Comparison of WiFi RSSI Filtering Methods

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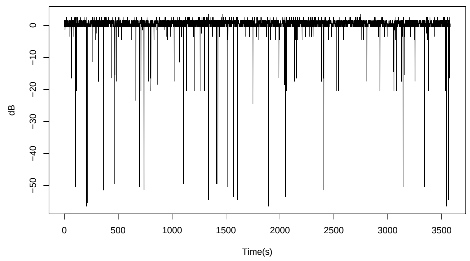
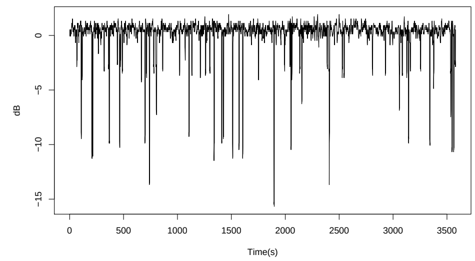
Indoor Positioning Systems have gained attention in the last decade. WLAN is one of the most popular technology among fingerprinting based Indoor Positioning Systems. RADAR was the first fingerprinting based system that recorded the WIFI RSSI value at known location. The HORUS system [1, 7] is location determining system [3] based on the IEE 802.11b WiFi connection. It showed that using time series instead of single values increases accuracy of indoor positioning algorithms. The system used a simple filter which was taking the average of the measurements.

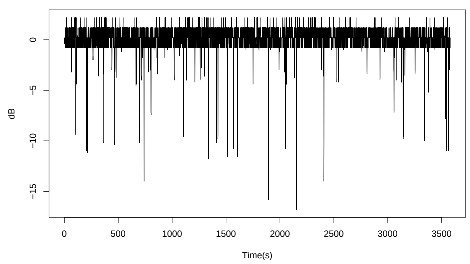
The applied use of filters [5] as preprocessing algorithms on ongoing measurements to separate data from noise is an important research area. The usage of such filters [2] can provide a data set free of inconsistencies. The filtered data can be used to accurately describe a location. This paper focuses on the analysis of time series [8] of WiFi RSSI measurements. The analysis of the time series could lead to the development of an efficient client site filtering method for indoor positioning systems [4, 6]. The Wifi RSSI values were recorded in order to perform the efficiency analysis of the Filters. The recording took place in the University of Miskolc's Institution of Information Science, Department of Information Technology. The values were used to create a data set in order to test the filters. The paper focuses on the comparison of three different filtering methods. The first filter is HORUS' algorithm which takes the average of the last m values where m is the memory size. The second filter is also based on time windowing but it has two parameters threshold and a memory size. The algorithm calculates the total difference of the values in the memory. If the sum exceeds the threshold, then the current value is replaced by the average of the values in the memory. The third filter differs from the second one because it calculates the threshold dynamically. Thus, this filter requires less parameters and could be more adaptive. These filters were tested and compared over the prerecorded dataset. R was used to implement the tested filtering methods that results are shown in Figure 1. These line charts show how the RSSI values (dB) changes over a time (s) period. Figure 1(a) shows the unfiltered dataset that range was up to -60 dB. The HORUS' filter could decrease the range to -15 dB that is shown in Figure 1(b). Moreover, the filtered RSSI values become real number due to the usage of average function. Figure 1(c) shows the results of the filter that uses a predefined threshold. The filtered values are not necessarily replaced with the average so the measured values can be contained in the yield data. So this method can be used to eliminate the random observation errors caused by temporal events. Figure 1(d) presents the results of the time windowing with dynamic threshold. However this method have larger range than the previous filters, but it depends on only one parameter which eases its usage. The presented comparison of filtering methods allows us to create efficient client side filtering to improve stability of the measured RSSI values. The filters create a more stable series where the range of values is reduced. Usage of client side filtering can improve the accuracy of the Indoor Positioning System. These filters will be implemented on Android platform in order to test them in real life scenarios and to test their effect on the ILONA system.



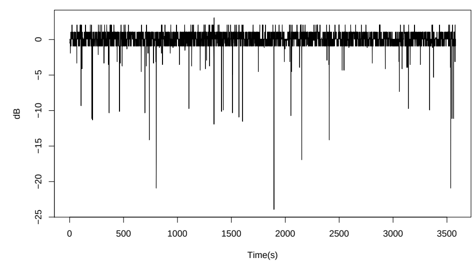
(a) Unfiltered Values



(b) HORUS filter



(c) Windowing with constant threshold



(d) Windowing with dynamic threshold

Figure 1: Results of the tested filtering methods

References

[1] The horus wlan location determination system. *https://www.usenix.org/legacy/publications/library/proceedings/mobisys05/tech/full_papers/youssef/youssef_html/index.html*.

[2] Properties of indoor received signal strength for wlan location fingerprinting.

[3] Artur Baniukevic, Christian S Jensen, and Hua Lu. Hybrid indoor positioning with wi-fi and bluetooth: Architecture and performance. In Mobile Data Management (MDM), 2013 IEEE 14th International Conference on, volume 1, pages 207-216. IEEE, 2013.

[4] Yongguang Chen and Hisashi Kobayashi. Signal strength based indoor geolocation. In Communications, 2002. ICC 2002. IEEE International Conference on, volume 1, pages 436-439. IEEE, 2002.

[5] Rudolph Emil Kalman. A new approach to linear filtering and prediction problems. Journal of basic Engineering, 82(1):35-45, 1960.

[6] Richárd Németh Judit Tamás Zsolt Tóth, Péter Magnucz. Data model for hybrid in-door positioning systems. Production Systems and Information Engineering, 7(1):67-80, 12 2015. HU ISSN 1785-1270.

[7] Moustafa Youssef and Ashok Agrawala. The horus wlan location determination sys-tem. In Proceedings of the 3rd international conference on Mobile systems, applica-tions, and services, pages 205-218. ACM, 2005.

[8] William Wu-Shyong Wei. Time series analysis. Addison-Wesley publ Reading, 1994.