W9DXCC

DX UNIVERSITY and NIDXA PRESENT

DX'ing FROM the BLACK HOLE 2

SESSION 1

ANTENNAS AND FEED LINE SYSTEMS WITH MODELING DESCRIPTIONS

Antenna and Tranny line Modeling

In this discussion I will be using modeling software to describe some characteristics of antenna and feed line systems. The examples that will be used are chosen to provide general information and demonstrate the capability of the analysis programs.

Why Model?

1) Experiment and Invent
2) General curiosity
3) Educated consumer
4) Help DXCC count (well maybe)
5) To become the local expert on the local repeater

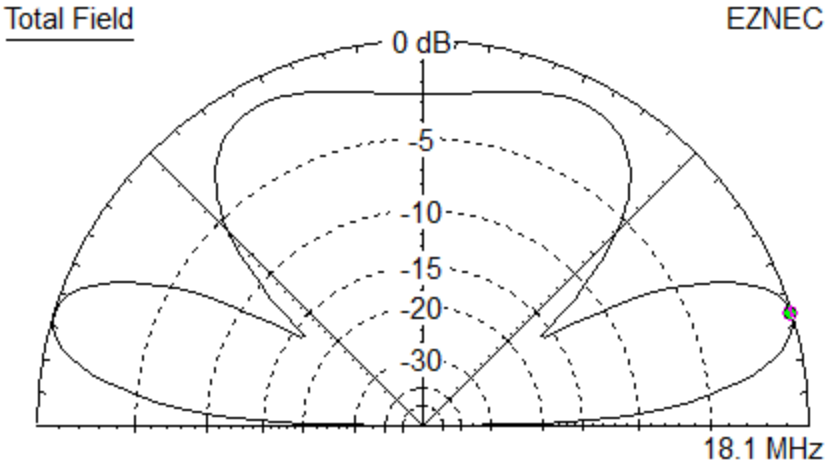
The effort may not make a huge difference in the amount of DX you work but may save a bunch of time and money. Rather than putting up a given configuration you can get a good feel about it from modeling.

The programs used to illustrate modeling.

1) EZNEC Written by Roy Lewallen W7EL. Been around a long time and probably best know and most used. It is not free and you need to check EZNEC web site for current prices. As of 2013 about $89.00 for EZNEC 5. Relatively easy to use. (Demo Available)

2) 4Nec2 Written by Arie Voors. Has been around a few years and has many nice features. Somewhat trickier to use that EZNEC and you need to watch it carefully. However it is free and has many nice features.

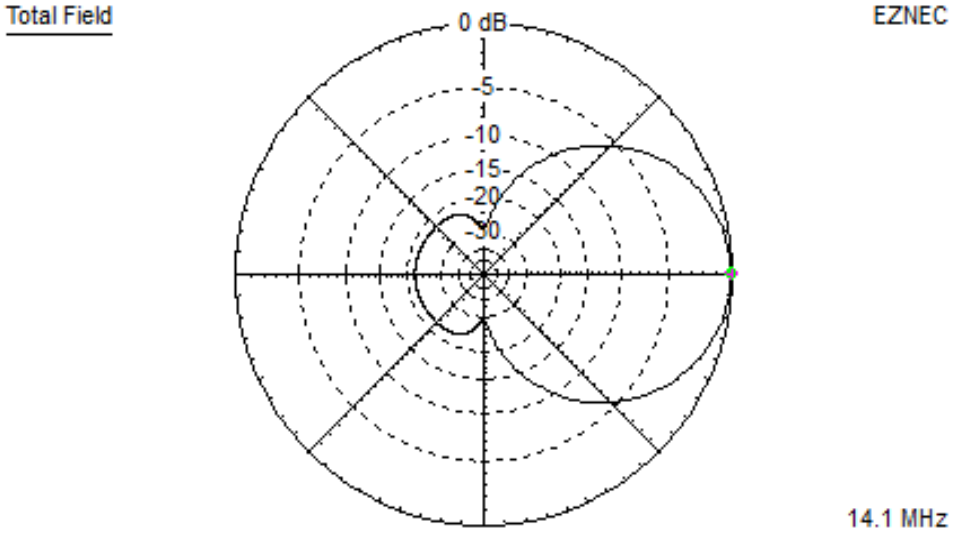
3) SimSmith Written by Ward Harriman AE6TY. New program and still in development but stable enough to use effectively. This is a very nice and fairly easy program to use for feed lines and has interfaces to antenna modeling programs for antenna data. It is free and has many good features.



