



Towards CSI enabled Closed-loop WiFi based SLAM

UC San Diego

JACOBS SCHOOL OF ENGINEERING

Aditya Arun, Chenfeng Wu, Roshan Ayyalasomayajula, Ish Jain, Dinesh Bharadia

University of California San Diego

Contact: P.I. Dinesh B. (dineshb@ucsd.edu), Aditya A. (aarun@ucsd.edu)

Website: <https://wcsng.ucsd.edu/locap/>



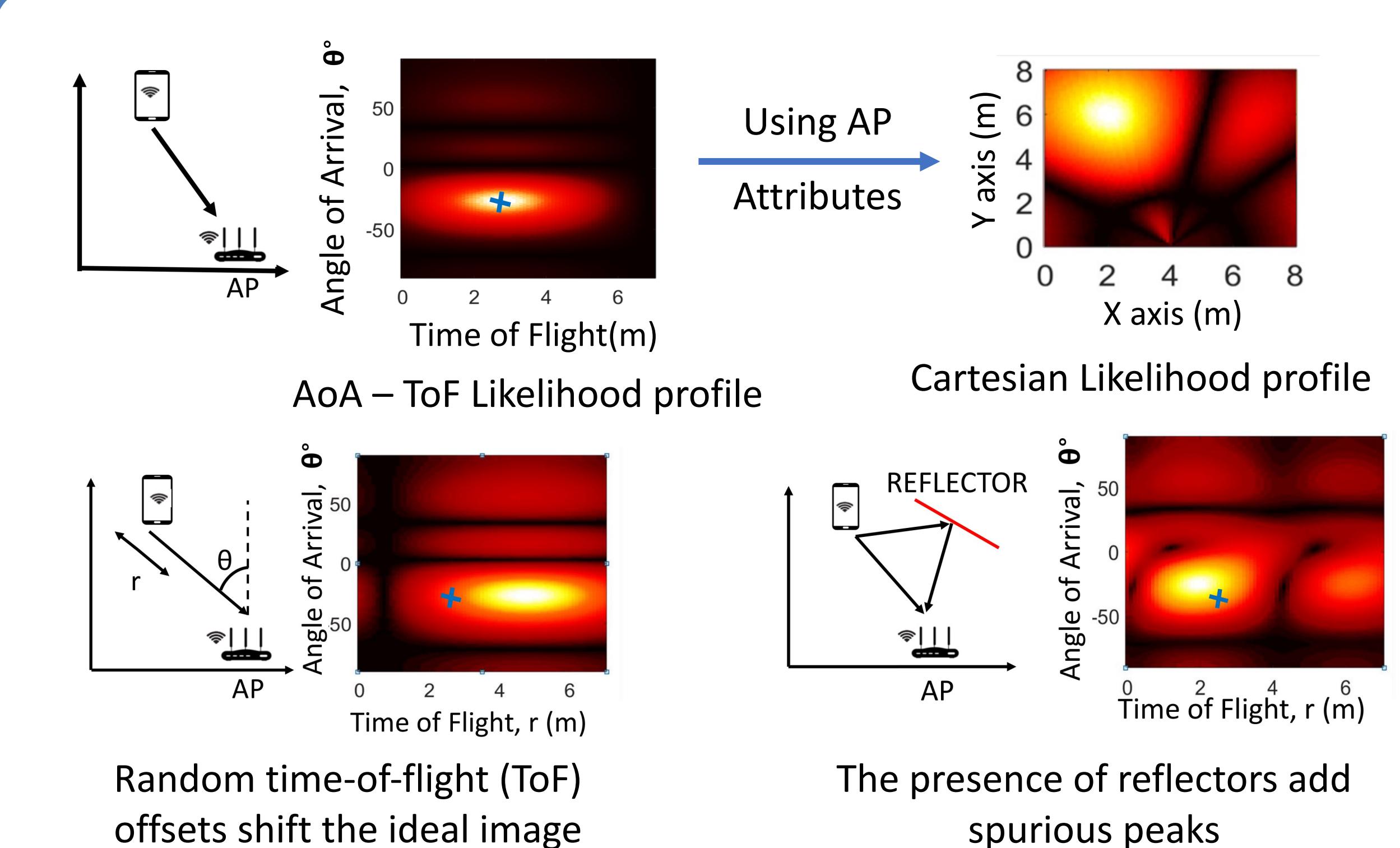
Motivation



- Locate the user in GPS-denied indoor environments
- Everyone has a Wi-Fi device on them making Wi-Fi ubiquitous
- Thus Wi-Fi localization has huge scope

