CSE 4215 :: Lab 1
Multipath Propagation

Issued March 23, 2009; Due April 9, 2009 (Revised April 6, 2009)

In this lab, you will explore the features of plane-earth multipath propagation.

Assume that the transmitting antenna is located at height h_T, the receiving antenna is located at height h_R, the antennas are distance d apart, and the signal is a pure sinusoid at carrier frequency f_c. Two paths are incident on the receiving antenna: the direct path and the ground-reflected path, where the reflection coefficient R is equal to -1.

Prepare a lab report answering all of the following questions. Ten percent of your lab grade will be awarded for the quality and clarity of your writing.

1. Show that the amplitude of this signal is given by $2 \sin(\pi f_c(d_1-d_2)/c)$, where d_1 is the length of the direct path between the two antennas, and d_2 is the length of the ground-reflected path.

2. Express d_1 and d_2 in terms of h_T, h_R, and d. Explain your expression.

3. Let h_T = 10m, h_R = 2m, and f_c = 1 GHz. Using MATLAB (or the method of your choice), plot the *absolute value* of the amplitude of the signal with respect to d on a log-log scale, for $1m \leq d \leq 100000m$. (Hint: in MATLAB, use the command loglog).

4. For the plot you produced in question 3, you should see several "deep fades". What causes these? At what distance does the last "deep fade" occur, and why is this the last one (before $d=\infty$)?

5. For the plot you produced in question 3, at what point does the O(1/d) behavior take over? Explain. (Hint: First try plotting y = 1/x on a log-log scale, to see how this expression behaves.)

6. Repeat parts 3, 4, and 5 for various values of f_c. Draw a general conclusion about the effect of f_c on plane-earth path loss, and explain your conclusion.

7. Returning to f_c = 1 GHz, repeat parts 3, 4, and 5 for various values of h_T. Draw a general conclusion about the effect of h_T on plane-earth path loss, and explain your conclusion.