Elevation Plot		Cursor Elev	17.0 deg.
Azimuth Angle	90.0 deg.	Gain	6.91 dBi
Outer Ring	6.91 dBi		0.0 dBmax

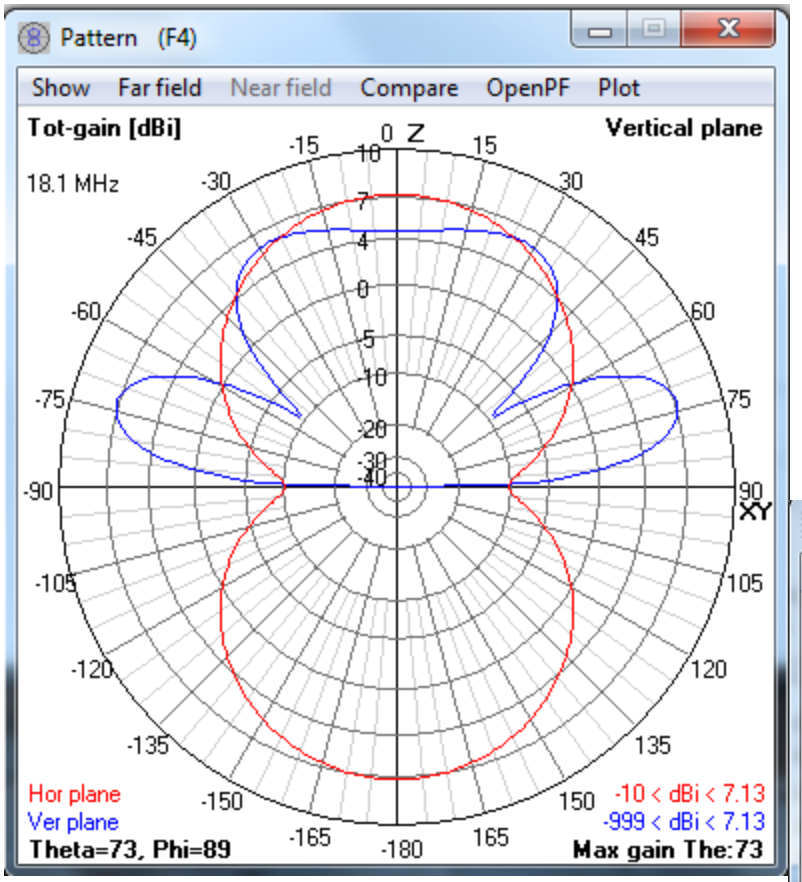
Slice Max Gain	6.91 dBi @ Elev Angle = 17.0 deg.
Beamwidth	18.0 deg.; -3dB @ 8.2, 26.2 deg.
Sidelobe Gain	6.91 dBi @ Elev Angle = 163.0 deg.
Front/Sidelobe	0.0 dB

Typical plots from EZNEC by W7EL. Program also gives VSWR plots and data files with antenna Z's



Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	13.0 deg.	Gain	12.84 dBi
Outer Ring	12.84 dBi		0.0 dBmax

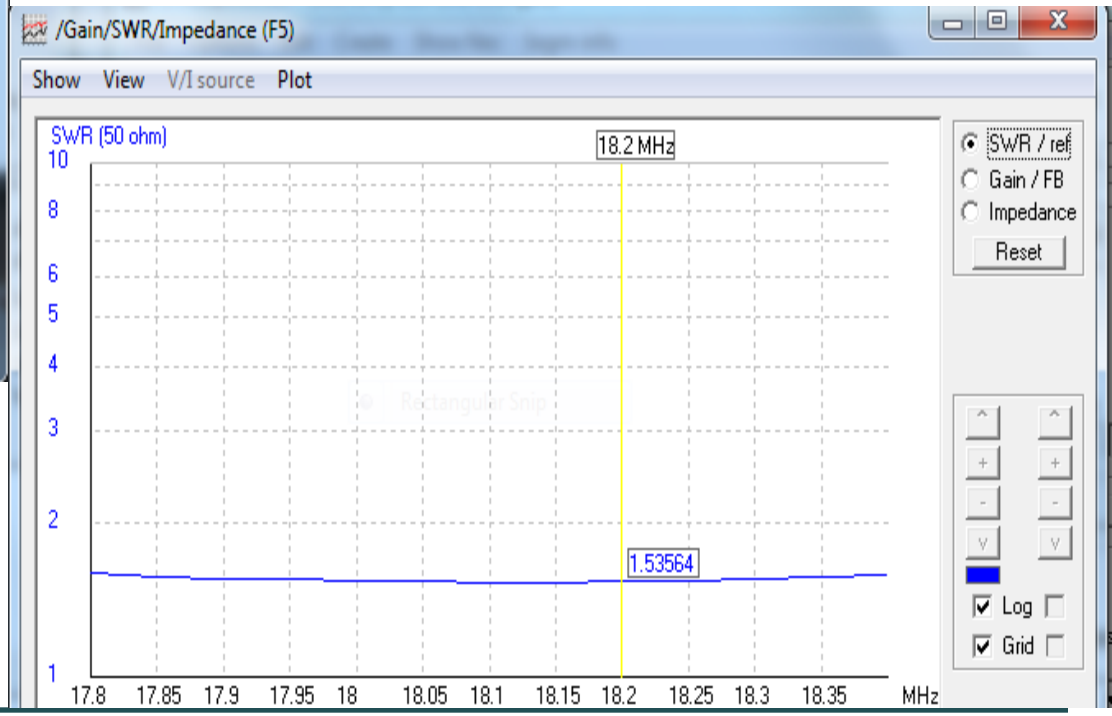
Slice Max Gain	12.84 dBi @ Az Angle = 0.0 deg.
Front/Back	21.89 dB
Beamwidth	67.2 deg.; -3dB @ 326.4, 33.6 deg.
Sidelobe Gain	-9.05 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	21.89 dB

