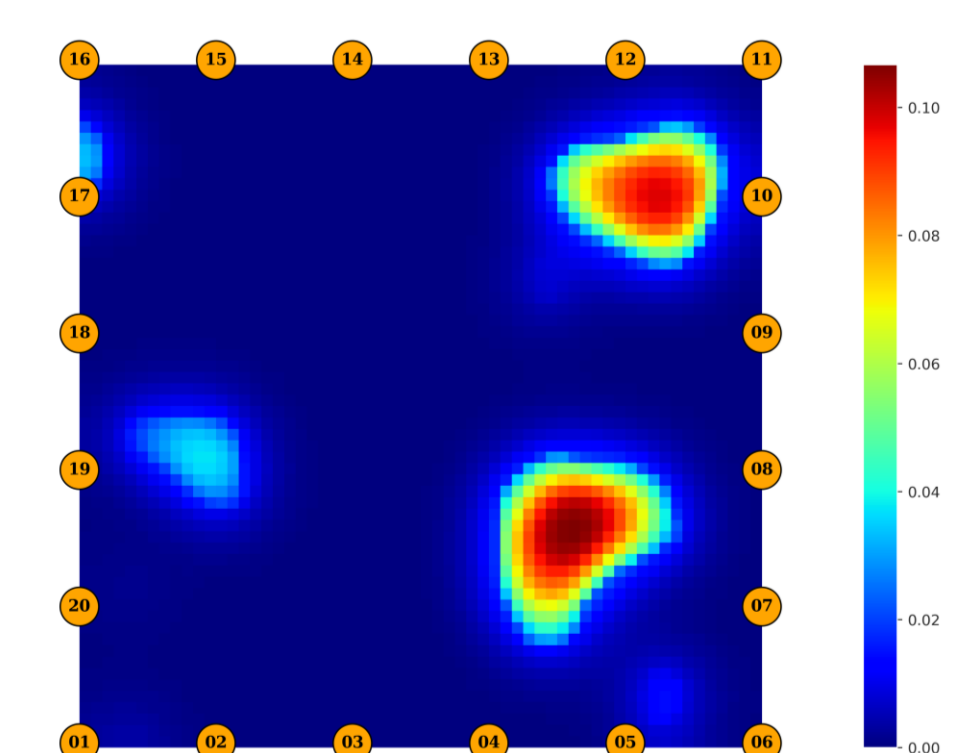
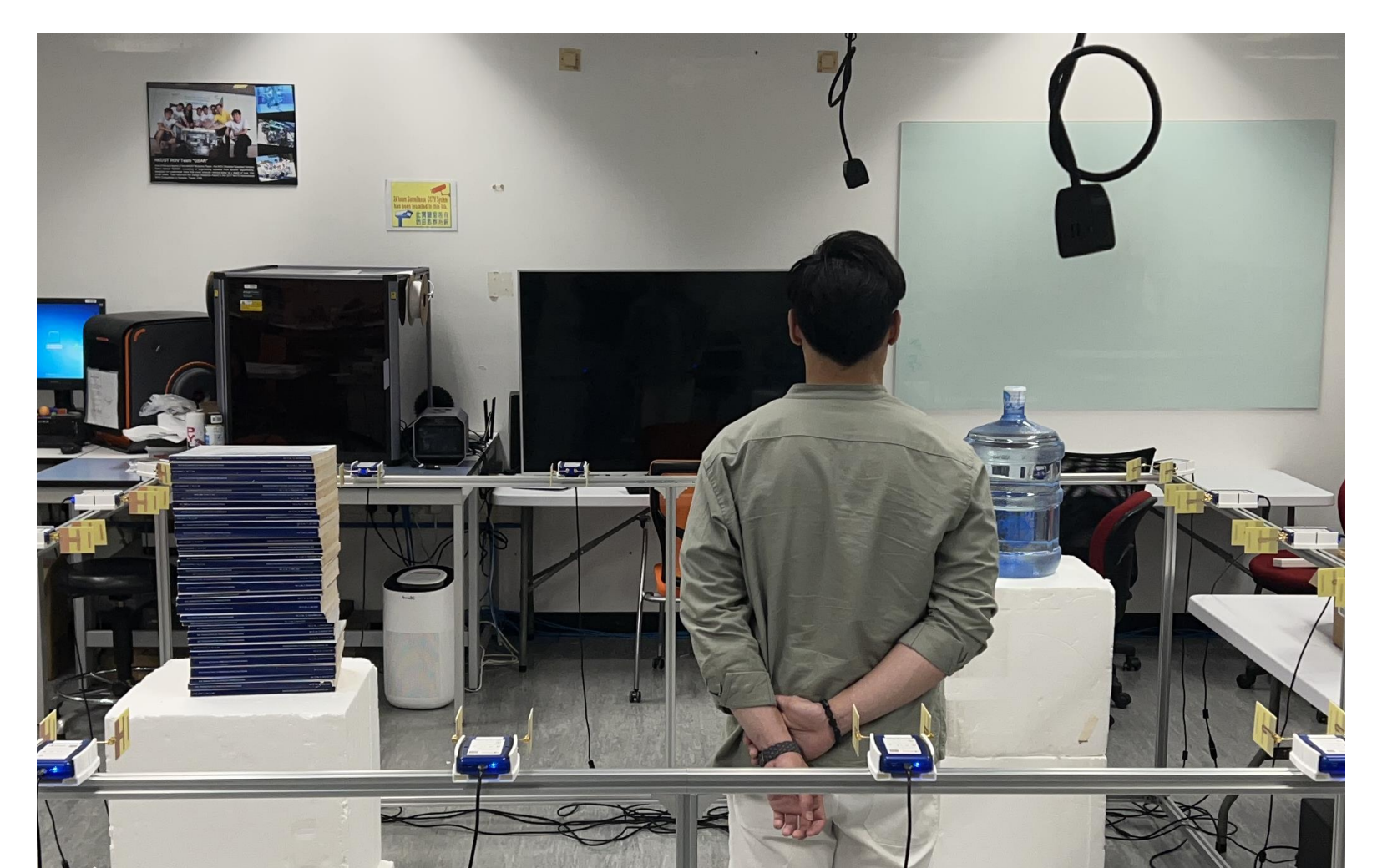
