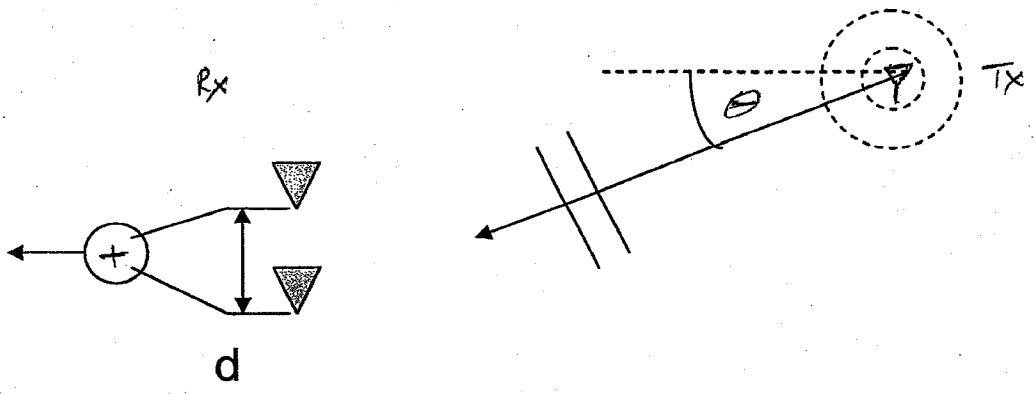
Quals Question – 2007
Prof. A. Paulraj

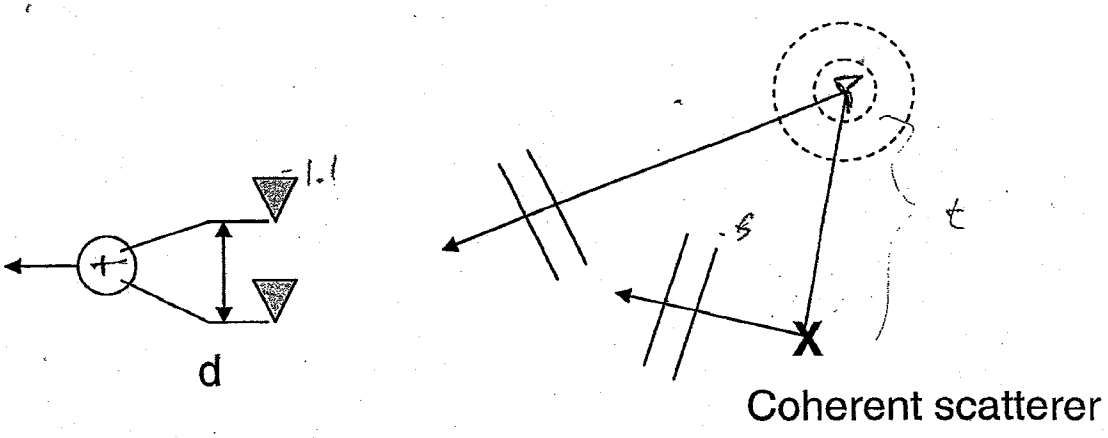
Consider a receiving antenna array with 2 omni directional elements and a beamformer that combines the antenna outputs (equi-phase: ie no phase shifts). Let a planar CW wave front impinge on the antenna array at angle θ



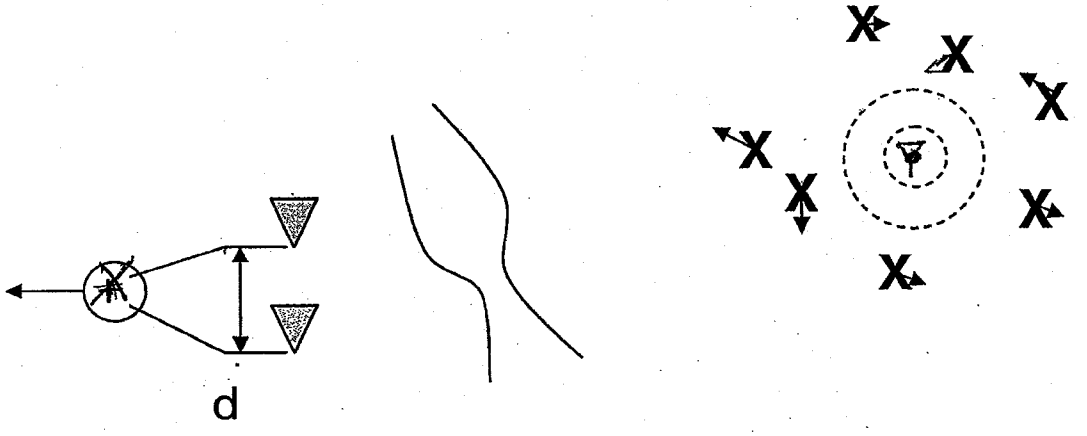
Questions:

1. If $d = \lambda/2$, what is the beamformer response as a function of the angle of arrival

2. If $d = 5\lambda$, what will be the new beamformer response



3. How will the beamformer response be different now ?



4. If the wave front is scattered by random and incoherent scatterers, what will the beamformer response be like.

5. What will the beamformer output waveform look like

6. What is the concept of antenna correlation and how does it depend on the angle spread of the scatterers

Quals Question – 2008
Prof. A. Paulraj

Consider y(t) a sum of three (A, B and C) continuous sine (or CW) waves

$$y(t) = a1 \sin(2\pi f1\, t + p1) + a2 \sin(2\pi f2\, t + p2) + a3 \sin(2\pi f3\, t + p3); \quad t = [0, 1] \text{ sec}$$