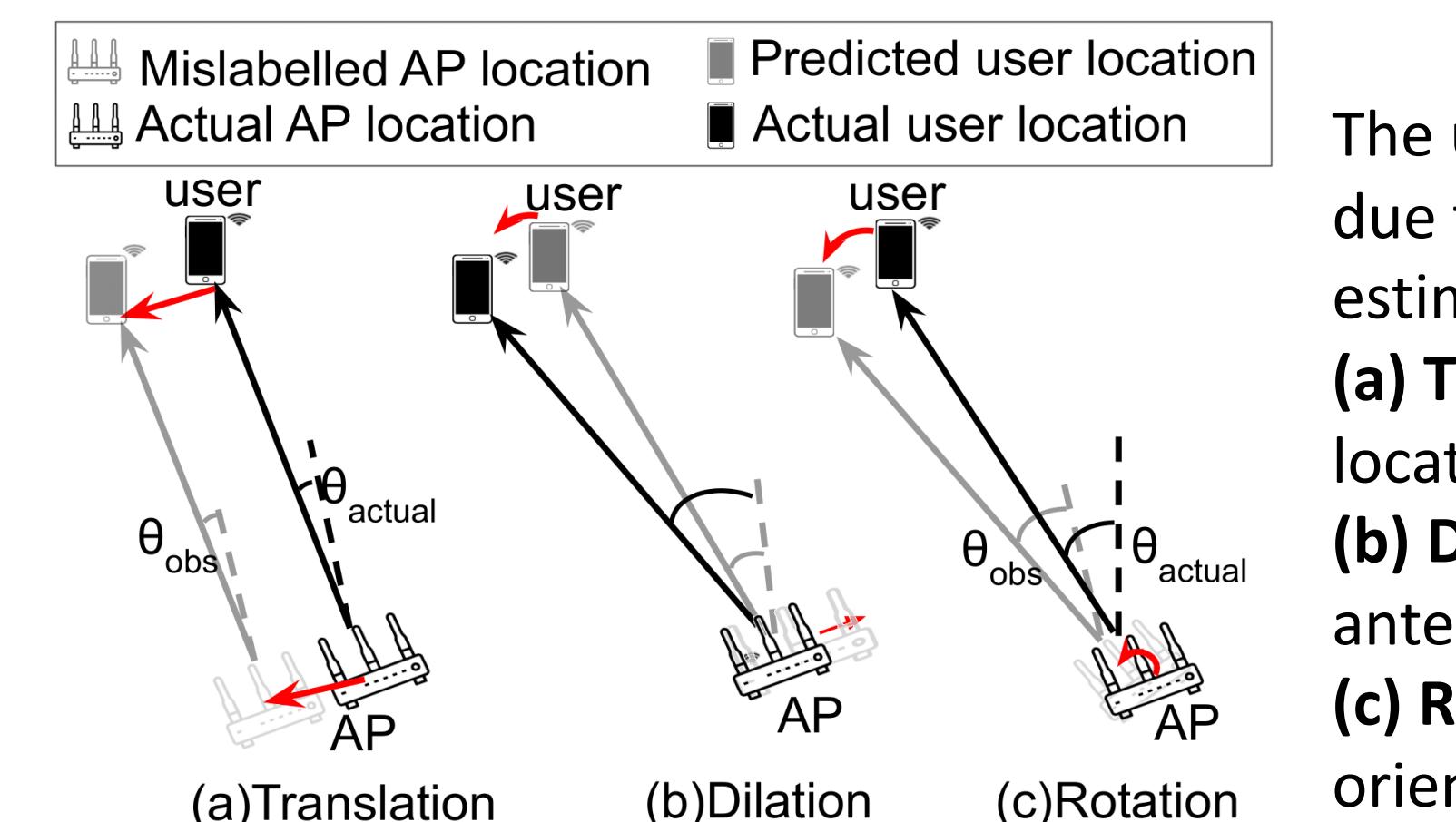
Connecting Locations with Maps

Challenges



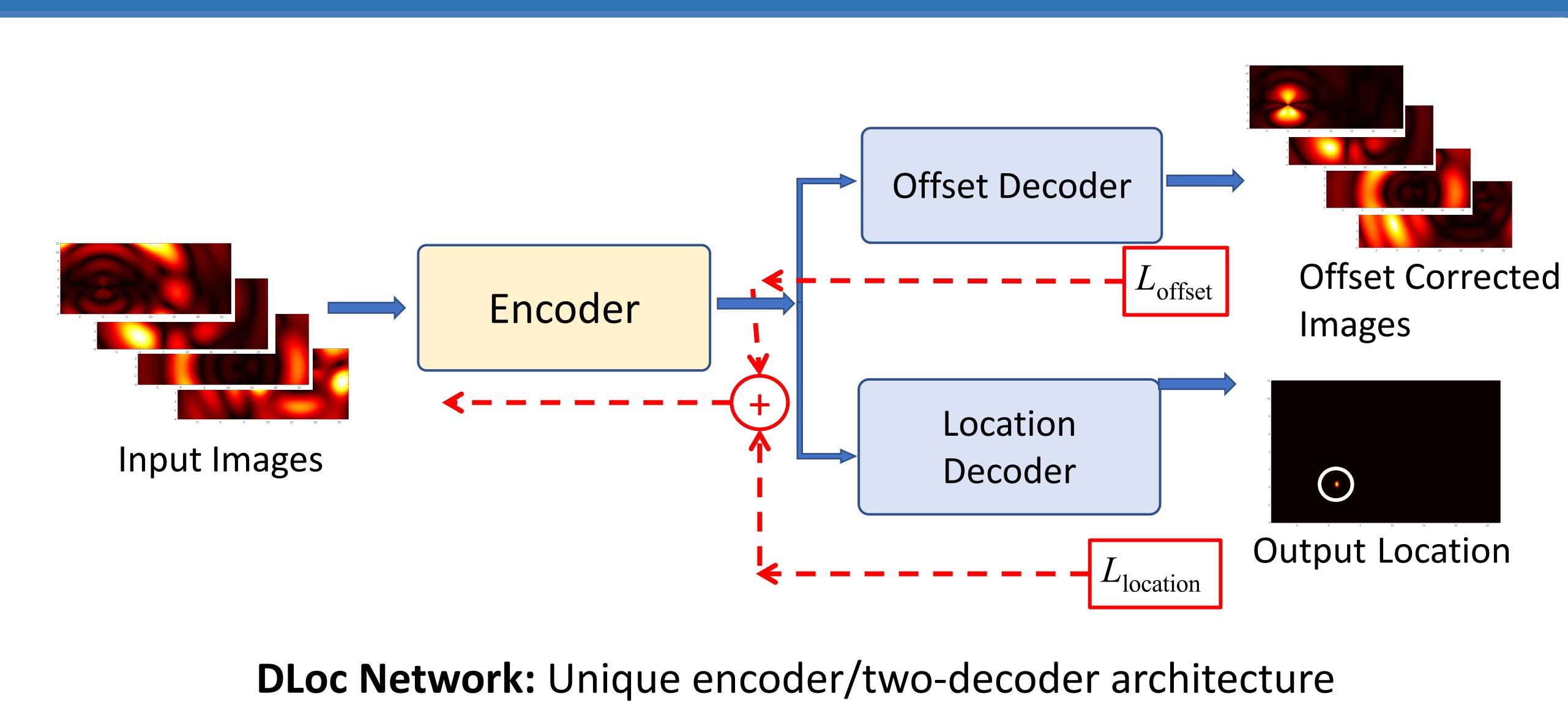
Building the Bridge

Challenges

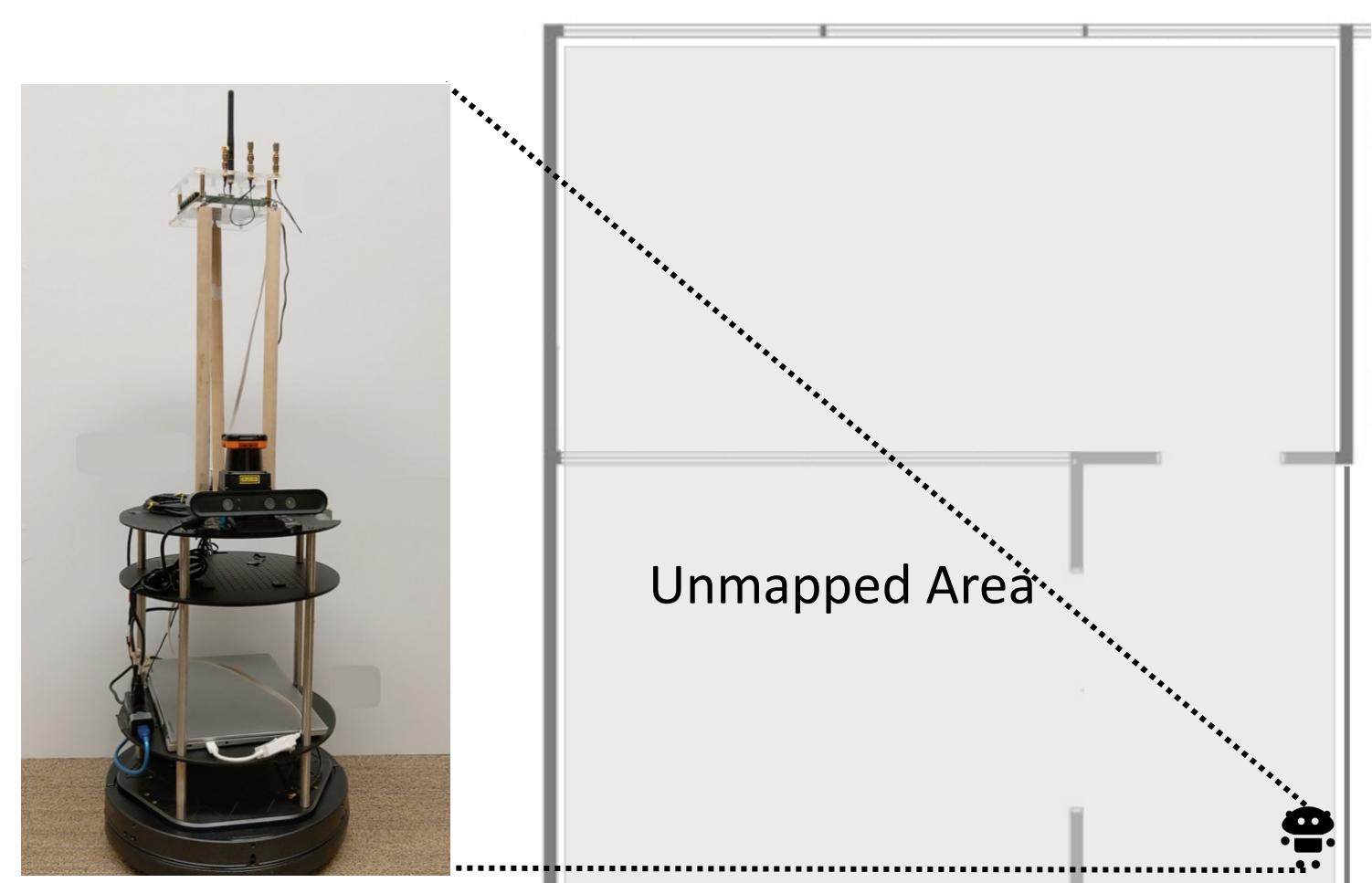


The user location is predicted wrong due to errors in access point's estimated details.
(a) Translation: Predicting the wrong location of the AP.
(b) Dilation: Predicting incorrect antenna separation
(c) Rotation: predicting the wrong orientation

