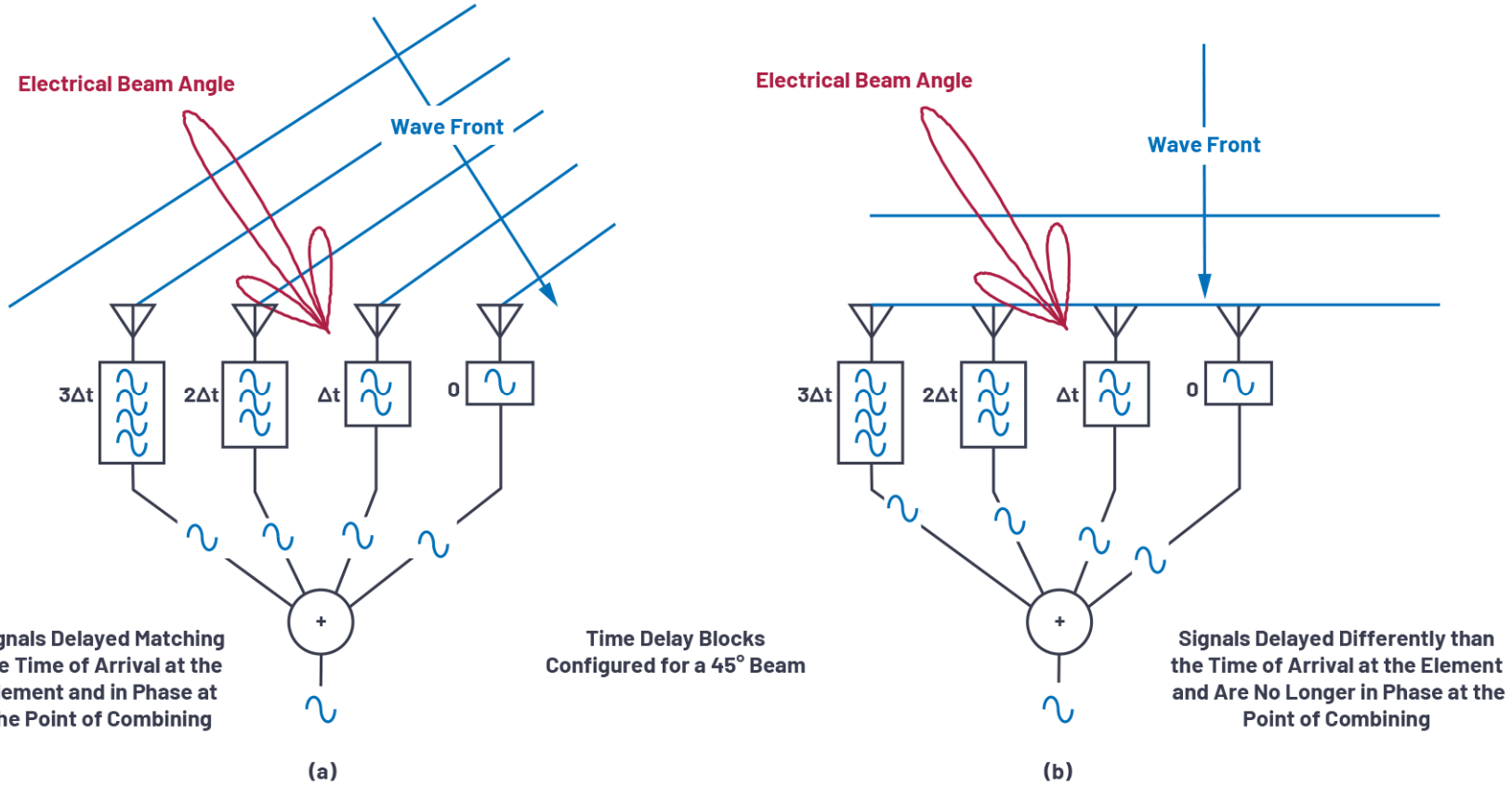
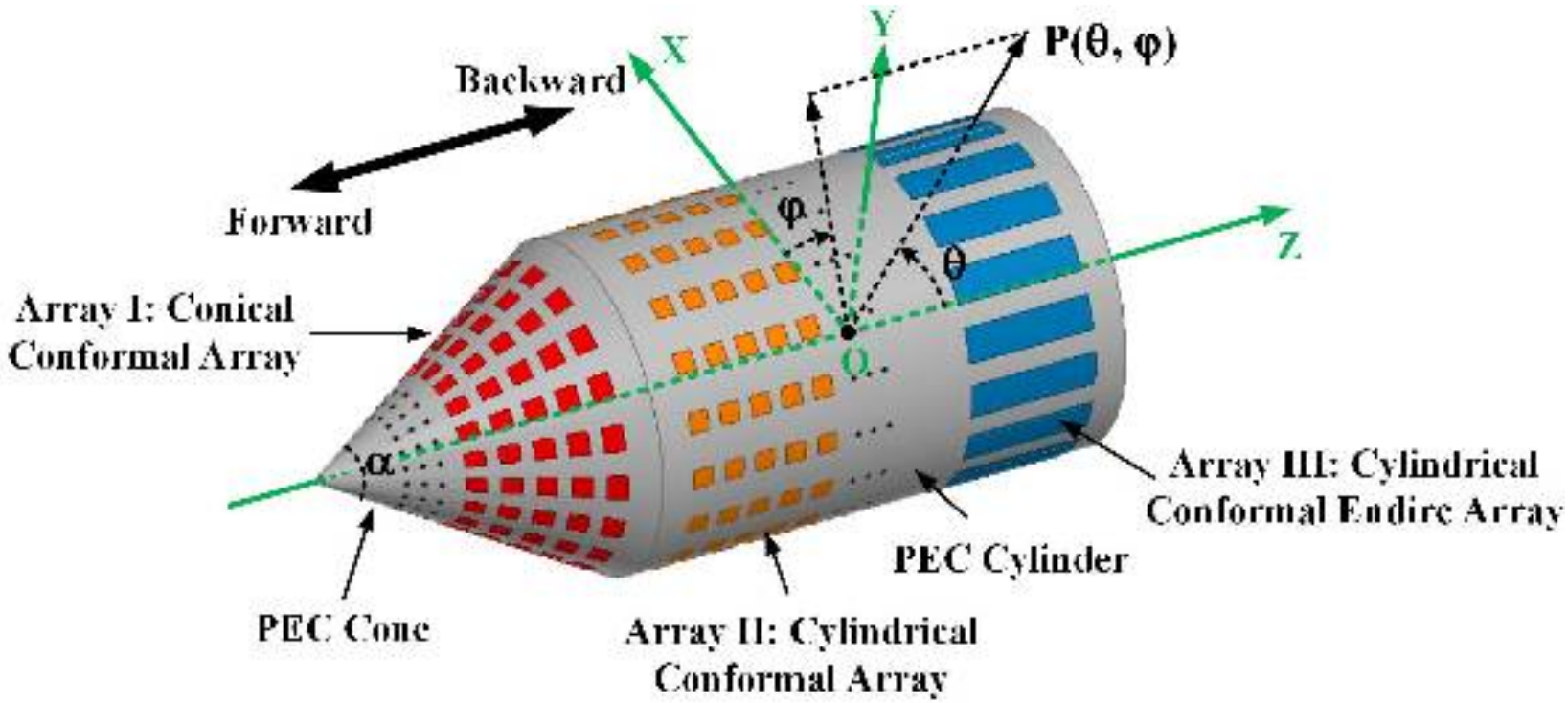
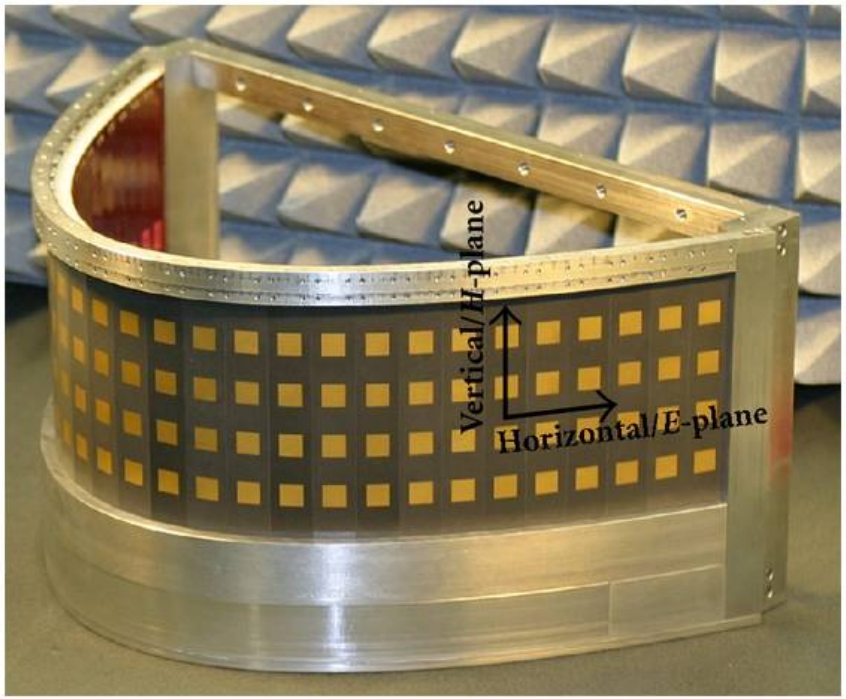
Antenna Array