Let f1 = 2 , f2 = 4 and f3 = 3.3 Hz/ Sec

Questions:

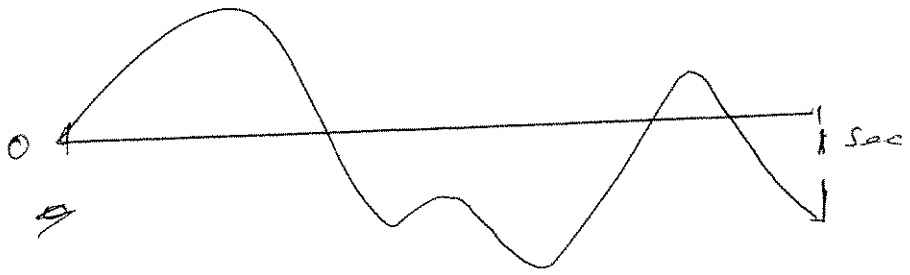
1. Sketch y(t) if a1= a2= 1 v and a3=0. p1=p2=p3=0 degrees

2. Sketch y(t) if a1= 1 v, a2= 0.5 v and a3= 0.5 v. p1= 0 , p2= 90 and p3=180 degrees

3. If a1 = 1 v and a2=a3= 0 v, how can you picture this signal in the frequency domain, can you device a some kind of Fourier transform (say DFT ?) that will reveal the frequency information properly

5. Now if all three sine waves are present (say a1= 1 v, a2= a3= 0.5 v. p1= 0 , p2= 90 and p3=180 degrees) what will your Fourier domain picture look like.

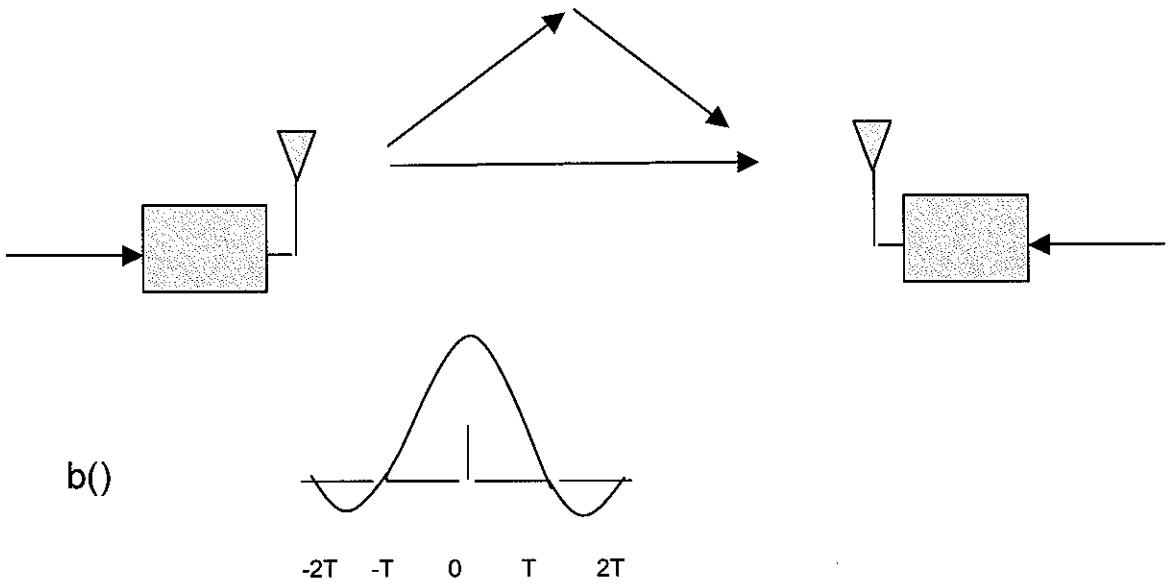
6. Given a waveform below of the class of y(t) (ie different frequencies, amplitudes and phases), how can we estimate the frequencies of these component sine waves.



A. Paulraj

PhD Oral Exam 2009

1. Given a digital transmission link and a multi-path environment shown. Let $s(t)$ be the transmitted signal. $s(t)$ is a sequence of BPSK modulated pulses, each pulse is $b(*)$ is sent at intervals T and is sent either as $+b(*)$ or $-b(*)$ for +1 or -1 resp.



Questions

1. Sketch a random sample Tx sequence $s(t)$

2. Let Rx signal be

$$y(t)=\sum a_i s(t-\partial_i)+ n(t)$$

Sketch $y(t)=\sum a_i s(t-\partial_i)$

If there is only path $a_1=1, a_2=0; \partial_1=0, \partial_2=T/2$,

If there are two paths $a_1=1, a_2=0.5; \partial_1=0, \partial_2=T/2$

3. How can we detect the Tx data bits +1 or -1 given $y(t)=\sum a_i s(t-\partial_i)+n(t)$

4. What is equalization?

5. If $a_1=1, a_2=0.5; \partial_1=0, \partial_2=T/2$ design a equalization filter

6. If $a_1=0.5, a_2=1; \partial_1=0, \partial_2=T/2$, design a equalization filter