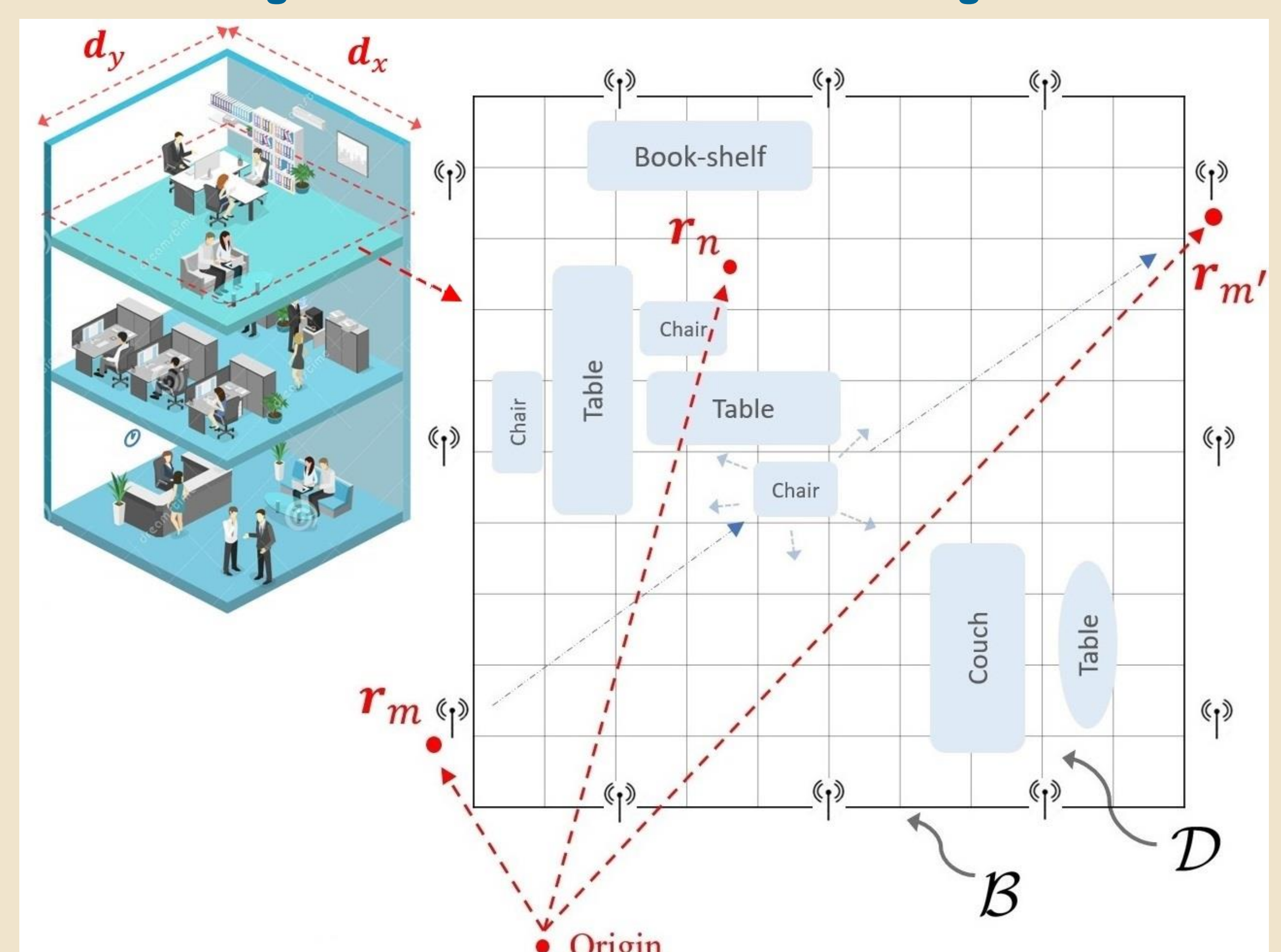


