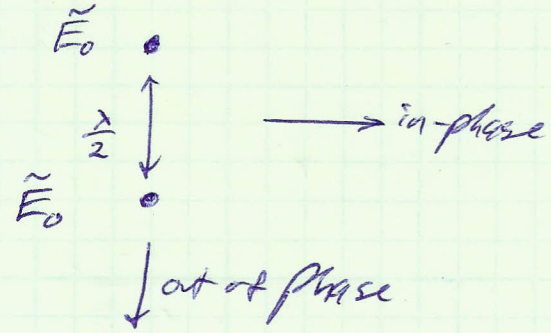
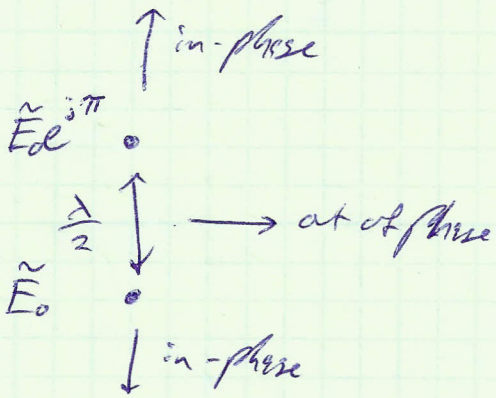
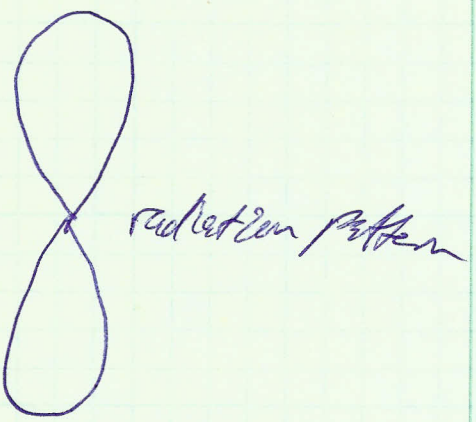
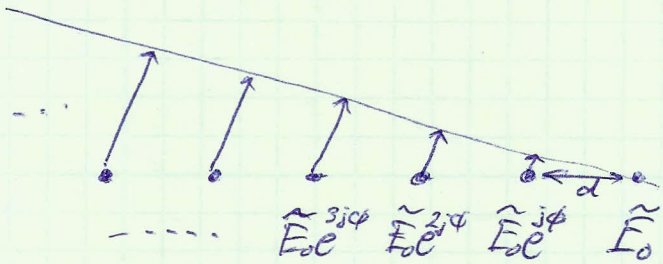
Phased Array Antennas

two-element array

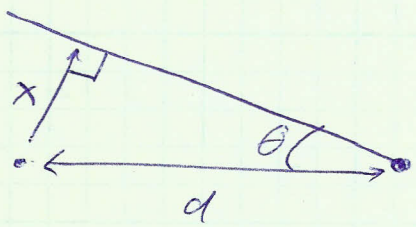








n-element array



$x = d\sin\theta$

$kx = \phi$

$\phi = kd\sin\theta$

True time Delay phased arrays

$\phi = kd\sin\theta$

only produces θ for the correct value of k

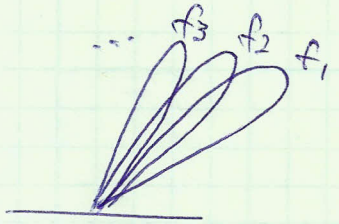
→ narrow bandwidth, beam squint

for very broadband arrays, TTD is used

$\phi = \frac{2\pi}{\lambda} d \sin\theta_d$ "θdesired" or "θdesigned"

$\phi = f_d \frac{2\pi}{c} d \sin\theta_d$ f_d = design frequency

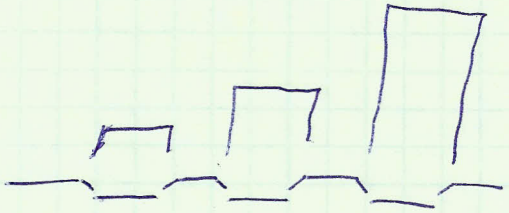
$\theta = \sin^{-1}\left(\frac{c\phi}{f 2\pi d}\right)$ → θ will change with frequency



beam squint limits the useful bandwidth of the antennas

For true time delay, phase is replaced by time (distance) delay or a phase delay that varies with frequency to produce constant beam angle

Typical switched delay phase shifter:



each successive delay is twice as long as the previous

n-bit phase shifter requires 2n switches