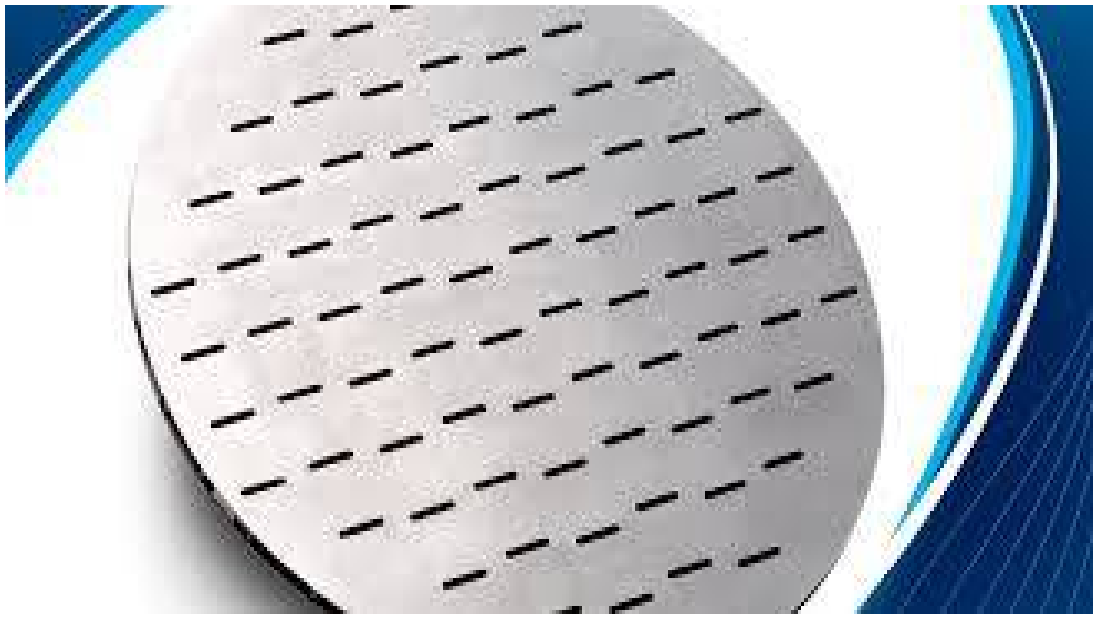

Electrical Beam Angle
Wave Front
3Δt
2Δt
Δt
0
+
Signals Delayed Matching the Time of Arrival at the Element and in Phase at the Point of Combining
Time Delay Blocks Configured for a 45° Beam
Electrical Beam Angle
Wave Front
3Δt
2Δt
Δt
0
+
Signals Delayed Differently than the Time of Arrival at the Element and Are No Longer in Phase at the Point of Combining

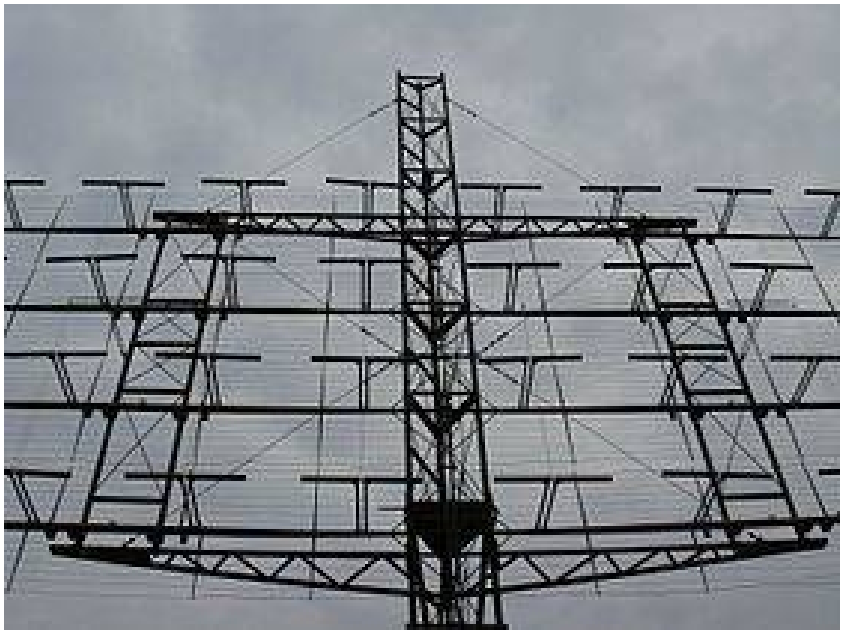
(a)

