

WiFi Sensing Using Environmental Context

Author : Andriy Teslenko
ateslenko@tudelft.nl

Responsible Professor:
Arash Asadi

Supervisor:
Fabian Portner

1 Background

- WiFi **CSI** captures how the environment changes wireless signals.
- CSI can be used for Human Activity Recognition (**HAR**).
- CSI models often overfit to transmitter/receiver layout.

2 Research Question

Main:

How can spatial geometry be incorporated into WiFi-based Human Activity Recognition models to improve generalization across unseen transmitter/receiver layouts?

3.1 Methodology

Directions

- Use geometry input for context
- Remove layout specific information

DAT Model

- Domain-adversarial training
- Tries to hide Tx/Rx layout from CSI features

PerceptAlign Model

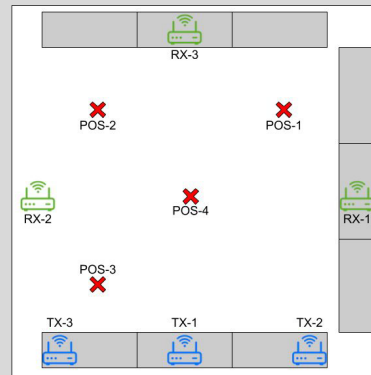
- Adds relative Tx/Rx coordinates

GeoDAT

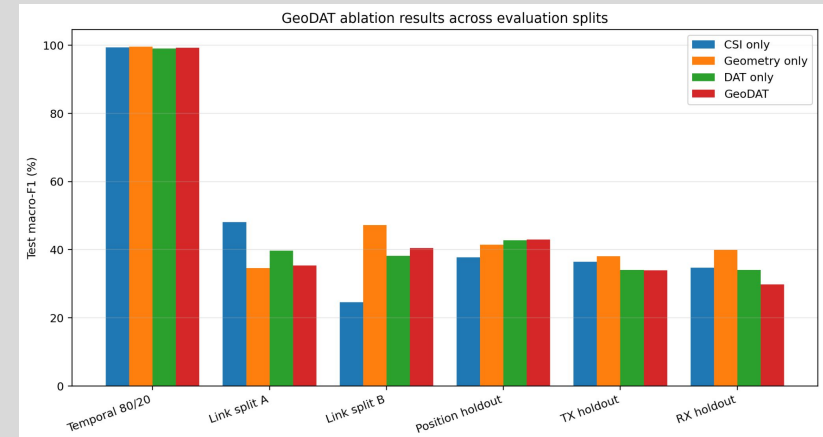
- Controlled ablation model
- Compares CSI only, Geometry only, DAT only, and GeoDAT

3.2 Dataset

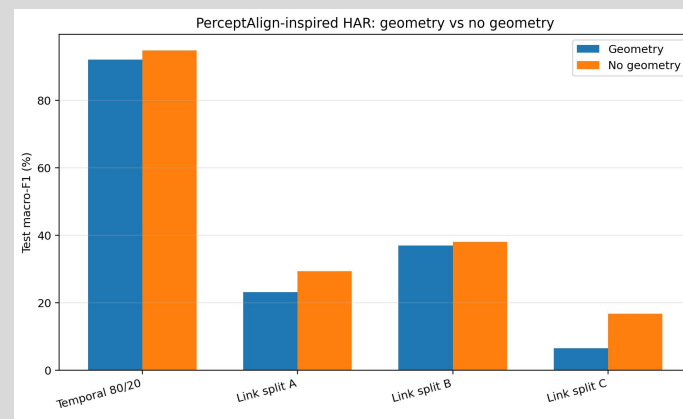
- Dataset collection diagram
- 80/20 split, ABC Links, Holdouts



4.2 GeoDAT Results



4.1 PerceptAlign Results



5 Conclusion

- Within-layout HAR works very well
- Cross-layout HAR remains difficult
- DAT alone does not reliably improve robustness
- Current geometry fusion is insufficient for robust unseen-layout HAR

6 Future Work

- More layouts, rooms, subjects, activities
- Extensive split retraining over all TX/RX pairs
- Further model development
- Evaluating additional Domain-invariant models