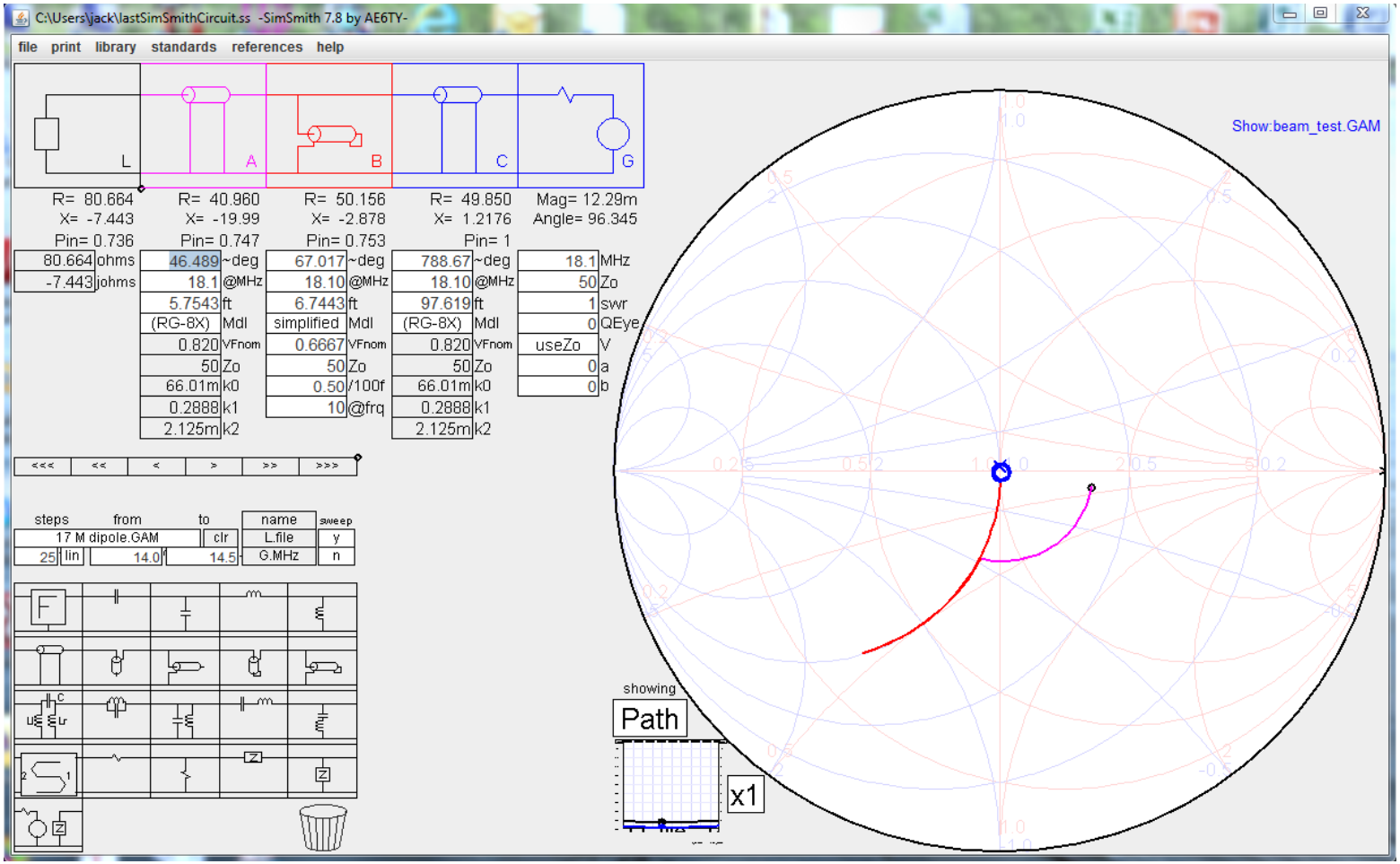


4NEC2 vertical and horizontal plots

VSWR and Impedance plots

Matching calculations

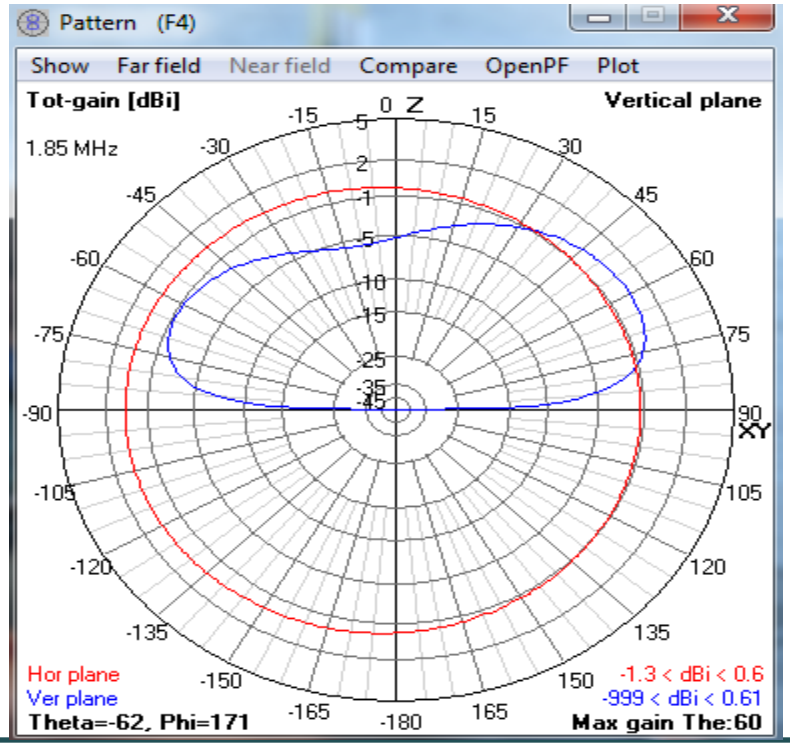


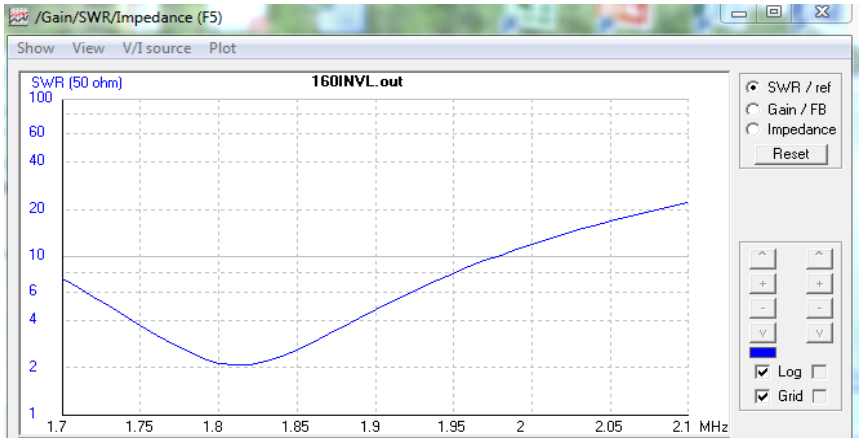


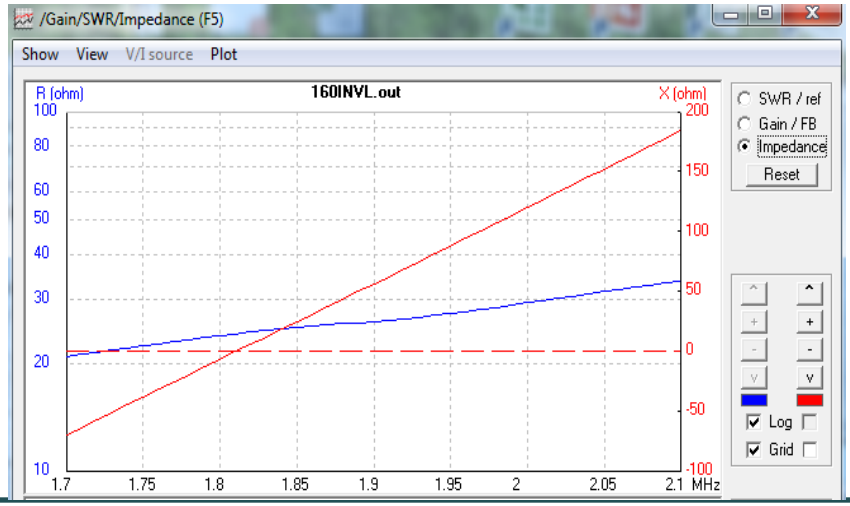
SimSmith Transmission line modeling with input from antenna modeling can model entire systems

What information do the antenna analysis programs Provide ?

1) Antenna patterns both horizontal and vertical
2) Gain over isotropic
3) VSWR plots
4) Impedance plots
5) Plot data of other programs