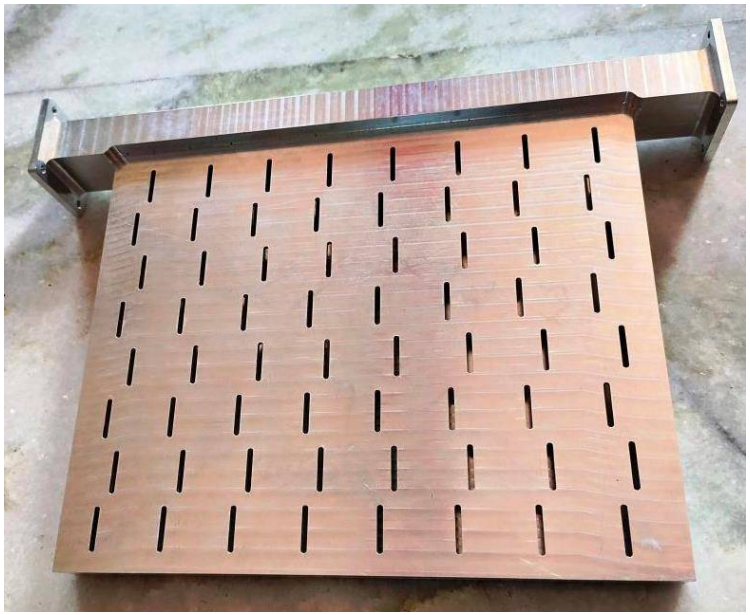
(b)

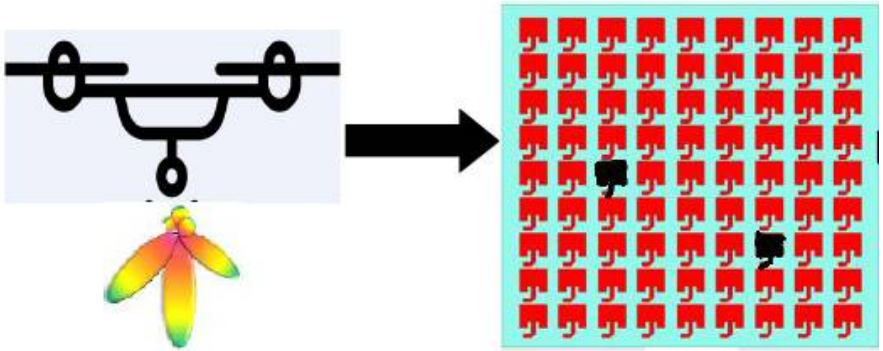

Backward
Forward
X
Y
P(θ, φ)
φ
θ
Z
O
Array I: Conical
Conformal Array
α
PEC Cone
Array II: Cylindrical
Conformal Array
PEC Cylinder
Array III: Cylindrical
Conformal Endire Array

