

Midterm Review

Aperture-Gain

Polarization

Dipole

Midterm on Thursday

- ↳ in-class 1.25 hrs, no calculators, 1 page crib sheet front/back
 - ↳ I'm trying to ramp difficulty ~ concept Q vs. analysis Q
 - ↳ Time/point management: try 3 of 4.
- ↓
like
 $\frac{Q}{W^2}$

Topics:

T-lines

- lumped vs distributed
- $\delta = \alpha + j\beta$
- Phase, velocity, Z_0

Reflections

- Γ
- square plots
- $\Gamma_{(2)}$ & $Z_{(2)}$
- VSWR

Smith Charts

- det Δ & Z_N
- Z_N to Γ & back
- caps, inds, t-lines
- series / shunt

S-parameters

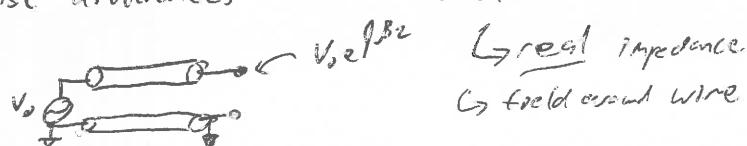
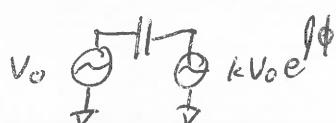
- what?
- power flow
- power gain
- Also filters

Z matching

- Q
- Π to series
- L, H, T

• We started looking @ antennas

- Radiation is caused by phase differences across lossless element

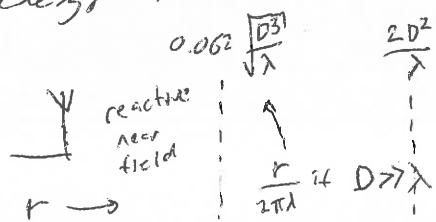


- Need long enough wires to make phase difference ~ $\lambda/4, \lambda/2, \dots$ etc.

- Radiation power must fall off as $1/r^2 \Rightarrow$ field as $1/r (\vec{E} \times \vec{H})$

- Radiation around point charge is $1/r^2$ for \vec{E} , called reactive field

- goes into & out of field



- $r \gg D$ & $r \gg \lambda$ also needed

- Alter nat'l. det Δ w/ $1/\lambda$ near $\sigma \lambda$ for

Predict power Xfer between two antennas



$$P_{RX} = \frac{P_{TX}}{4\pi r^2} \cdot A_{RX} \cdot D_{TX}(\theta, \phi) \cdot \eta_{TX}$$

↑
EIPD receive
 aperture

↑
Directivity

$$G_{TX}(\theta, \phi)$$

$$\frac{P(\theta, \phi)}{P_{TX}/4\pi} \sim \text{solid } L \text{ version}$$

$$= P_{TX} G_{TX}(\theta, \phi) G_{RX}(\theta, \phi) \left(\frac{\lambda^2}{4\pi r^2} \right)$$

path loss

→ expressed as dBi ~ $\eta_{isotropic}$
so is EIRP = $\frac{P_{TX} G(\theta, \phi)}{EIPD}$

- Aperture of isotropic radiator is $\frac{\lambda^2}{4\pi}$ → thermodynamics

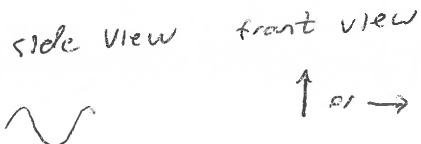
↳ receive gain is $G_{RX} = \frac{A_{RX}}{\lambda^2/4\pi} \sim$ how much nice do you capture

↳ same as TX gain ... "sensitised" in one direction you transmit

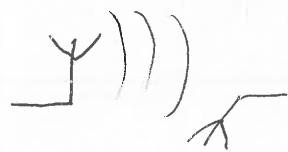
↳ Large aperture → high gain → narrow beam width

- Polarization

↳ what is it? compare $\sqrt{\square}$ vs. $\sqrt{\wedge}$



↳ orientation of EM wave, describe



~~parallel cancellation~~

Almost no voltage @ RX antenna in this case

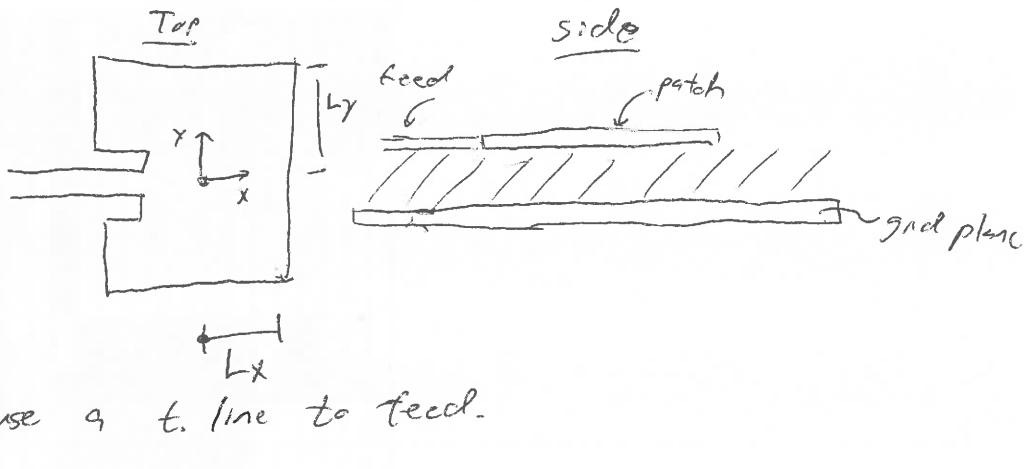
- Link budget

↳ Express Friis in dB $P_{RX} = P_{TX} + G_{TX} + G_{RX} - PL$

↳ As we go forward, we'll add noise & linearly budgets to compute overall comm. system goodness.

Antenna Examples

- patch antennas



- use a t. line to feed.
- What is Zantenna?

\hookrightarrow voltage patterns excited by feed line \rightarrow standing waves in x

\hookrightarrow (usually make $L_x \ll L_y$ so only 1 dir standing wave)

