Midterm Review

Aperture Gain

Polarization

Dipole

Midterm on Thursday

1 hr, no calculators, 1 page crib sheet, front/back

I'm trying to ramp difficulty - concept vs. analysis

Time/point management: try 3 of 4.

Topics:

- T. lines
  - lumped vs distributed
  - \( \delta = \alpha + j\beta \)
  - phase, velocity, \( Z_0 \)

- Reflections
  - \( \Gamma \)
  - \( \Gamma(\alpha) + Z(\alpha) \)
  - VSWR

- Smith Charts
  - \( \text{data} \leftrightarrow Z_0 \)

- S-parameters
  - \( Z \) matching
  - \( Q \)

- \( \Pi, \Omega, \Lambda \)

- \( \text{Also filters} \)

* We started looking at antennas

- Radiation is caused by phase differences across lossless element

\[ V_0 \rightarrow |\begin{array}{c} \text{kvoe} \end{array}| \rightarrow |\begin{array}{c} \text{real impedance} \end{array}| \rightarrow \text{field around wire} \]

- Need long enough waves to make phase difference - \( \lambda/4, \lambda/2 \) ...

- Radiation power must fall off as \( 1/r^2 \) \( \Rightarrow \) field as \( 1/r \) \( (\mathbf{EoA}) \)

- Radiation around point charge is \( 1/r^2 \) for \( \mathbf{E} \), called receivable field

- Energy into \( \mathbf{E} \) out of field

\[ \frac{1}{2} \pi \frac{0.061}{20^2} \frac{20^2}{20} \]

* r > D \( \Rightarrow \lambda \) also needed

* Alternative data of \( 1/8 \) for...
Predict power Xfer between two antennas

\[
P_{RX} = \frac{P_{TX}}{4\pi r^2} \cdot A_{RX} \cdot D_{TX}(\theta, \phi) \cdot 2_{TX} \quad \text{loss}
\]

\[
= P_{TX} \cdot G_{TX}(\theta, \phi) \cdot G_{RX}(\theta, \phi) \cdot \left(\frac{\lambda^2}{4\pi r^2}\right) \quad \text{with loss}
\]

Aperture of isotropic radiator is \( \frac{\lambda^2}{4\pi} \rightarrow \text{thermodynamics} \)

Receive gain is \( G_{RX} = \frac{A_{RX}}{\lambda^2/4\pi} \rightarrow \text{how much noise do you capture?} \)

Same as TX gain..."sensitive" in the direction you transmit

Large aperture \( \rightarrow \) high gain \( \rightarrow \) narrow beam width

Polarization

In what is \( \hat{E} \) compare \( \mathbf{N} \) vs. \( \mathbf{V} \)

Orientation of \( \mathbf{E} \) or \( \mathbf{H} \) wave, describe

Almost no voltage @ RX antenna in this case

Link budget

To express Friis in dB

\[ P_{RX} = P_{TX} + G_{TX} + G_{RX} - PL \]

As we go forward, we'll add noise & linearity budgets to compute overall comm. system goodness.
Antenna Examples

- patch antennas

- use a t. line to feed.

- What is $Z_{antenna}$?

  $Z_{antenna}$ voltage patterns excited by feed line $\rightarrow$ standing waves in $x$

  $L_x$ usually make $L_x < L_y$ so only 1 dir standing wave

  $Z = V/I$