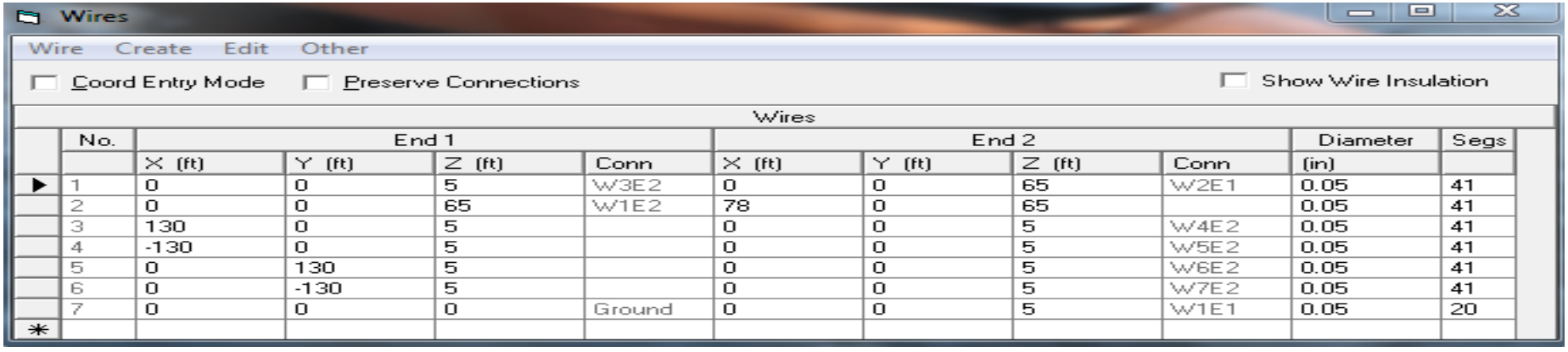


What can you model with antenna software:

1) wire antennas of almost any configuration
2) Beams any type Yagi, log periodic, etc
3) Traps and loaded antennas
4) Any type of source
5) Matching networks
6) Transmission lines
7) Ground characteristics

How is modeling done in programs:

1) Entry of element position in Cartesian coordinates (both programs)
2) Graphical entry (4Nec2)
3) NEC2 format (4Nec2)



Wires

Wire Create Edit Other

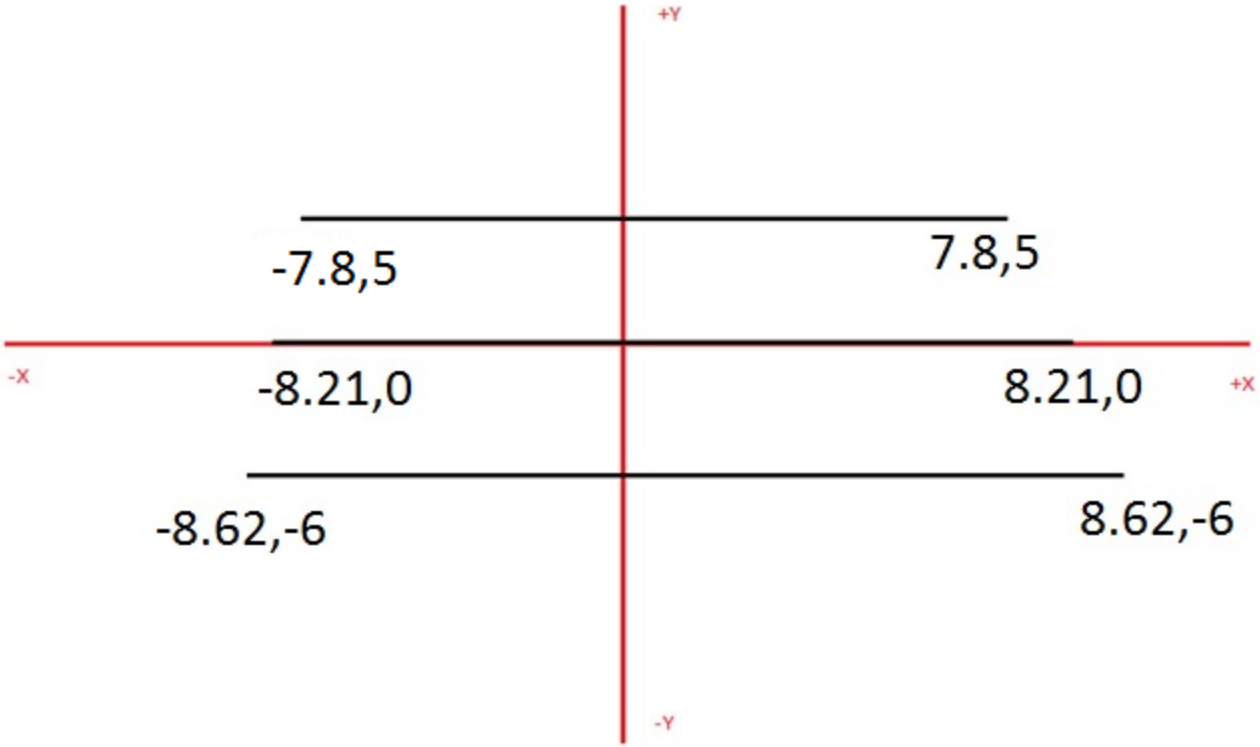
Coord Entry Mode Preserve Connections Show Wire Insulation

Wires

	No.	End 1				End 2				Diameter	Segs
		X (ft)	Y (ft)	Z (ft)	Conn	X (ft)	Y (ft)	Z (ft)	Conn	(in)	
▶	1	0	0	5	W3E2	0	0	65	W2E1	0.05	41
	2	0	0	65	W1E2	78	0	65		0.05	41
	3	130	0	5		0	0	5	W4E2	0.05	41
	4	-130	0	5		0	0	5	W5E2	0.05	41
	5	0	130	5		0	0	5	W6E2	0.05	41
	6	0	-130	5		0	0	5	W7E2	0.05	41
	7	0	0	0	Ground	0	0	5	W1E1	0.05	20
*											