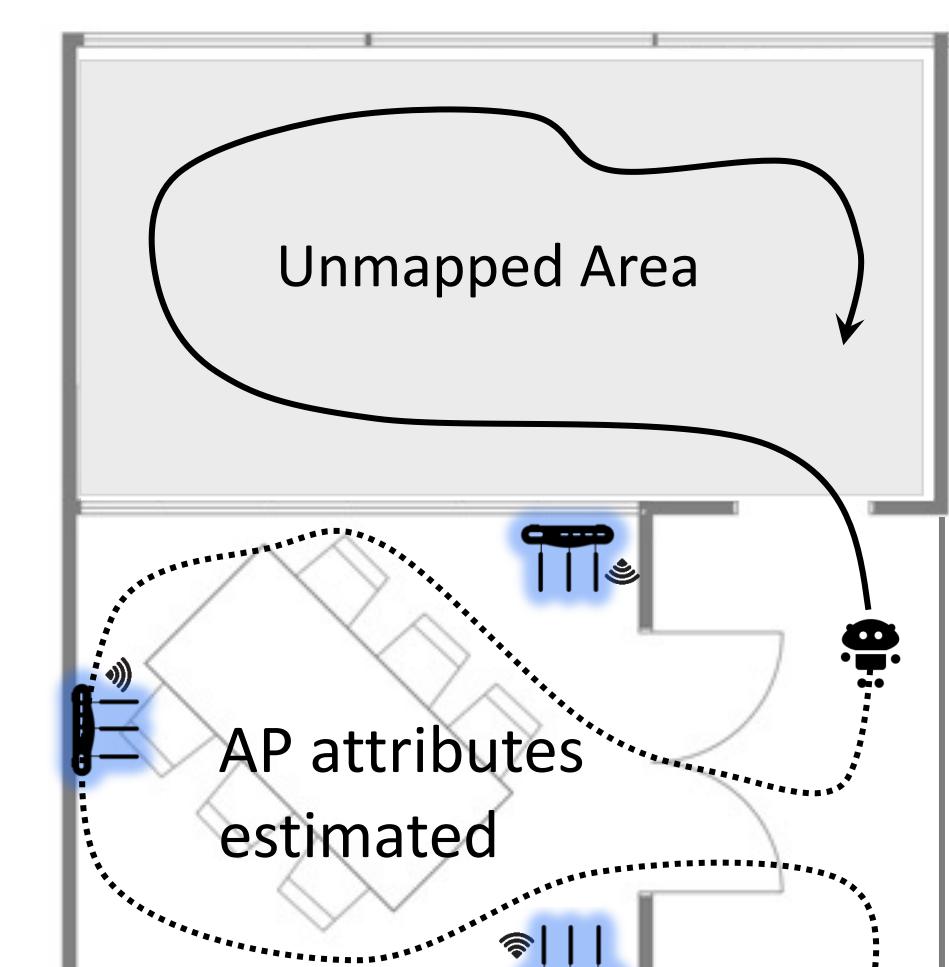
Idea



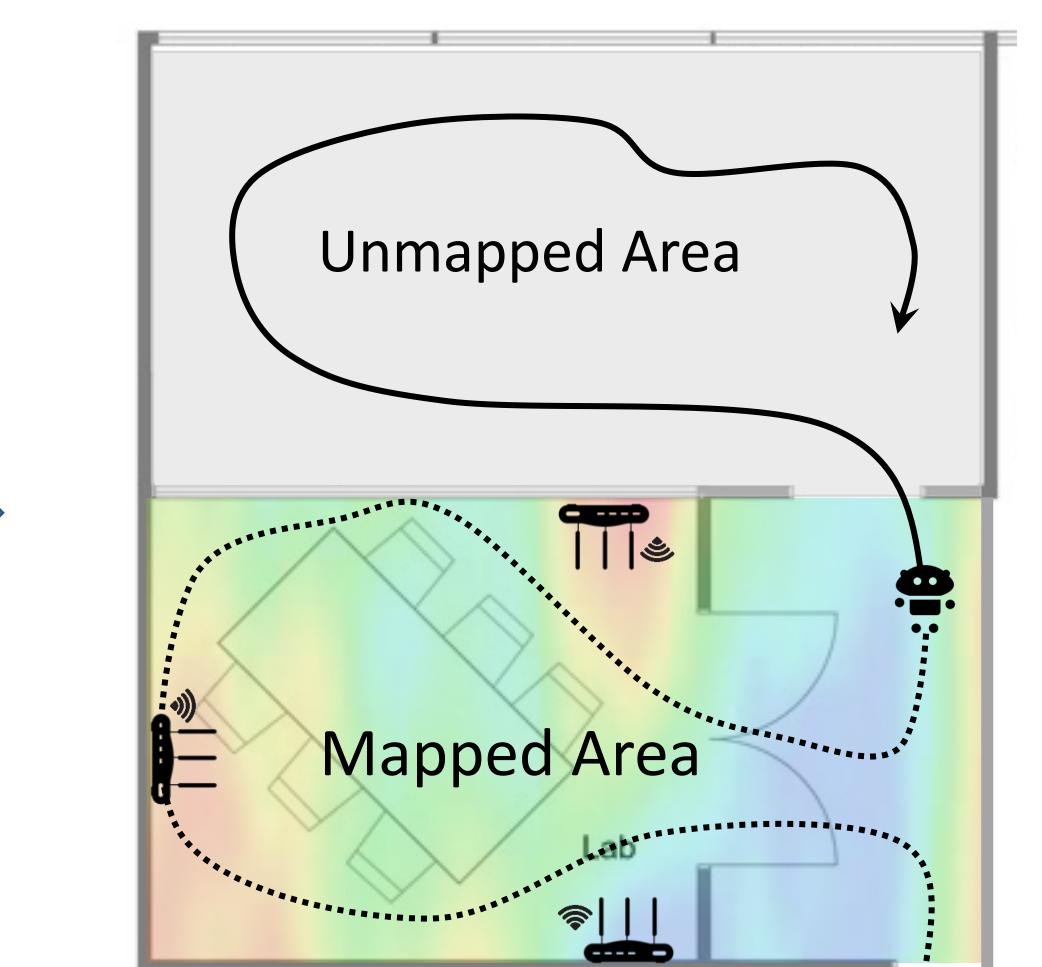
Overview



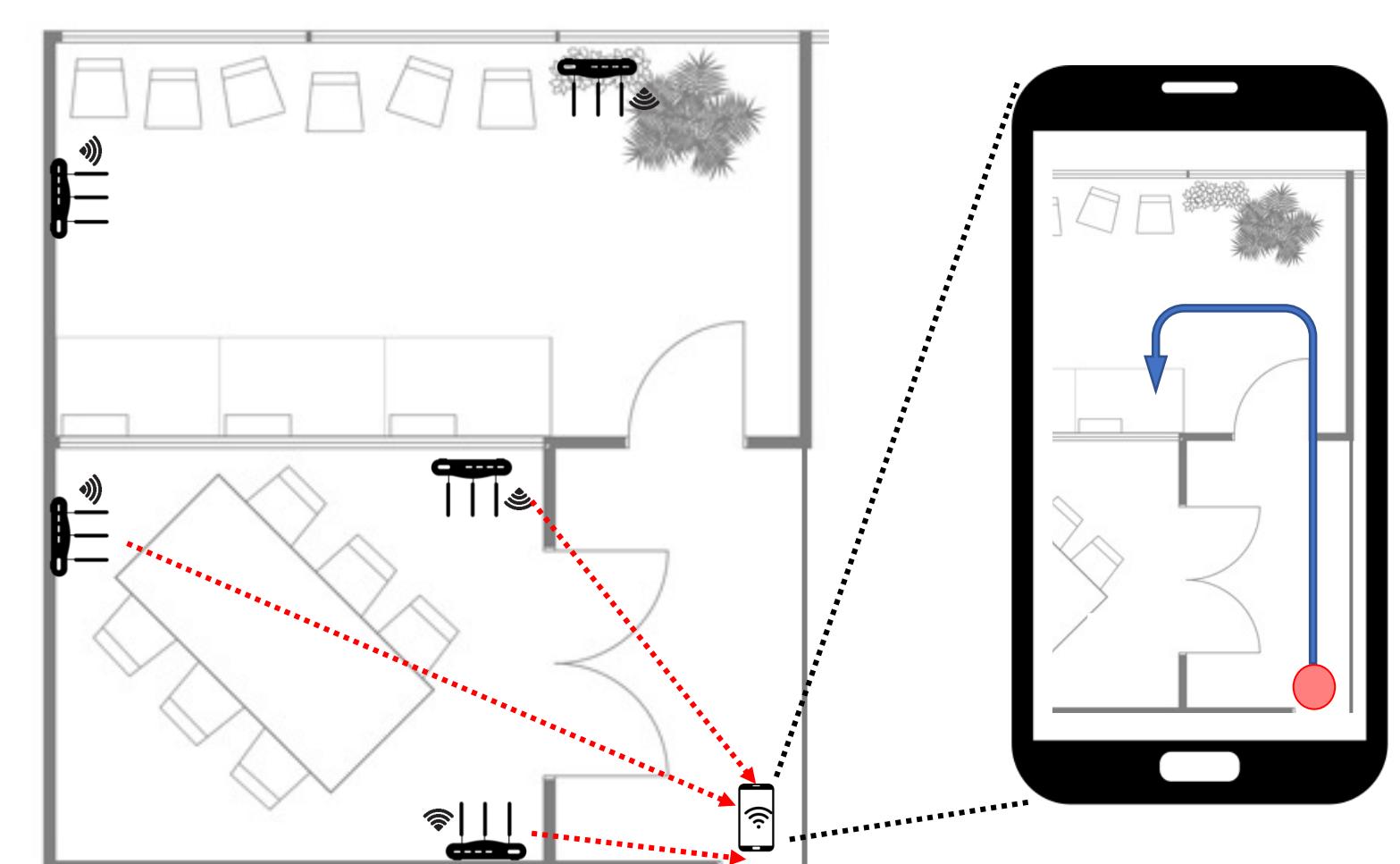
An unknown environment with unknown AP attributes where **LocAP** [1] is deployed



