Aprenentatge Automàtic per a Xarxes (ML4Net)

Seminar 2 - Problem statement

April 9, 2025

Abstract

This time, you will implement a Support Vector Machine (SVM) algorithm that classifies human poses. To do that, you will not use images but instead, Wi-Fi signals. Wi-Fi sensing has recently attracted a lot of attention thanks to the plethora of use cases that can be covered, including positioning, object detection, seeing through walls, measuring vital signs, etc. The dataset that you are going to use in this seminar (`dataset_Seminar2.zip`) contains Wi-Fi signals (in the form of Channel State Information matrix) measured when a person was doing a given pose (e.g., walk, run, sit down, etc.).[1] The goals of this seminar are as follows: (1) understand the Wi-Fi signals (CSI) to be used as features, (2) train and evaluate a classifier based on SVM using the target dataset.

1 Part I: Data preparation & analysis

The provided dataset contains features (CSI matrices) and labels (human poses), which are split into train and test partitions. Apart from that, `SkelletonPoints` are provided to visualize the actual pose captured with a camera. In this first part, you will have to prepare and understand the data that you are going to use to train and evaluate your SVM. Complete the following tasks:

- Create a function/script that takes `SkelletonPoints` as input and plots the corresponding pose. Your plotting function should also display the label associated with the pose being plotted.

- Now, focus on the CSI data (for instance, from `Train_features.csv`) and implement the code for plotting the average CSI amplitude per subcarrier. Such a plot should allow for understanding the status of the channel at a given specific moment and for a specific subcarrier.

- Finally, plot the distribution of the CSI amplitude across each subcarrier for each class.

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[1] Zhou, Y., Xu, C., Zhao, L., Zhu, A., Hu, F., & Li, Y. (2022). CSI-former: Pay more attention to pose estimation with WiFi. Entropy, 25(1), 20.

2 Part II: Model implementation

Once the data to be used are clear, now is the time to implement the classifier based on SVM, so that we can guess the pose of someone simply by analyzing Wi-Fi signals. In particular, you have to:

- Create a module that loads the training data and fits it into an SVM. You can leverage existing libraries that implement SVMs (e.g., pytorch).

- Generate predictions on the test dataset using the SVM trained in the previous step.

- For evaluating the SVM, you should define one or more success rate metrics.