KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-543 – Mobile Computing and Wireless Networking
Assignment 1 – Due March 21st, 2010.

Problem 1 (30 points):

The Mobile WiMAX community recommends the usage of the ITU model for modeling multipath for performance evaluation purposes of the Mobile WiMAX system. The model is specified by the following profiles:

Environment	Tap	Channel A			Channel B		
		Relative delay (ns)	Average Power (dB)	RMS (ns)	Relative delay (ns)	Average Power (dB)	RMS (ns)
Indoor office	1	0	0	35	0	0	100
	2	50	-3.0		100	-3.6	
	3	110	-10.0		200	-7.2	
	4	170	-18.0		300	-10.8	
	5	290	-26.0		500	-18.0	
	6	310	-32.0		700	-25.2	
Outdoor to indoor & pedestrian	1	0	0	45	0	0	750
	2	110	-9.7		200	-0.9	
	3	190	-19.2		800	-4.9	
	4	410	-22.8		1200	-8.0	
	5	-	-		2300	-7.8	
	6	-	-		3700	-23.9	
Vehicular	1	0	0	370	0	-2.5	4000
	2	310	-1.0		300	0	
	3	710	-9.0		8900	-12.8	
	4	1090	-10.0		12900	-10.0	
	5	1730	-15.0		17100	-25.2	
	6	2510	-20.0		20000	-16.0	

1) **(10 points)** For channel B, verify that the RMS delay spread figures for the indoor office, pedestrian, and vehicular profiles are equal to 100 ns, 750 ns, and 4000 ns, respectively. Estimate the coherence bandwidth for these channels.

2) **(10 points)** Plot the multipath intensity profile function for channel B (pedestrian).

3) **(10 points)** Focusing on the channel B (pedestrian), one can use the Matlab function "rayleighchan()" to model a multipath channel. The following code is used to model the required channel.

```
0001 clear all
0002 N = 2000; %number of samples;
0003 OFDMA_Symbol_Time = 102.9e-6;
0004 Tsample = OFDMA_Symbol_Time;
0005 Fdoppler = 10;
0006 PathGainsdB = [0 -0.9 -4.9 -8.0 -7.8 -23.9];
0007 RelativeDly = [0 200 800 1200 2300 3700]*1e-9; % in nano seconds
0008 c = rayleighchan(Tsample,Fdoppler, RelativeDly, PathGainsdB);
0009 sig = j*ones(N,1); % Signal
0010 y = filter(c,sig); % Pass signal through channel.
0011 c % Display all properties of the channel object.
0012 % Plot power of faded signal, versus sample number.
0013 plot(Tsample*[0:1:N-1],20*log10(abs(y)))
```

In the above code, the signal envelope is sampled every `Tsample` time. The code selects the OFDMA symbol time of 102.9 micro seconds as the sampling time. Since the code generate `N` equal to 2000 samples, then the code produces a trace of the channel fading envelope for a duration of $2000*102.9 \times 10^{-6} = 0.218$ seconds. The code plots the power of the signal

envelope in dB. Remember the power of the signal envelope is proportional to the square of the absolute value of the signal level.

Plot the signal power for three different value of the `Fdoppler` parameter: 1 Hz, 10 Hz, and 100 Hz. Put all three resulting curves on one plot and *comment* on the result in terms of speed of variation of the signal level or power. Estimate the coherence time for *all* three Doppler values.

References:

Overview of Fading Channels:: Channels (Communications Toolbox) – Matlab online help.

Textbook Problems:

2.2 (10 points) – assume hm = 2 meters while hb = 30 m. Which model provides better prediction and why?

2.4 (10 points) (but for 90% coverage and 8 dB standard deviation),

2.9 (10 points): parts (a) and (b) only, and

2.11 (10 points) – CANCELLED (given in Quiz 1)

Textbook Questions: Note these are the question set and NOT the problem set. Be very brief and concise in your answers. **Not more** than few lines are expected per question. Each question carried the weight of 5 points.

2.3, 2.5, 2.10, and 2.13.