LocAP once deployed determines the AP attributes in the physical map.

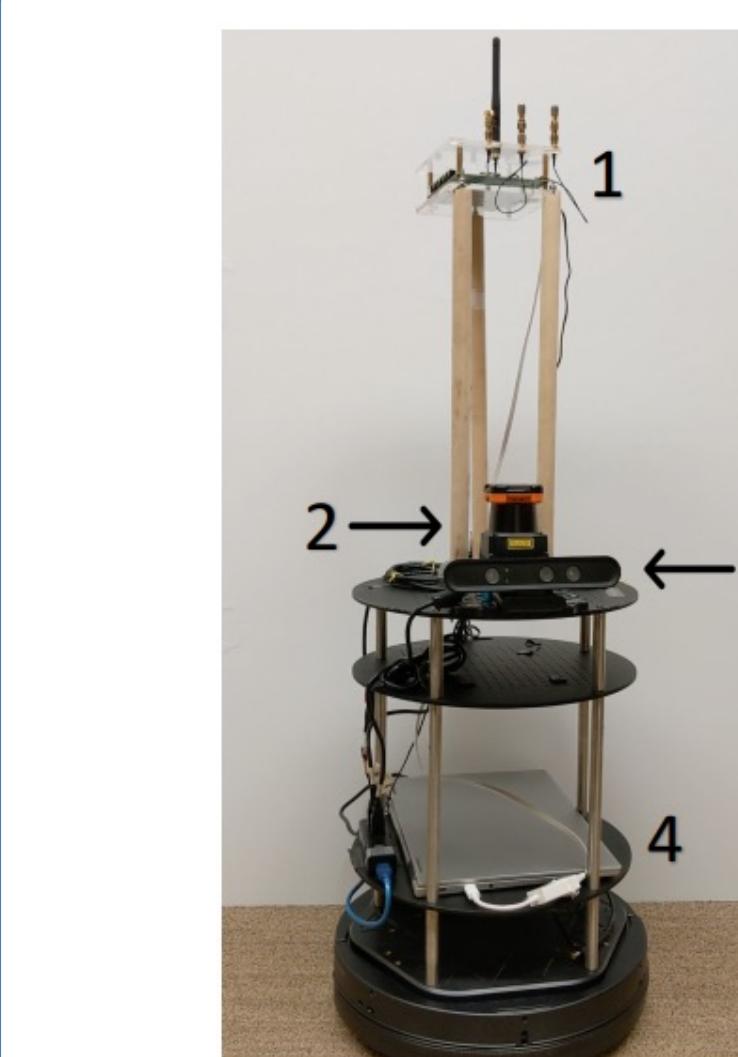


An autonomous platform maps an indoor environment while collecting wireless training data

