

Appendix

A.1

Theorem 1. The weight matrix β in Eq. 8 is equivalent to computing L_1 -normalized K univariate Gaussian probability density functions (PDFs).

Proof. According to Eq. 8 and Eq. 9, a cell β_{ij} of β is defined as:

$$\begin{aligned}\beta_{ij} &= \frac{e^{b_{ij}}}{\sum_l^K e^{b_{il}}} \cdot \frac{e^{0.5\log(2\pi)}}{e^{0.5\log(2\pi)}} \\ &= \frac{\frac{1}{\sigma^{(i)}\sqrt{2\pi}} e^{-\frac{(x-\mu^{(i)})^2}{2\sigma^{(i)2}}}}{\sum_l^K \frac{1}{\sigma^{(l)}\sqrt{2\pi}} e^{-\frac{(x-\mu^{(l)})^2}{2\sigma^{(l)2}}}} \\ &= \frac{p_i^{(j)}}{\sum_l^K p_i^{(l)}}\end{aligned}$$

where $p_i^{(j)} = \frac{1}{\sigma^{(i)}\sqrt{2\pi}} e^{-\frac{(x-\mu^{(i)})^2}{2\sigma^{(i)2}}}$ is the PDF for Gaussian distribution with parameters $\mu^{(j)}$ and $\sigma^{(j)}$. Thus, Theorem 1 holds. \square

A.2

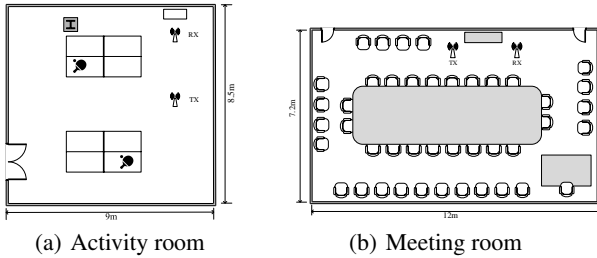


Figure 5: The working scenarios for Activity room and Meeting room datasets.

- **Activity Room** There is a scarcity on publicly available dataset for CSI-based HAR. To make evaluation comprehensive, we develop a prototype system to collect data in different scenarios. In this dataset, the transmitter is a commercial WiFi router (TP-link) and the receiver is a laptop with Intel 5300 NICs. The layout of working scenario is shown in Fig. 5(a). The transmitter (TX) and the receiver (RX) are 4.5 meters apart in an 8.5 meters \times 9 meters activity room, with two table tennis tables as obstacles. During data collection, some subjects may move into or out of this room. We use a 802.11 CSI Tool running on Ubuntu operating system to acquire CSI values over 30 subcarrier and 3 antennas. The sampling frequency on the receiver is fixed at 500Hz (a data point is generated within 2ms). Seven volunteers are asked to perform six activities, *i.e.*, empty, jump, pick up, run, sit down, wave hand, and walk, in a period of 4 seconds. Each activity is performed 100 times. The channel dimension of raw CSI data is fixed to 90 and temporal dimension is fixed to 2000.
- **Meeting Room** The settings are almost identical to Activity Room, except for the working scenario switched to a meeting room. As shown in Fig. 5(b), The transmitter and the receiver are placed 0.9 meters apart installed in an 7.2 meters \times 12 meters meeting room, where furnished with tables and chairs.
- **Activity+Meeting** To validate the robustness of the model under hybrid scenarios, we combine and shuffle both Activity Room and Meeting Room datasets to yield a new dataset Activity+Meeting.

- **Office Room** This dataset was released by the authors in (Yousefi et al. 2017). The hardware devices are a commercial WiFi router (work as a transmitter) and a laptop with Intel 5300 NIC (work as a receiver), both have 3 antennas and 30 sub-carriers. The transmitter and the receiver are placed 3 meters apart in an indoor office area (line-of-sight (LOS) condition). There are six persons involved in data collection. Each person is asked to act seven common daily activities, *i.e.*, lie down, fall, pickup, run, sit down, stand up, and walk, in a period of roughly 20 seconds. There are blank periods at the beginning and end of each activity, indicating the person remains stationary at that time. The sampling frequency is set to 1kHz indicating each data point is generated within 1ms. Each person performs each activity 20 times, and the activities are recorded and the labels are manually labeled. The channel dimension of raw CSI data has a size of 90. The size of temporal dimension is varied, ranging from 15813 to 20000. The size of the dataset is around 17GB.