Lab2: Adversarial Localization

Released Jan 28, 2020

Due: Feb 17 and Feb 21, 2020 11:59pm (via dropbox links listed below)

In this lab, you will learn how to localize an WiFi device behind the walls using RSS (Received Signal Strength) data measured by traveling around the device.

This lab has two parts. Part I is data collection using the robotic car. This part requires 1 laptop (you need to bring one) per group. Part II is algorithm design for adversarial localization, which you will do offline.

Part I: You need to collect RSS data traces at at 3 different regions (marked by the TAs). Each of these 3 regions contains a marked trajectory that the robot car will follow to measure the RSS data. The absolute locations of the starting and end points are in **Appendix**. You will need to submit the traces (via dropbox link below by Monday 2/17, 11:59pm, https://www.dropbox.com/request/mVb2kyImC8YygSNhEXqu). The TAs will release the traces from all the groups on Tue 2/18.

Part II: Design algorithms for adversarial localization. Your goal is to locate every WiFi device measured by your robot car by their MAC address. We will provide the location of one anchor device so you can test your algorithm/code. You will design your algorithm to estimate the exact location of the other two WiFi devices (MAC addresses will be provided by the TA at the time of the experiment) Note that your robot car measurements need to include the RSS data from both of these two addresses.

To get credit for this part, you will need to submit your localization result of the two devices. You will also need to submit your code and a document describing your algorithm by Friday 2/21, 11:59pm via the following dropbox link. https://www.dropbox.com/request/wIunLJLzNi7b0XSMKnyQ

Grading: 20% on submitting the RSS data traces, 40% on algorithm documentation and code, 40% on accuracy of localization of the two devices memtioned above.

Step 0: "SSH" to the car

After you connect to the car, open a terminal on your laptop and type:

```
$ ssh stu@192.168.42.1
```

If you are not familiar with this step, check Step 1-3 in lab 1.

Step 1: Create your dataset

When collecting RSS data, you should put the robotic car to one of the marked points and drive it toward another marked point in a straight-line.

To record the activity, under your working directory, run `python record_rss.py` to record one data race, for example:

```
$ python record_rss.py --team=0 --from-to=A12
```

`record_rss.py` accepts two parameters: `--team` is your team number; `--from-to` contains two characters, the start point and the end point. Remember to modify parameters of this command before each time you are going to record.

After you running this command, the car will start moving at a constant speed and you can press '**a**', '**d**' to turn left/right. Once the car reaches the destination, press '**p**' to stop recording and stop driving. Then you will get a file named `rss-team0-1515728861.742783.txt` and also a `.pcap` file which contain the metadata(e.g., *from-to*, *start_time*) and collected RSS data.

After you submit your dataset, we will convert the raw RSS data to a format described in **Appendix**.

Data collection will start 5 minutes after the beginning of your time slot. You will collect data at each region for 5 minutes. After 5 minutes of collection, you will go to next region to collect data.

After you recorded all the data segements you need, run following command to compress them into one file:

```
$ tar -cvf rss-dataset-teamX.tar rss*.txt *.pcap
```

Step 2: Transfer the dataset to you laptop

While connected to the robotic car, use `scp` to transfer files between your laptop and the robotic car.

Open a terminal on your laptop, run:

```
$ scp stu@192.168.42.1:~/teamX/rss-dataset-teamX.tar DESTINATION
```

Substitues `DESTINATION` for path of a folder on your laptop.

A full example:

```
$ scp stu@192.168.42.1:~/team0/rss-dataset-team0.tar ~/Downloads
```

After running this command, `rss-dataset-team0.tar` should appear in `~/Downloads` on your laptop. **Double check your laptop before you leave the lab.**

Step 3: Submit your dataset

Send your dataset to dropbox link https://www.dropbox.com/request/mVb2kyImC8YygSNhEXqu

This allows us to collect datasets from all the teams to form a big dataset and put it on Piazza, so you can have more data to play with. We will also convert the raw RSS data to a format described in **Appendix**.

Step 4: Localize WiFi devices

You can refer to Adversarial Localization against Wireless Cameras, HotMobile 2018 for one possible method. Other methods are also accepted.

Submit your report on the localization algorithm and your code, together with the localization result to the following dropbox link

https://www.dropbox.com/request/wIunLJLzNi7b0XSMKnyQ

Appendix

RSS data format

Each data segment is a list, and each element of the list is a dict contains `mac`: MAC address, `RSS`: rss (*dBm*), `time`: timestamp.

A full example:

```
[{'time': 1515728861.742783, 'mac': '8c:85:90:16:0a:a4', 'rss': '-27'}, {'time':
1515728862.852683, 'mac': '8c:85:90:16:0a:a4', 'rss': '-28'},
{'time': 1515728863.683245, 'mac': 'c8:53:05:14:ee:32', 'rss': '-40'}]
```

Note that the hotmobile 2018 paper (and see 1/28 lecture) provided a propagation model based localization method. It requires you to calculate the absolute location of each measurement point (i.e. each point on the trajectory where you collect the data). Since we configure the robot car to travel at a constant speed, you can calculate the location of each measurement point by its timestamp and the vehicle travel speed.

Specifically, in each trace, the car is running from marked points A to B at a constant speed v, and the coordinates x_A, x_B of A, B are given in the floor plan. Given t_A, t_B in the trace when the car is at A, B, you can compute the speed of the car: $v = \frac{x_B - x_A}{t_B - t_A}$. Then you can compute the coordinates of each timestamp in the data segment and its Mac Address as well as RSS. You will use the list of `(coordinates, mac, rss)` to do the localization.

Floor Plan

Note: It will be measured and released on Feb. 3rd.