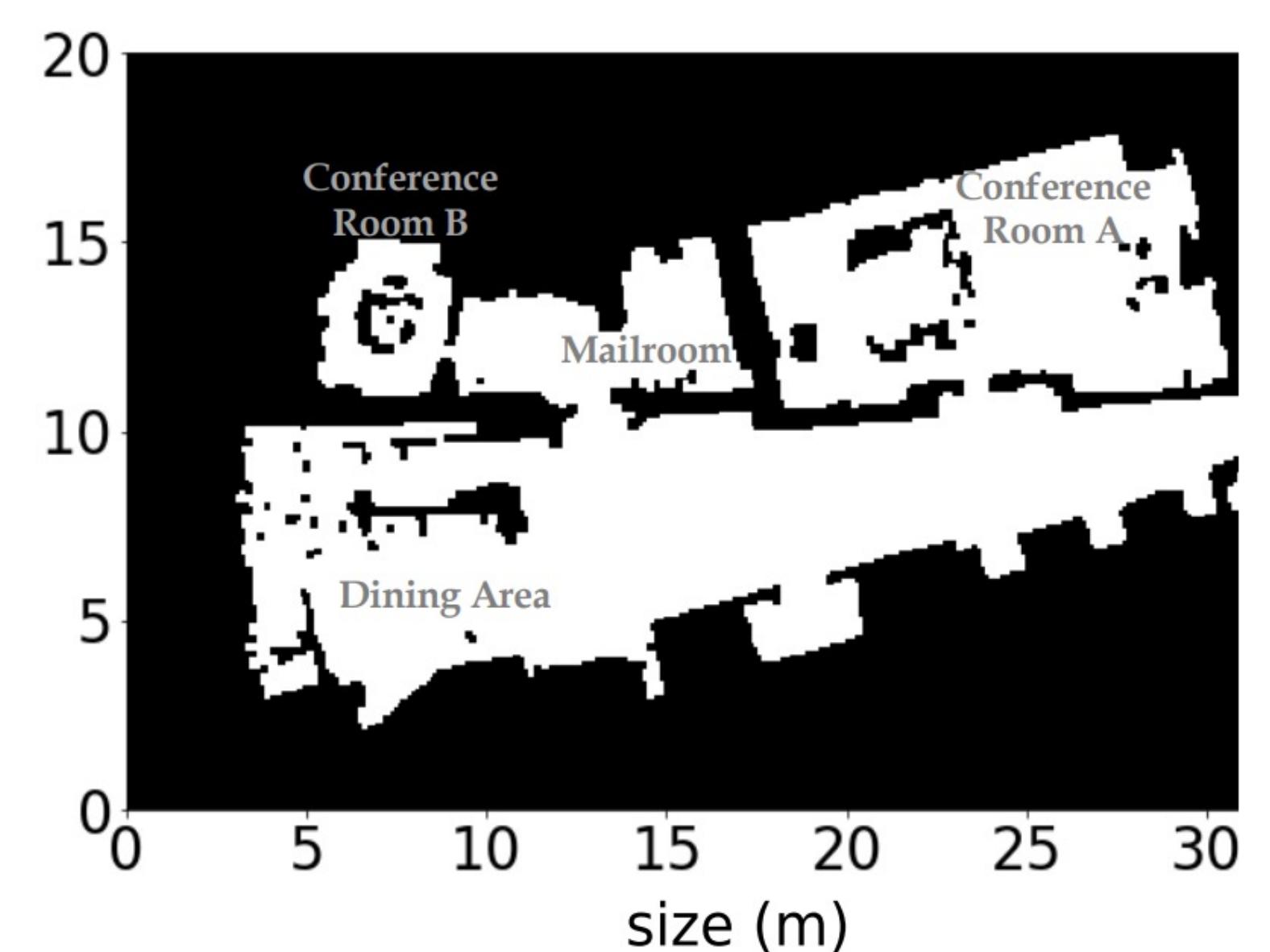


DLoc [2] uses the training data to learn a model and localize users in the generated map.