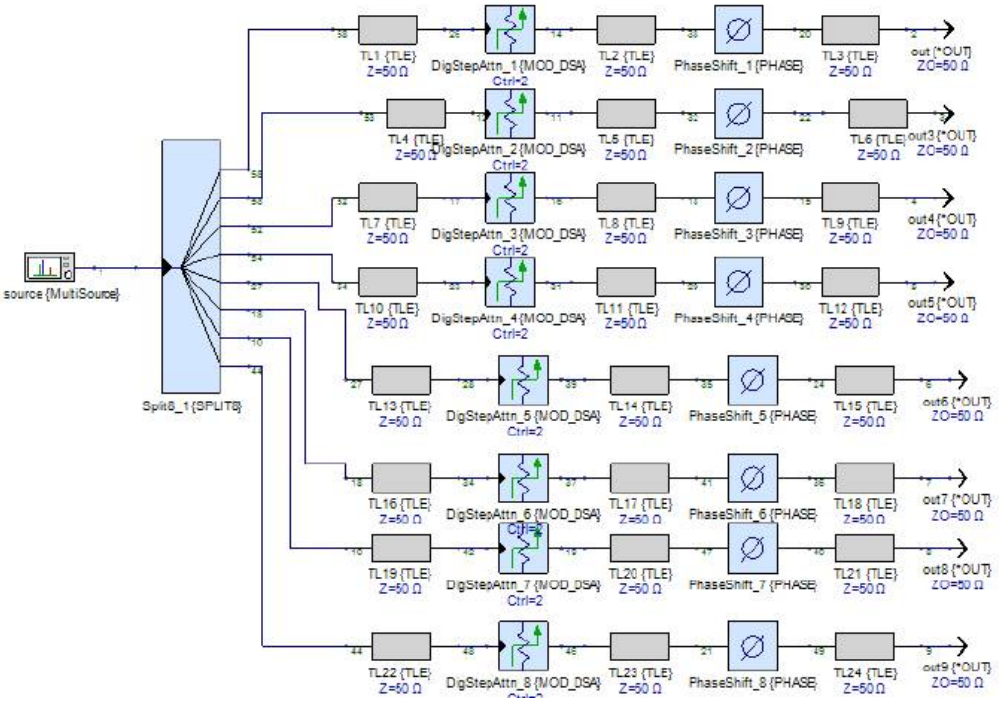

Vertical/H-plane
Horizontal/E-plane



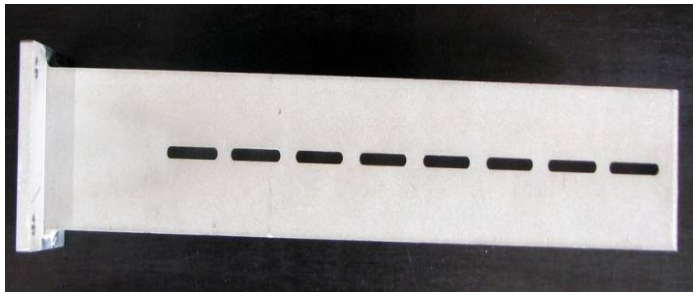


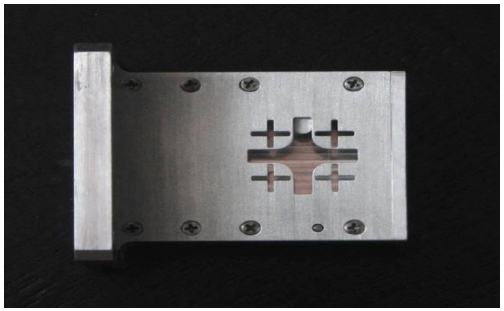


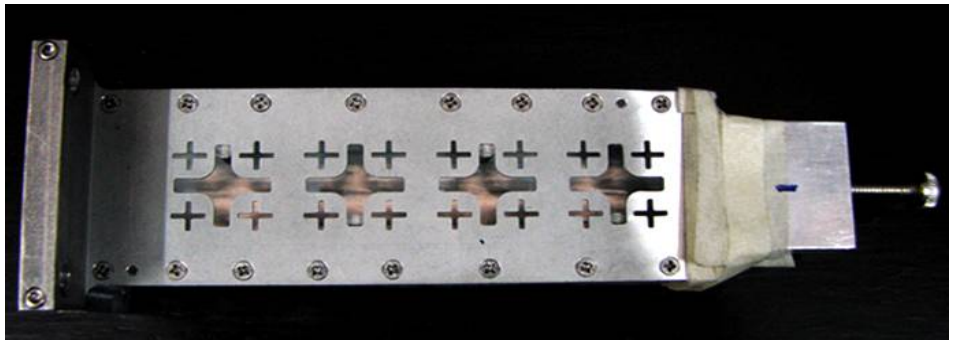


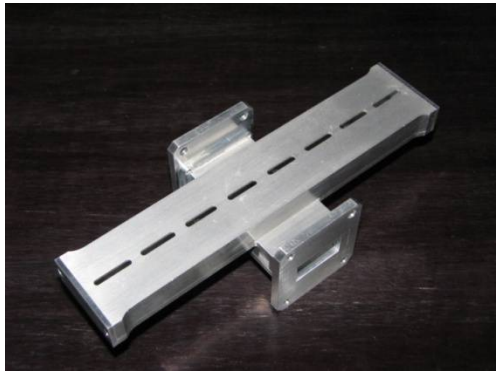

source {MultiSource}
Split8_1 {SPLIT8}
TL1 {TLE} Z=50 Ω
DigStepAttn_1 {MOD_DSA} Ctrl=2
TL2 {TLE} Z=50 Ω
PhaseShift_1 {PHASE}
TL3 {TLE} Z=50 Ω
out {*OUT} ZO=50 Ω
TL4 {TLE} Z=50 Ω
DigStepAttn_2 {MOD_DSA} Ctrl=2
TL5 {TLE} Z=50 Ω
PhaseShift_2 {PHASE}
TL6 {TLE} Z=50 Ω
out3 {*OUT} ZO=50 Ω
TL7 {TLE} Z=50 Ω
DigStepAttn_3 {MOD_DSA} Ctrl=2
TL8 {TLE} Z=50 Ω
PhaseShift_3 {PHASE}
TL9 {TLE} Z=50 Ω
out4 {*OUT} ZO=50 Ω
TL10 {TLE} Z=50 Ω
DigStepAttn_4 {MOD_DSA} Ctrl=2
TL11 {TLE} Z=50 Ω
PhaseShift_4 {PHASE}
TL12 {TLE} Z=50 Ω
out5 {*OUT} ZO=50 Ω
TL13 {TLE} Z=50 Ω
DigStepAttn_5 {MOD_DSA} Ctrl=2
TL14 {TLE} Z=50 Ω
PhaseShift_5 {PHASE}
TL15 {TLE} Z=50 Ω
out6 {*OUT} ZO=50 Ω
TL16 {TLE} Z=50 Ω
DigStepAttn_6 {MOD_DSA} Ctrl=2
TL17 {TLE} Z=50 Ω
PhaseShift_6 {PHASE}
TL18 {TLE} Z=50 Ω
out7 {*OUT} ZO=50 Ω
TL19 {TLE} Z=50 Ω
DigStepAttn_7 {MOD_DSA} Ctrl=2
TL20 {TLE} Z=50 Ω
PhaseShift_7 {PHASE}
TL21 {TLE} Z=50 Ω
out8 {*OUT} ZO=50 Ω
TL22 {TLE} Z=50 Ω
DigStepAttn_8 {MOD_DSA}
TL23 {TLE} Z=50 Ω
PhaseShift_8 {PHASE}
TL24 {TLE} Z=50 Ω
out9 {*OUT} ZO=50 Ω