Image of a stack of books (left), water bottle (top right) and a person (bottom right).

Our Related Journal Publications

1. A., Dubey S. Deshmukh, L. Pan, X. Chen and R. Murch, "A Phaseless Extended Rytov Approximation for Strongly Scattering Low-Loss Media and Its Application to Indoor Imaging," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-17, 2022, Art no. 2005017.
2. A. Dubey, P. Sood, J. Santos, D. Ma, C. -Y. Chiu and R. Murch, "An Enhanced Approach to Imaging the Indoor Environment Using WiFi RSSI Measurements," in *IEEE Transactions on Vehicular Technology*, vol. 70, no. 9, pp. 8415-8430, Sept. 2021.
3. A. Dubey, S. Deshmukh, D. Ma, Q. Chen and R. Murch, "Physics Assisted Deep Learning for Indoor Imaging using Phaseless Wi-Fi Measurements," in *IEEE Transactions on Antennas and Propagation*, doi: 10.1109/TAP.2022.3177533.
4. S. Deshmukh, A. Dubey and R. Murch, "Unrolled Optimization With Deep Learning-Based Priors for Phaseless Inverse Scattering Problems," in *IEEE Transactions on Geoscience and Remote Sensing*, vol. 60, pp. 1-14, 2022, Art no. 2007614, doi: 10.1109/TGRS.2022.3214495
5. A. Dubey, X. Chen and R. Murch, "A New Correction to the Rytov Approximation for Strongly Scattering Lossy Media," in *IEEE Transactions on Antennas and Propagation*, vol. 70, no. 11, pp. 10851-10864, Nov. 2022, doi: 10.1109/TAP.2022.3188367.

The xPRA-LM Radio Tomographic Imaging System be used for Integrated Communication and Sensing in 6G



Acknowledgment

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