Matt Buland
1/26/2014
Homework #2.B
Hours worked on: 2hrs

Response To:
A. Overeem, H. Leijnse, R. Uijlenhoet, Measuring urban rainfall using microwave links from commercial cellular communication networks, Water Resource Reseach, 47, W12505, 2011.
http://onlinelibrary.wiley.com/doi/10.1029/2010WR010350/abstract

Summary

In this paper, the subject of using attenuation in microwave communication to estimate rainfall is explored. The mathematical properties of microwaves in rain are explained, an algorithm for determining rainfaill from this attenuation is created, and a comparison with measured railfall is made.

Goal

The goal of this paper is to explore the accuracy seen by measuring rainfall using microwave communications. If the result is successful, the measurement technique would not serve as a full replacement for measuring rainfall, but an aggregation or correction would be added to current measurement techniques, enhancing the accuracy in rainfall measurement.

Do

Using microwave connections greater than 1km, and with an accuracy of 0.1dB and 10Hz sampling as the means of data gathering, a method of estimating the intensity of 15-minute rainy periods using attenuation on the radios was developed. Starting with a dry-weather reference signal strength, the minimum and maximum specific attenuation for the 15-minute time-period are calculated, and the estimated rainfall is derived from the specific attenuation difference, length of the transmission, heaviside equation, and attenuation contribution constants. Alpha, one of the coefficients, may be derived from the length of the transmission, and thus the frequency as well, which is why frequency isn't directly taken into account for the rain estimator. These coefficients were calculated for each frequency class, since different attenuation is experienced depending on the frequency. A simulation was done from the research link data gathered to show the viability of the attenuation-derived rainfail estimation.

Results

The comparison of simulated results to actual gathered data had a strong result. The correlation was certainly there, but there was relatively significant error seen: 19-33% bias. The author attributes some of this bias to the chosen coefficients. Since they were calculated from only a few sets of data in one area, there may be a bias with them, having them act as a more serious source of error. The author's recommendation is to investigate further on the accuracy of these coefficients, and evaluate their accuracy.

Field Impact

This paper takes a look at the usefullness of time-based attentuation statistics with a specific application to rain-fall. It highlights the number of variables that can be seen with radio communication; something that all wireless networks needs to be aware of. However, it also takes a look at the usefulness of displayed electromagnetic properties in data collection and environment evaluation.

Discussion

This paper initially caught me off guard: I assumed that a wireless sensor network would be deployed with forms of rain-collection techniques. However, the paper evaluates the usability of pure frequency-level collected data. It makes me wonder how many other environmental properties can be extracted from the other forms of radio communication. Also, how would object and environmental status effect localization? If there were a microwave network with localization algorithms implemented, how drastically would rain effect the algorithm? What if Xbee radios were used? This paper isn't particularly dated: the properties of rain on microwaves will always remain the way they are. This research will always be viable with the effects of water on microwave communication.