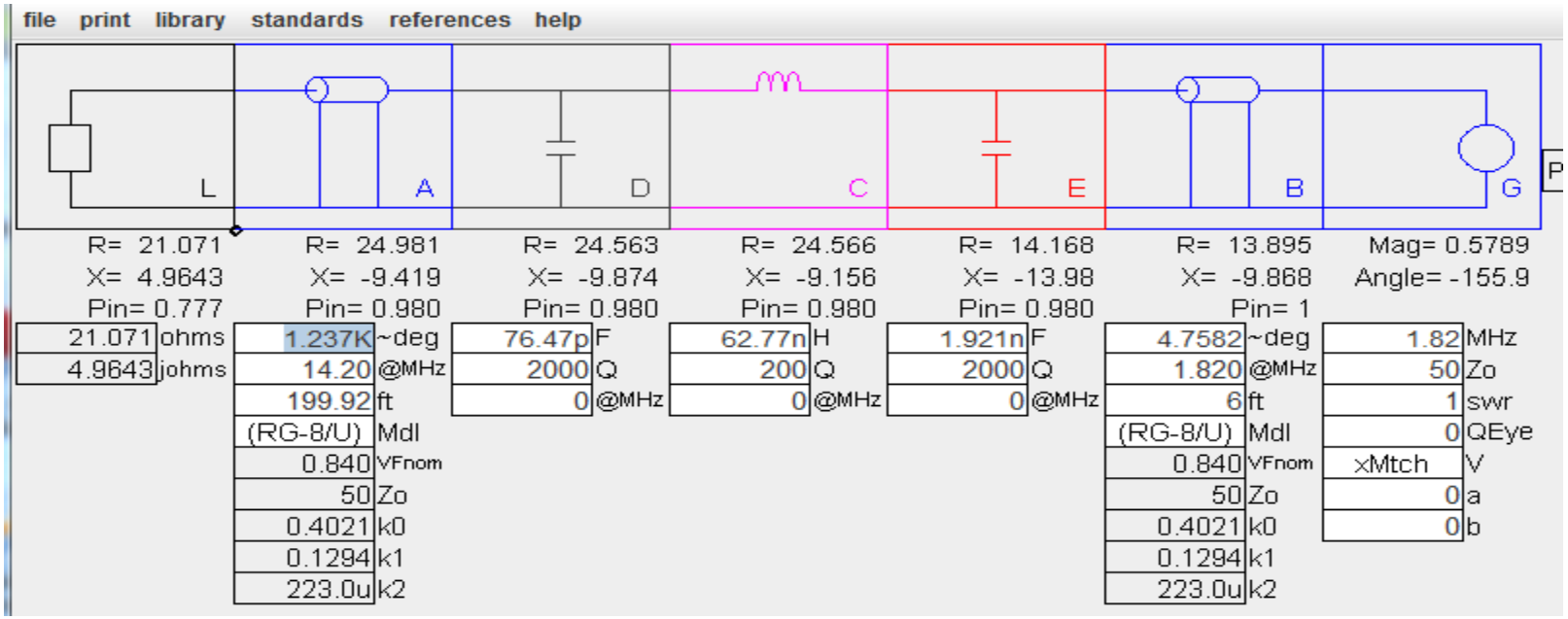
The best way to begin modeling with antenna programs: On a piece of paper draw X,Y axis. Sketch antenna on axis and label each point given antenna design. Using graph or engineering paper helps.

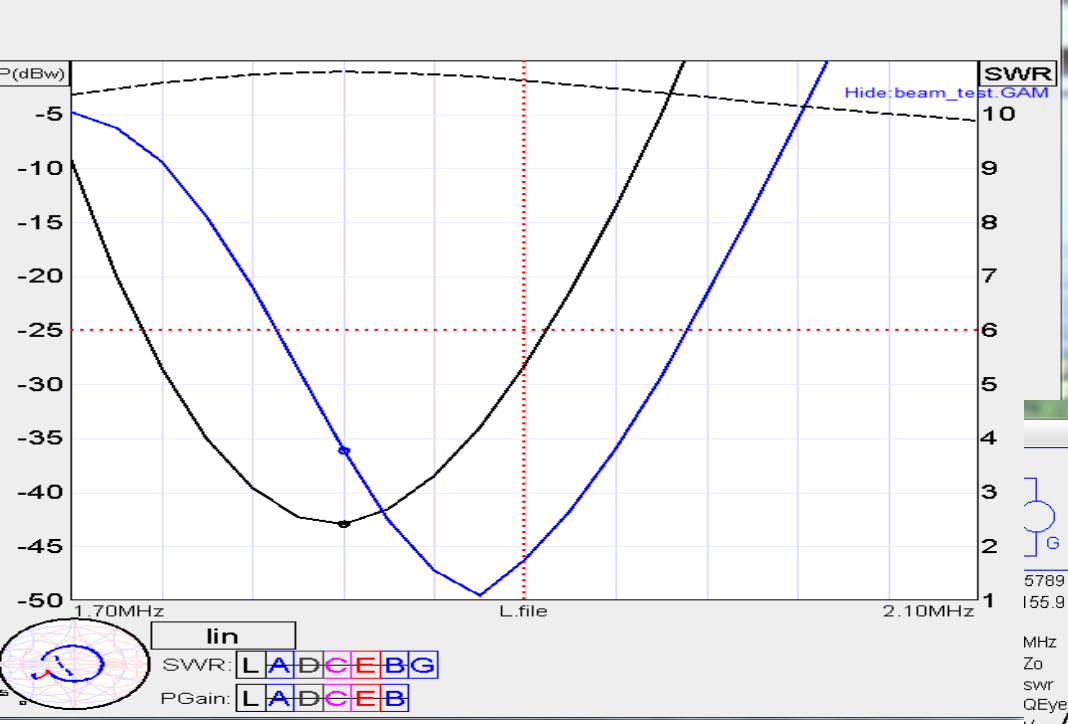
Then enter points into The antenna program.