Implementation

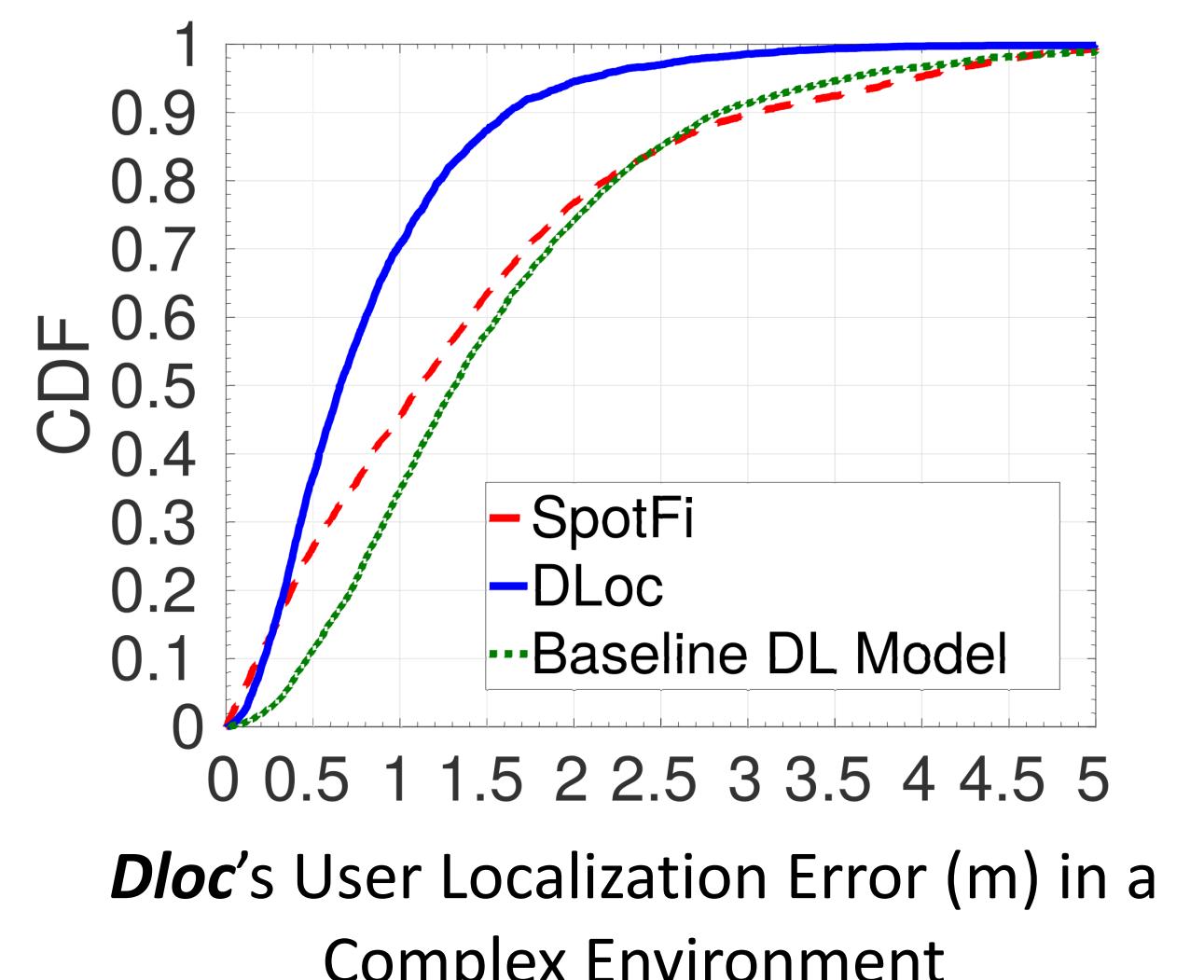
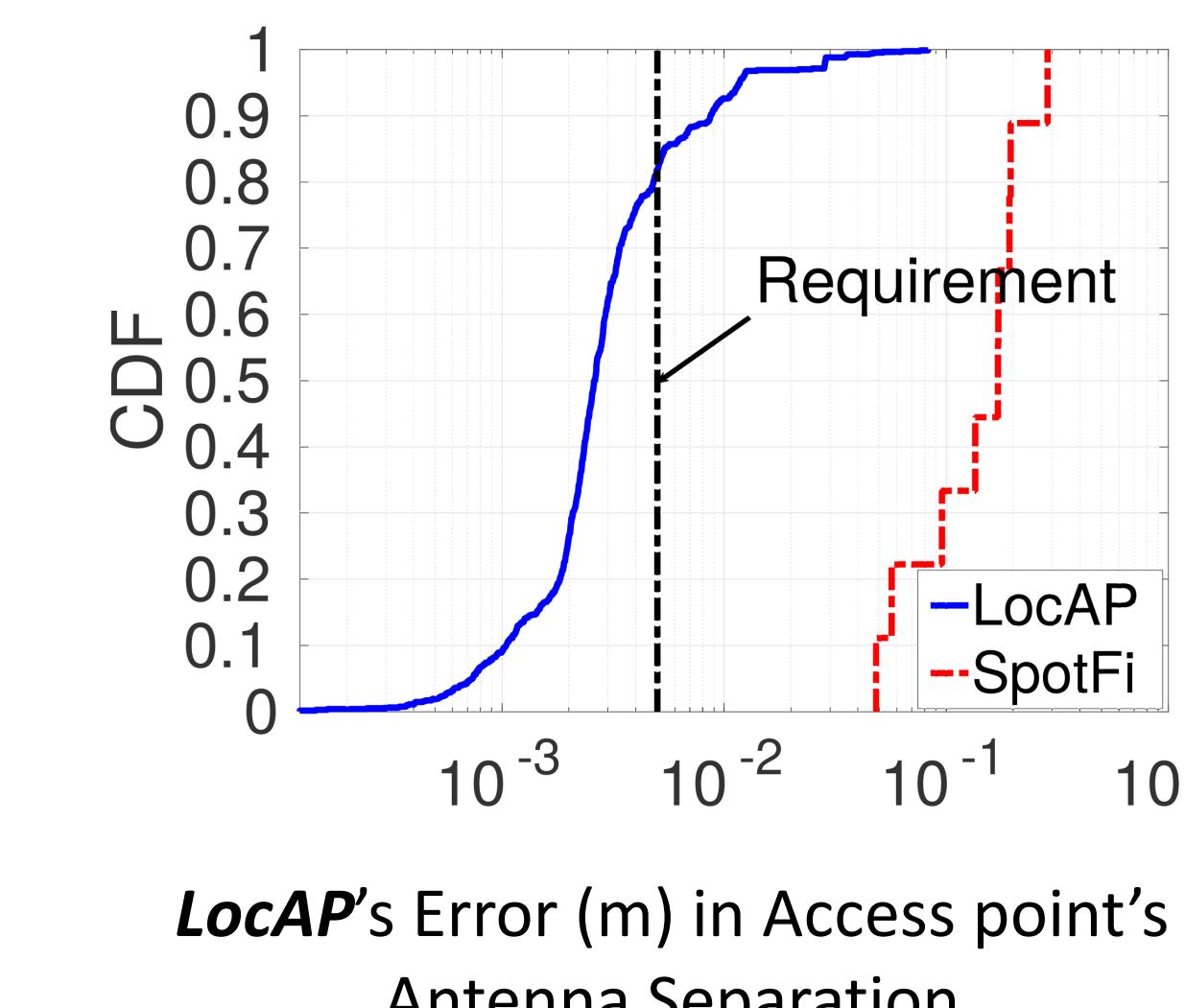