Development in Slotted Array Antenna



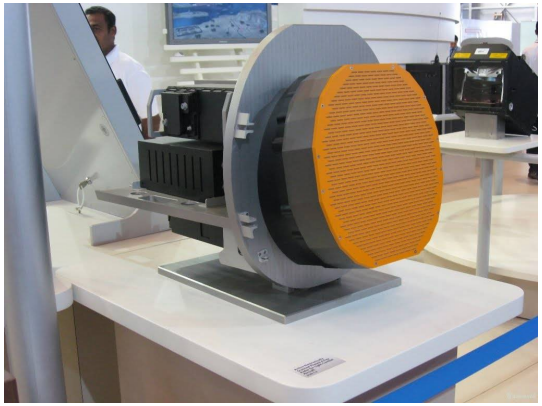


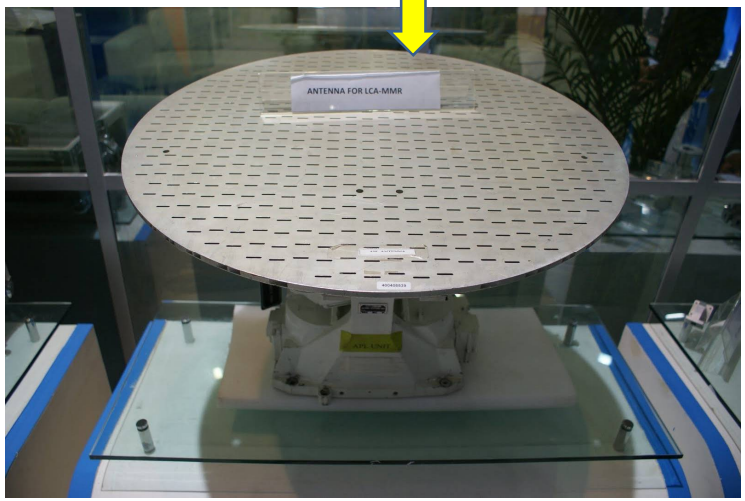




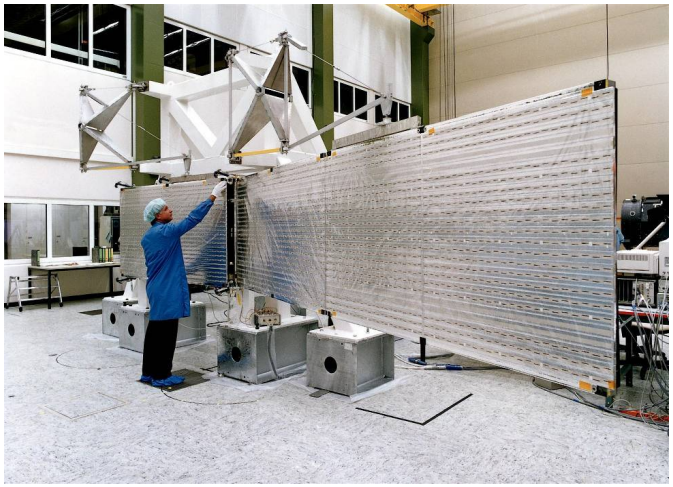
Monopulse RADAR in Light Combat Aircraft (Tejas)

Slotted array antenna at X band in LCA MMR





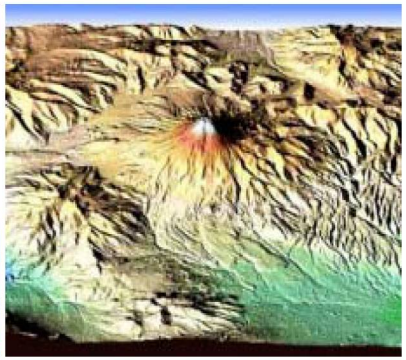
Shuttle RADAR Topographic Mission



C Band (5GHz) Slotted array for Satellite Reception

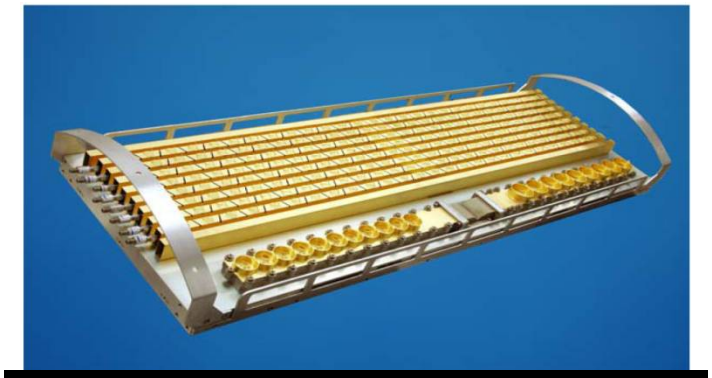
XSAR / SRTM (Shuttle Radar Topography Mission)

SRTM in orbit, artist view



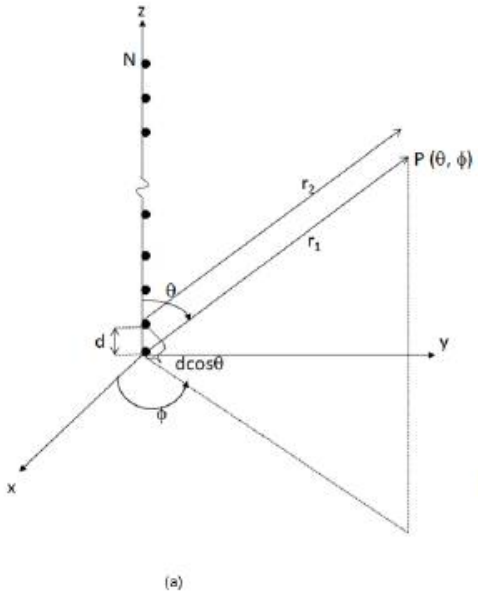
Cotopaxi - interferometric image generation resulting from SRTM data

X Band (9.6GHz) Slotted array for Topographic SAR

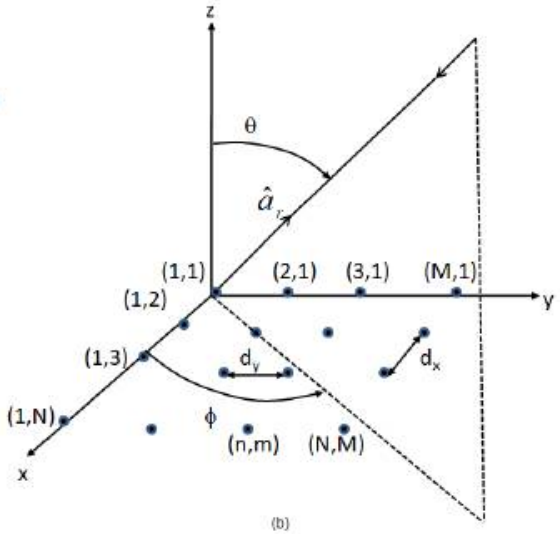


MESSENGER (MErcury Surface, Space ENvironment, GEochemistry and Ranging)

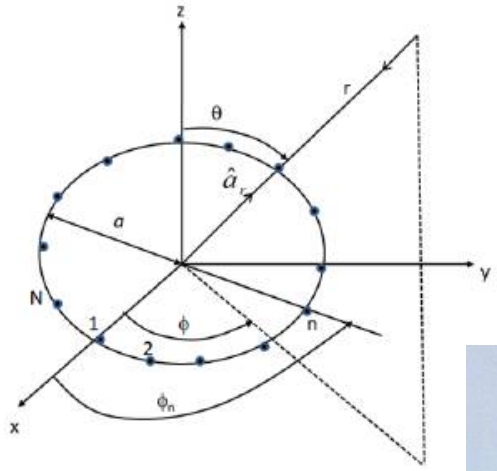
- **Advantages**
- The following are the advantages of using antenna arrays –
- The signal strength increases
- High directivity is obtained
- Minor lobes are reduced much
- High Signal-to-noise ratio is achieved
- High gain is obtained
- Power wastage is reduced
- Better performance is obtained
- **Disadvantages**
- The following are the disadvantages of array antennas –
- Resistive losses are increased
- Mounting and maintenance is difficult
- Huge external space is required