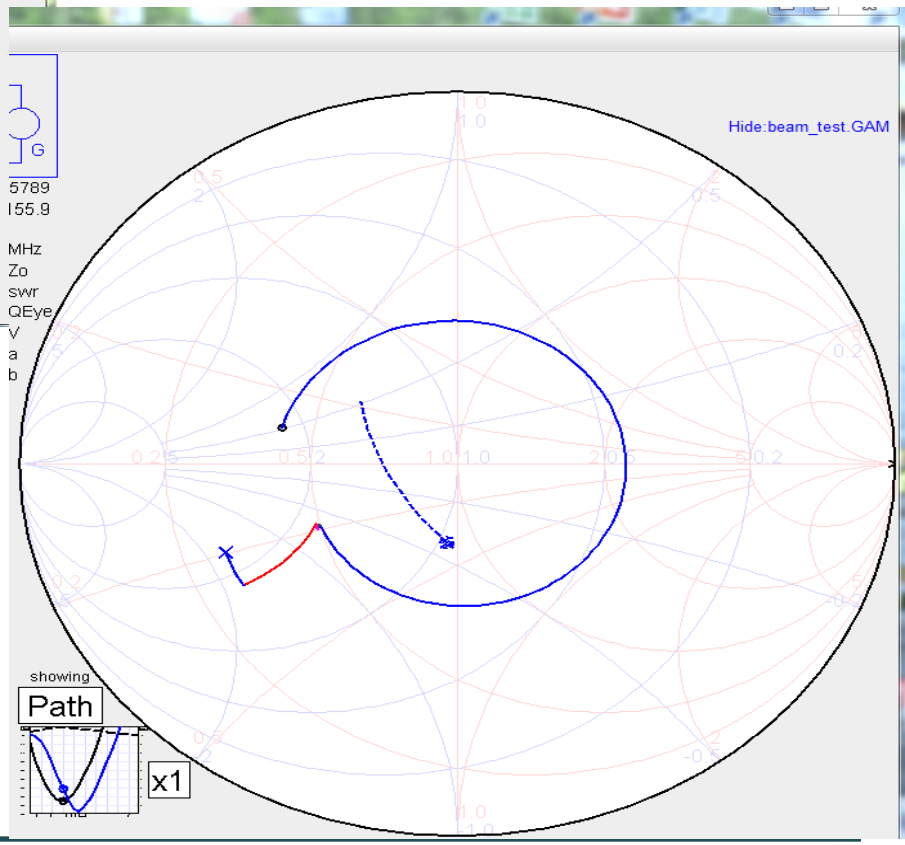
What do you get from Tranny line software:

1) Many types of real lines broken up any way you want
2) Specific loads or load files from antenna analysis program
3) Inductors, capacitors and resistors
4) Shunt and series "stubs"
5) Smith chart plots
6) VSWR and Power plots VS Frequency
7) Element value changes
8) Different sources





Smith charts for the hard core folks



Above is plot of VSWR at transmitter end and load end with antenna tuner in line.

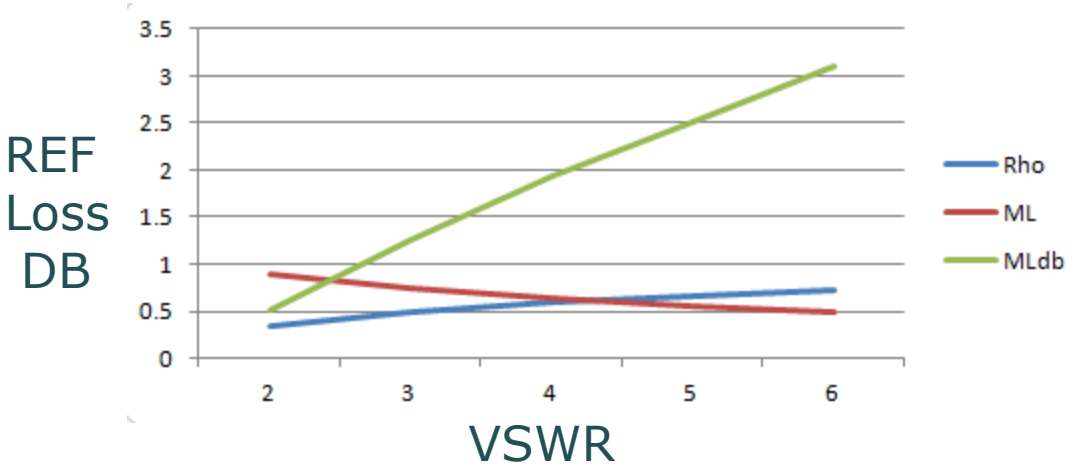
Power at load end is also shown

A quick word about Tranny lines

All lines have some loss of power. The VSWR at the transmitter end will always be less than the load end. The amount of reflected power depends upon the VSWR at the load and is shown as reflection loss below.