Makeup of our autonomous robot

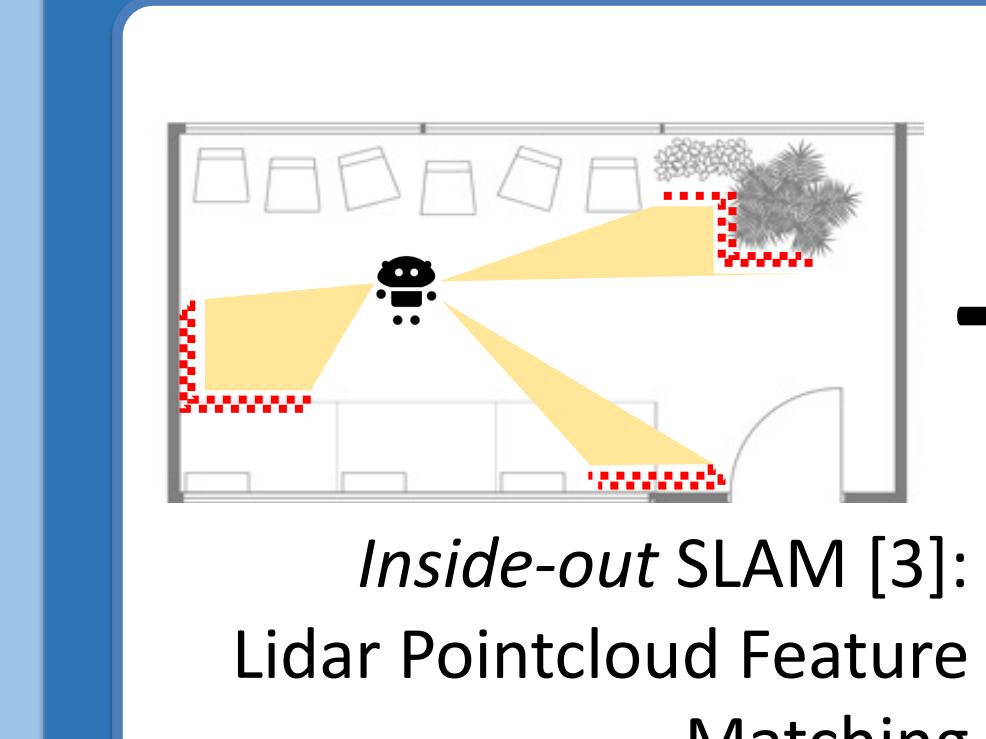


An example of a segmented and labelled map

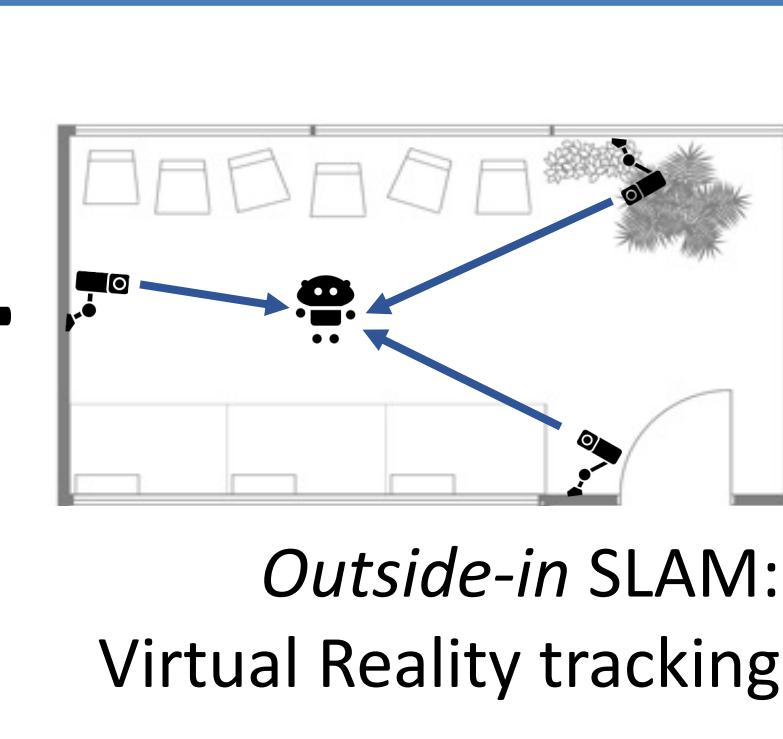
Results



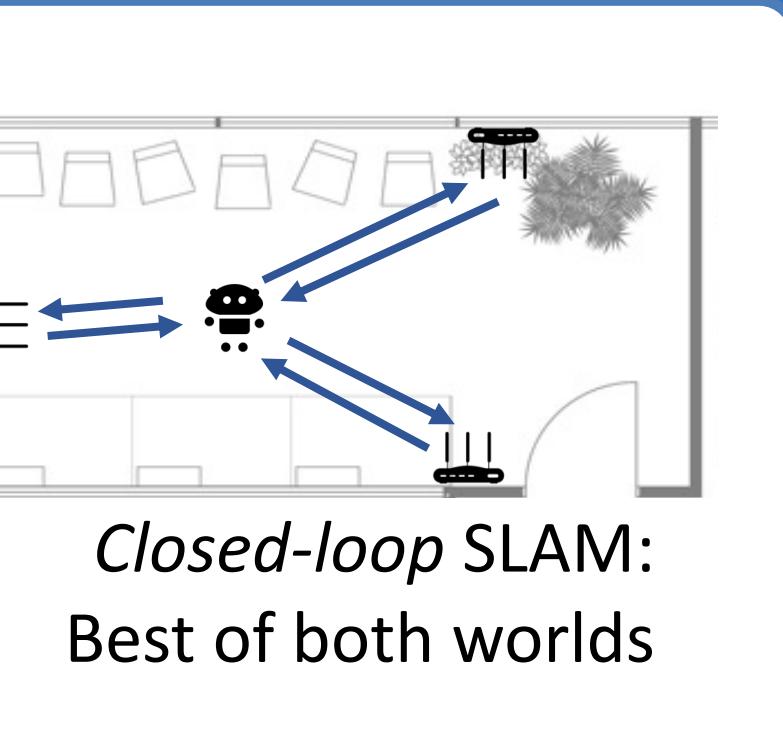
Tandem Deployment



Inside-out SLAM [3]:
Lidar Pointcloud Feature Matching



Outside-in SLAM:
Virtual Reality tracking



Closed-loop SLAM:
Best of both worlds

References:

- [1] Roshan Ayyalasomayajula, et al. "LocAP: Autonomous Millimeter Accurate Mapping of WiFi Infrastructure." 17th USENIX Symposium on Networked Systems Design and Implementation (NSDI '20). USENIX Association.
- [2] R. Ayyalasomayajula, A. Arun, C. Wu, S. Sanatan, S. Abhishek, D. Vasishtha, and D. Bharadia. Deep learning based wireless localization for indoor navigation. In *The 26th Annual International Conference on Mobile Computing and Networking (MobiCom '20)*. ACM, 2019.
- [3] Grisetti, Giorgio, et al. "A tutorial on graph-based SLAM." *IEEE Intelligent Transportation Systems Magazine* 2.4 (2010): 31-43.