z
N
P (θ, ϕ)
r2
r1
θ
d
dcosθ
y
ϕ
x

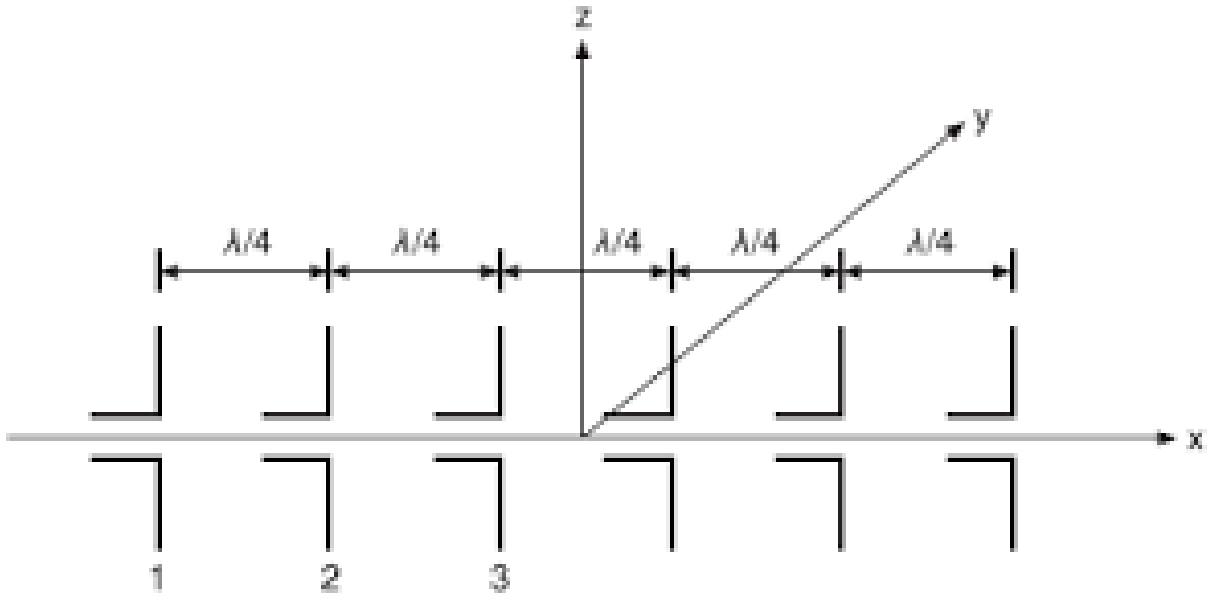
(a)

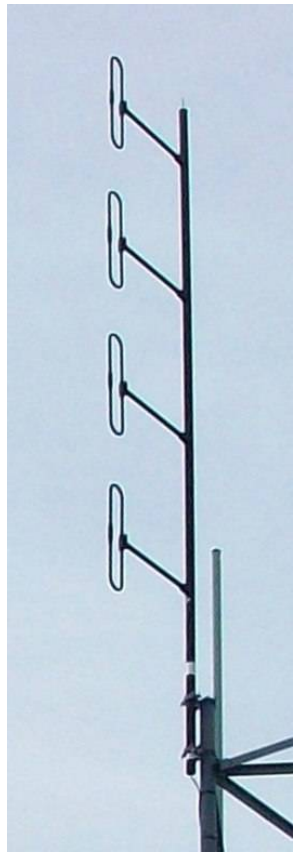

z
θ
$\hat{a}_r$
(1,1)
(2,1)
(3,1)
(M,1)
(1,2)
y
(1,3)
d_y
d_x
(1,N)
ϕ
(n,m)
(N,M)
x

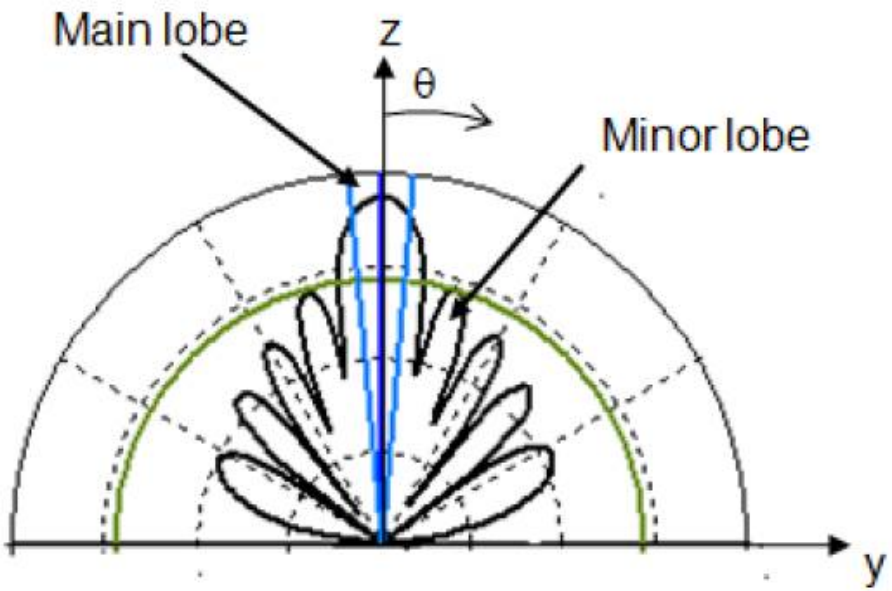
(b)

