End-to-end Learning Systems in WiFi Localization

Broader Impacts and the Challenges

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1 Indoor Localization

Since there is no GPS, so other source of information should be used for localizing the objects.

2 WiFi Signal in Localization Purposes

Since WiFi has become ubiquitious, it started being utilized in different applications varying from customer tracking indoors to robot localization along with communication purposes. However it is available, the information can be extracted from is suffers from being sparse and severely effected by the layouts of environments where WiFi based systems are deployed. Thus, it is a great challenge to use this source of information in localization purposes due to the fact that the localization problems require to have higher level of success in localization accuracy and shorter localization time.

3 Summary of The Proposed System

This research proposes a localization system with WiFi signal where a machine learning algorithm is used to infer where the object(s) of interests are in a given environment. Similar to the most of the conventional systems proposed earlier, the proposed system is based on the fingerprinting technique where some properties of WiFi signal is obtained in offline stage. The collected data are then used for localization during online stage. The main contribution of this research is that the proposed technique can handle sparse, noisy RSS measurements acquired from the off-the-shelf AP's under LoS and NLoS situations, while achieving comparable localization accuracy to thes state-of-the-art methods by utilizing a state-of-the-art machine learning technique to fully exploit the avaliable information.

4 Broader Impacts

The research is mainly focusing on using solely WiFi information to localize the object of interest in an environment. Thus, it is important to note that the research does not require any additional hardware than WiFi infrusracture. One may realize that this compact design makes it easier to deploy the system various applications with different hardware setups.

The proposed system, on the contorary to a major part of current research trend, this research requires no additional hardware. Two common sensor suits which have been employed for localization problems are LiDAR and cameras. However, there are various concerns for these sensors. Cameras and LiDARs, for instance, are limited to Line of Sight (LoS) measurements to infer where the sensor suit is located. On the other hand, it is possible to extract information with WiFi beyond physical limits where optical sensors cannot, such as behind walls and other obstruction sources. Thus, using information from an unconventional source which can extract information beyond such physical contraints would increase our knowledge about the environment.

Another implication of having no additional sensors is that the system can be easily deploy to variety of hardware infrasracture from embedded devices, Internet-of-Things (IoT) to sophisticated robotic systems. For instance, the proposed system can be deployed to drones where the feasibility of operations heavily depend on the payload limits. Considering that, LiDAR sensors would not be a good choice for the mentioned example. The last implication is that deploying the proposed system in large scale costs significantly lower than the sophisticated sensors would. It is typical, for instance, to expect large volume of forklifts in the industrial manufactoring, or product storing area. It would cost significantly more to employ LiDAR systems than the proposed system.

5 The Challenges

Even though the WiFi infrasracture is widely available in indoor environments, the information we can extract for the localization is subject to different challenges. This section we will address the challenges posed by WiFi signal.

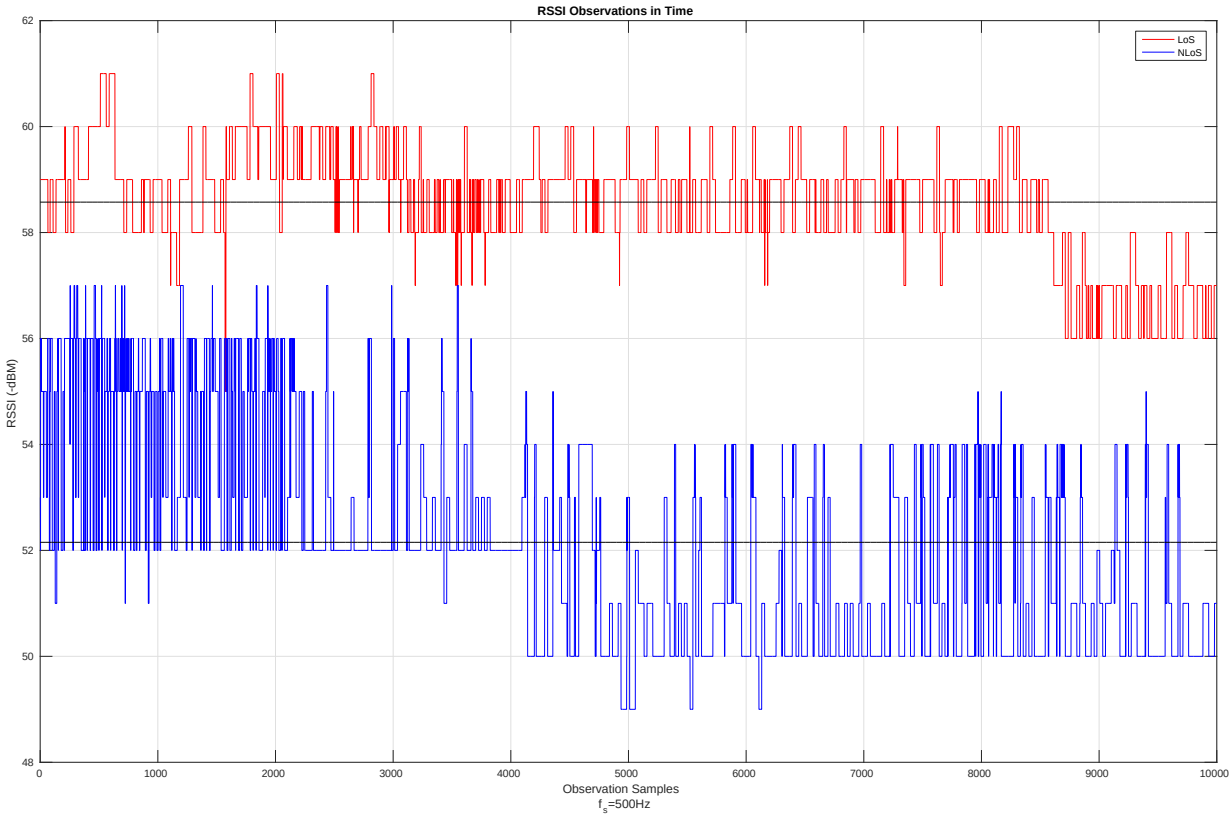

Figure 1: RSSI readings of NLoS and LoS AP's acquired with a stationary agent