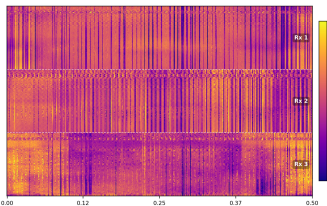


# PIPE: Teaching WiFi Sensing to Ignore Position

## 1. WiFi data: CSI

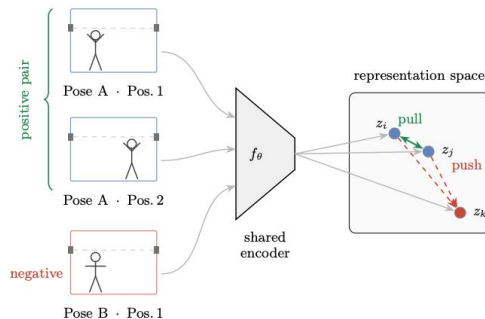
- > **WiFi signals** take many paths from transmitter to receiver.
- > These paths are affected by **room geometry** and the **position & movement** of people.

- > We can measure things about the environment!



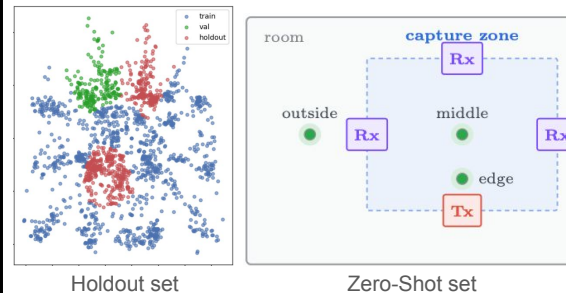
Kenzo Heijman | [k.e.heijman@student.tudelft.nl](mailto:k.e.heijman@student.tudelft.nl)

## 3. Pose Supervision



- > We teach a model to give a similar output for a similar **pose**, regardless of **position**.
- > Can MoCap give better representations vs naive?

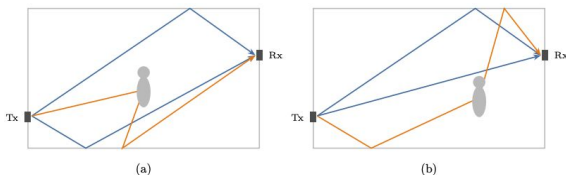
## 5. Evaluation protocols



We test performance on:

- > **Holdout**: same subject, diff. position
- > **Zero-Shot**: diff. subject & position, no adaptation

## 2. Position Dependence

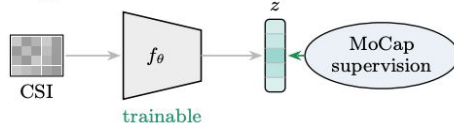


- > The signal seen by a router depends heavily on the subject's **position**, regardless of **pose**.
- > Doing an activity at position (a), and doing the exact same activity at position (b), looks wildly **different** to the receiver!

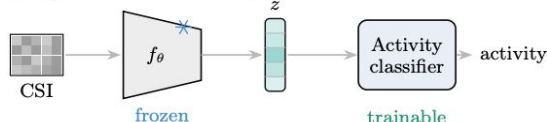
## 4. Approach

- > **PIPE** (Position-invariant pose embedder,  $f_\theta$ ), learns to encode a WiFi signal into a single vector.
- > Evaluate using pre-segmented **activity recognition**

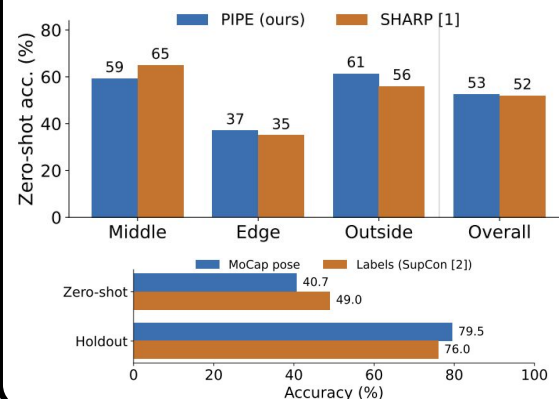
### Stage 1 · Train encoder



### Stage 2 · Train activity classifier



## 6. Results



[1] Francesca Meneghello, Domenico Garlisi, Nicolò Dal Fabbro, Ilenia Tinnirello, and Michele Rossi. SHARP: Environment and Person Independent Activity Recognition with Commodity IEEE 802.11 Access Points. IEEE Transactions on Mobile Computing, 22(10):6160–6175, 2023.

[2] Prannay Khosla, Piotr Teterwak, Chen Wang, Aaron Sarna, Yonglong Tian, Phillip Isola, Aaron Maschiot, Ce Liu, and Dilip Krishnan. Supervised Contrastive Learning. In Advances in Neural Information Processing Systems (NeurIPS), 2020.