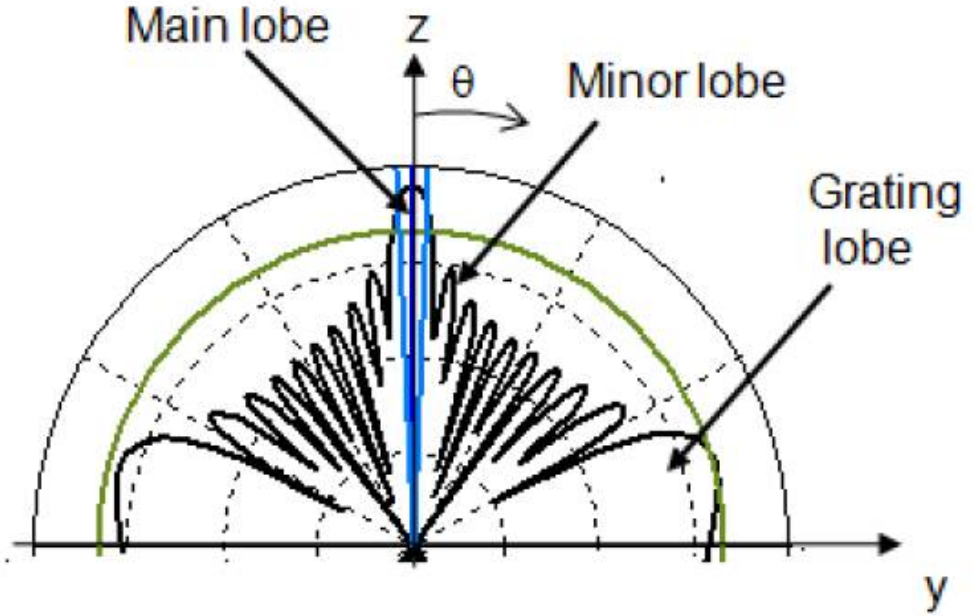

z
θ
r
$\hat{a}_r$
a
y
N
1
ϕ
n
2
ϕ_n
x

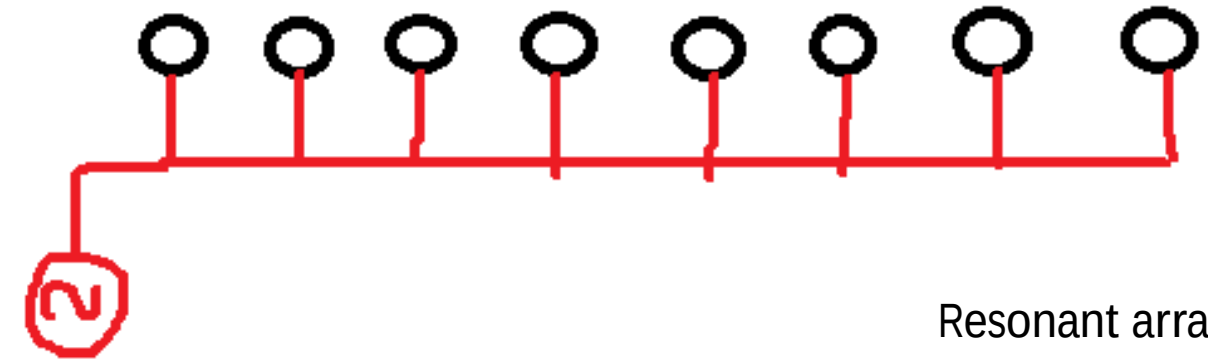
(c)