How much of that power is lost depends upon conditions at the transmitter end. Generally not all of the reflection loss is actually lost but it is a worst case prediction.

Rho - Reflection Coefficient
ML- numeric loss
MLdb- Loss in DB



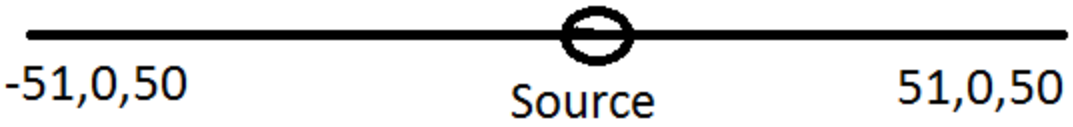
Antenna Survey: There are two fundamental antennas used on the HF bands by the ham radio community.

1) Horizontal antennas start with the ½ wave dipoles and generally add (Yagi) elements for directivity and directional gain. Vertical angle of radiation controlled by height. DX'er star antenna the 3 element tri-bander.
2) Vertical antennas start with the ¼ wave antenna and typically don't have horizontal directivity. Typically used on low bands or where horizontal antenna can't be erected.

Variations of these antenna exist in a bewildering array of single band and multiband variations. Feed lines may be Coaxial as well as open wire of some form. Feed points may also vary.

Modeling will help sort out performance of the various configurations.

1) G5RV type of antennas
   A) EZNEC models
   B) SimSmiith
      1) Standard feed
      2) Coaxial Feed
      3) With tuner



Basic G5RV without feed line

EZNEC

1) Wires
2) Source
3) View Ant
4) VSWR 40 M
5) VSWR 20 M
6) Vertical pattern
7) Horizontal Pattern
8) Sweep data

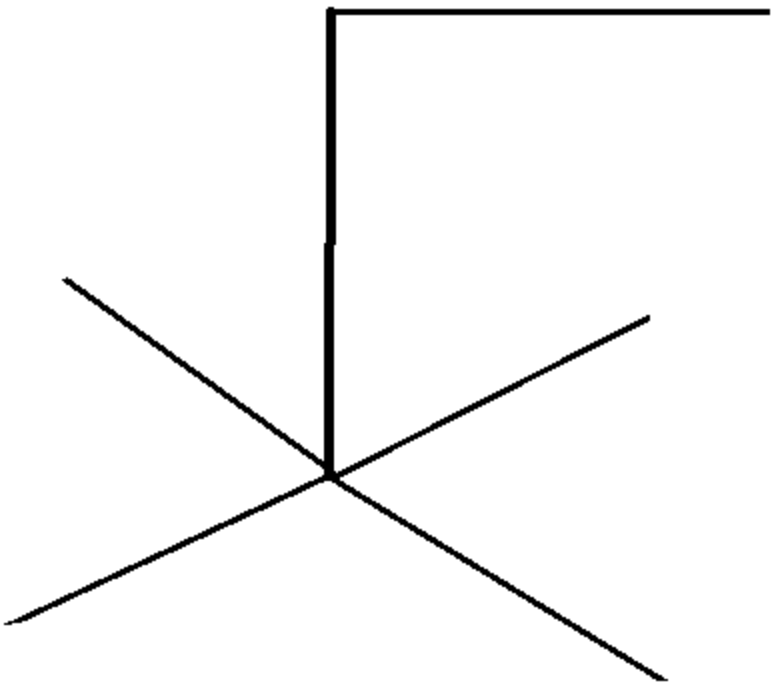
SimSmith

1) Coax feed
2) Open Wire
3) Std Feed

160 M Inverted L with 4 above ground radials

A) 4NEC2

B) SimSmith



4NEC2

1) Initial model Wires
2) Graphical model
3) VSWR and Z
4) Patterns

SimSmith

1) VSWR
2) POWER Loss

HAM Story

80 Meter Sloper

Local expert suggest sloper for 80 meters on your 50 foot tower. Great idea as he says he works a lot of DX with it. So up the tower and hang it. Throw a couple of radials under it since it is supposed to be a "vertical" like antenna.

1) High connection Eznec-SimSmith
2) Low connection Eznec-SimSmith
3) High with Stub SimSmith

Comments Questions

Antenna modeling for Beginners Ward silver N0AX (ARRL)

http://www.qsl.net/4nec2/
http://eznec.com/
http://ae6ty.com/Smith_Charts.html