z
y
λ/4
λ/4
λ/4
λ/4
λ/4
x
1
2
3

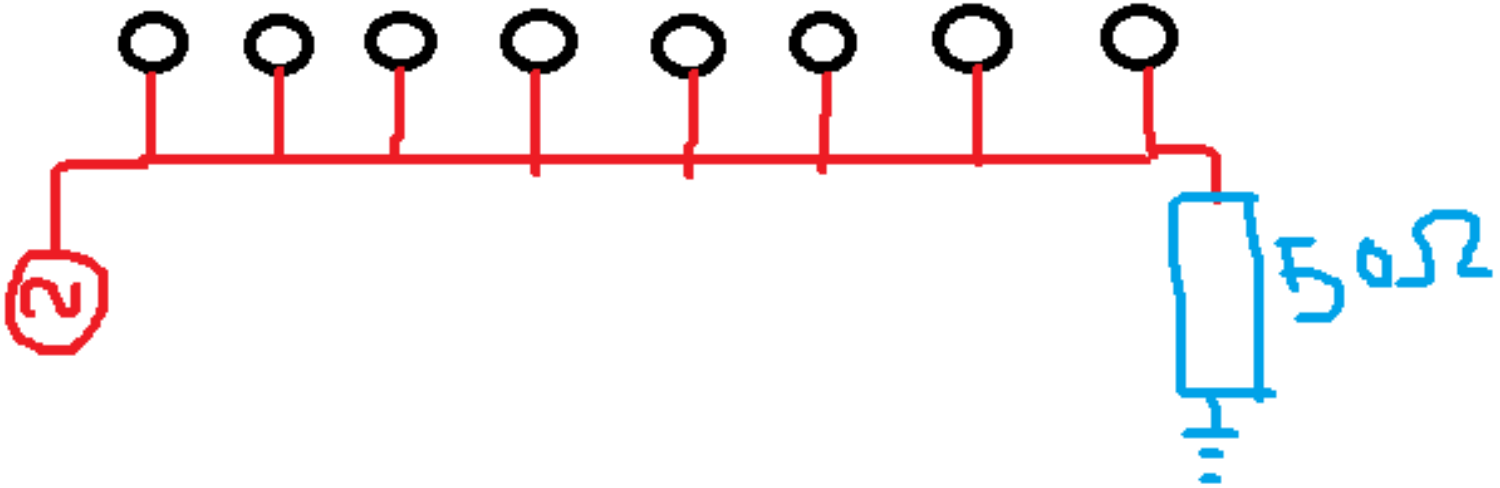



Main lobe
z
θ
Minor lobe
y

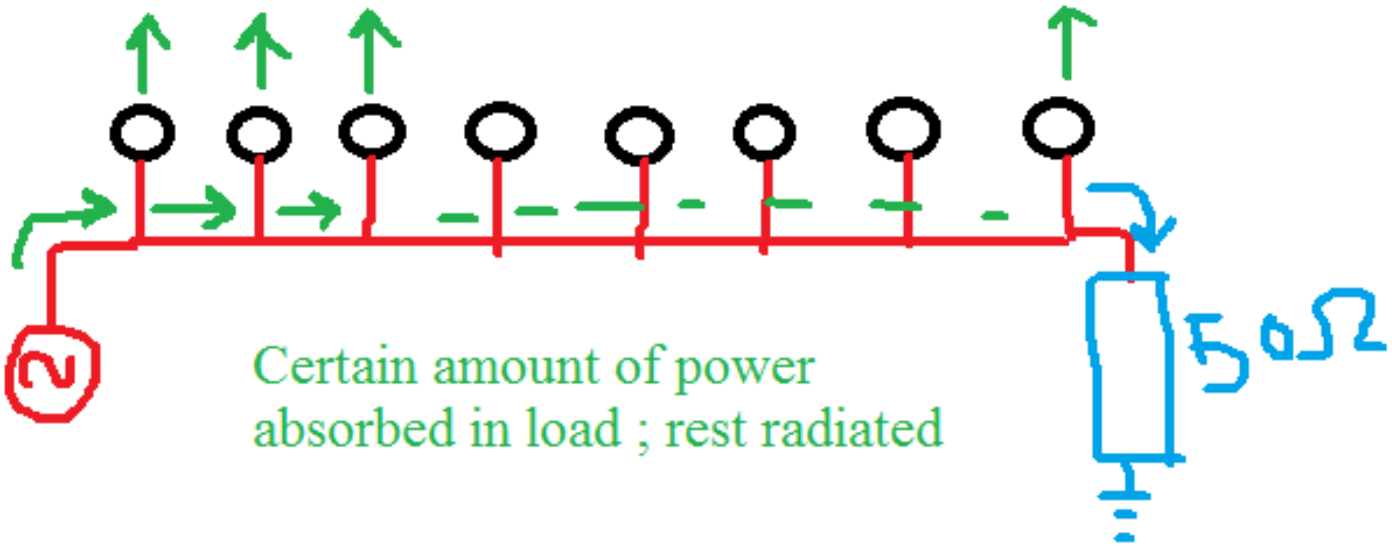

Main lobe
z
θ
Minor lobe
Grating
lobe
y

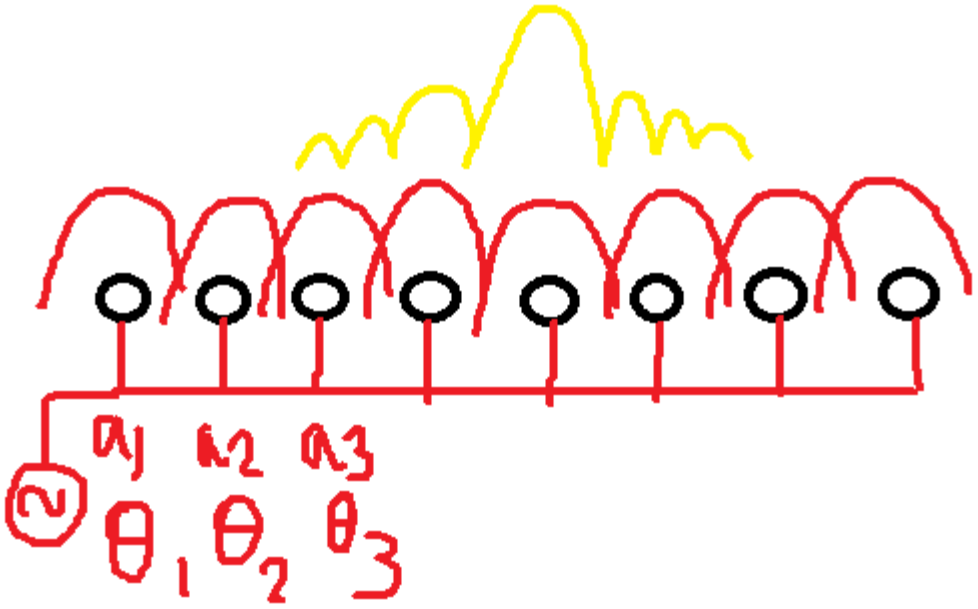


Resonant array



Travelling wave array

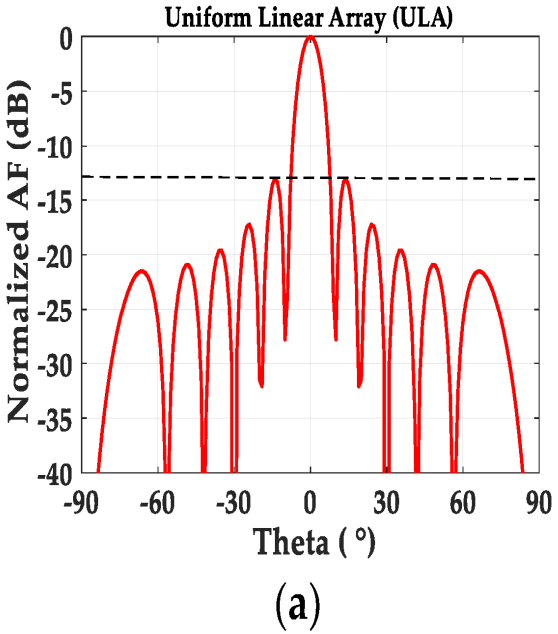

Certain amount of power
absorbed in load ; rest radiated
50Ω


a1 a2 a3
θ1 θ2 θ3

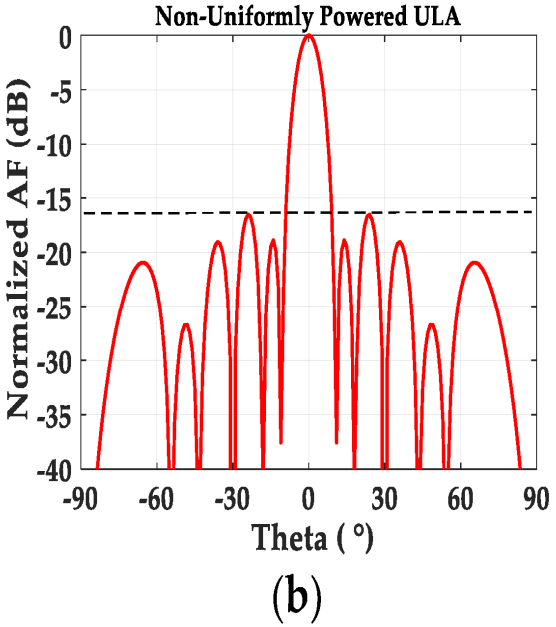
- Each element will have an amplitude called excitation amplitude ; got from source
- Each element have phase relative to source
- Two kinds of phase ; i) phase from source, ii) phase between the inter-element called spatial phase
- Now when all the element radiating then there will be phasor addition
- As the amount of power due to all radiating elements is increased hence gain increases

- We know that if gain increases then pattern looks like directive
- More directive pattern means beamwidth decreases.
- So antenna array is used for directive radiation pattern
- Now what is the distribution ratio of amplitudes?
- Now if all a1, a2, a3... are equal we call them uniform array

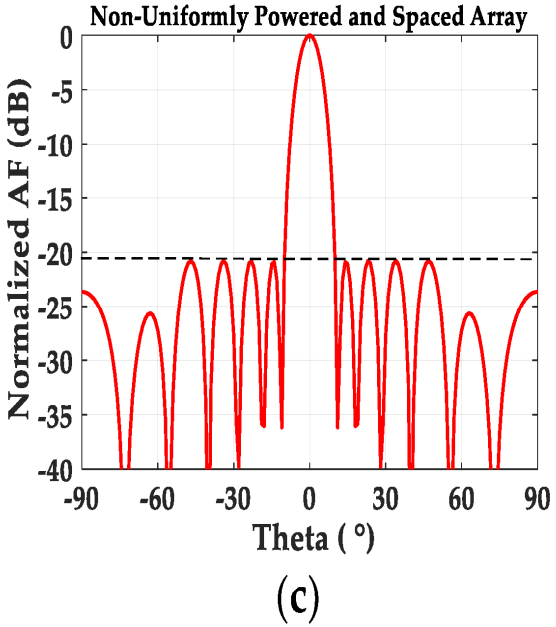
- But there are some other distribution termed under non uniform distribution
- Typically Binomial . Chebyshev, Taylor etc



(a)



(b)



(c)