Antenna Modeling for Beginners

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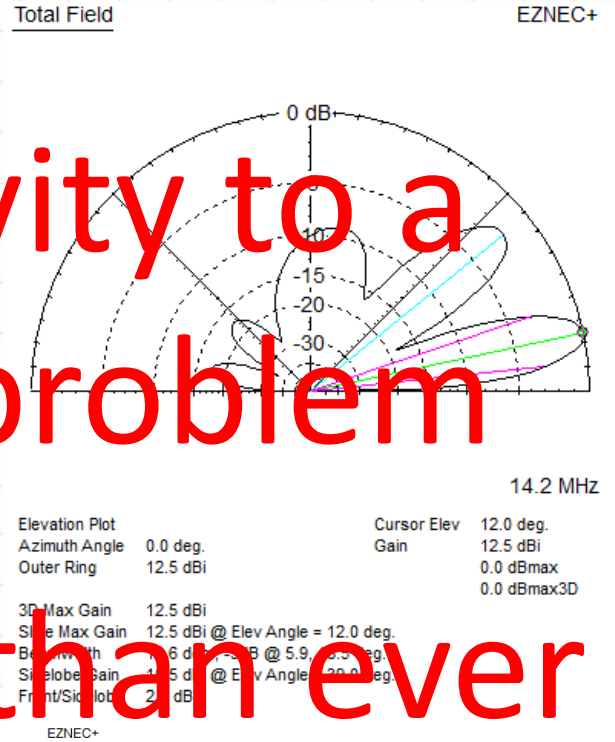
Why antenna modeling?

Why antenna modeling?

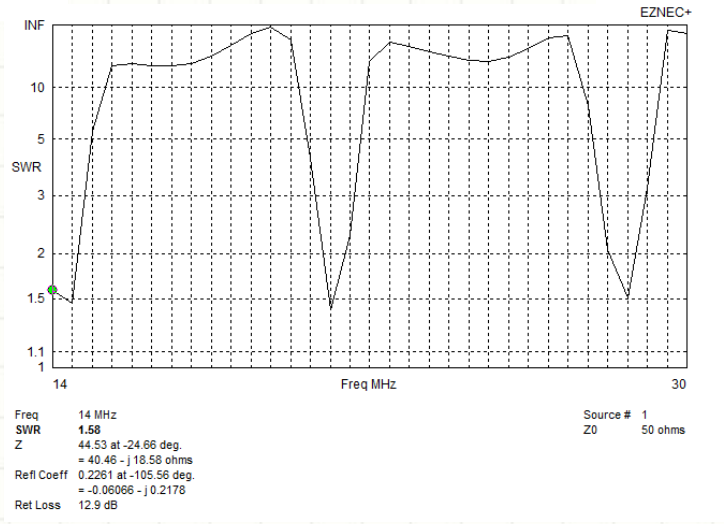
- Which antenna would be the best choice given your QTH/XYL/budget constraints.
- Antenna home-brewing.
- Antenna shopping- performance comparison/validation.
- Multi-band antennas- check performance by band.
- Determine effects of raising or lowering an antenna.
- Check interactions on multiple antenna installations.
- Saves time, money, and frustration.

Why antenna modeling?



Brings objectivity to a very complex problem

And it's easier than ever



How To Get Started

NEC (*neck*)- a modeling engine

- NEC stands for Numerical Electromagnetics Code. Dates back to the 1970's and written in Fortran.
- NEC engine hasn't been updated. However modeling *tools* such as EZNEC continues to advance.
- EZNEC is a modeling *tool* that uses the modeling *engine* NEC. Many other modeling *tools* are available, some are free-of-charge and some are not. The use of the engine NEC-2 is free (public domain).

EZNEC (EZ *neck*)- a modeling tool

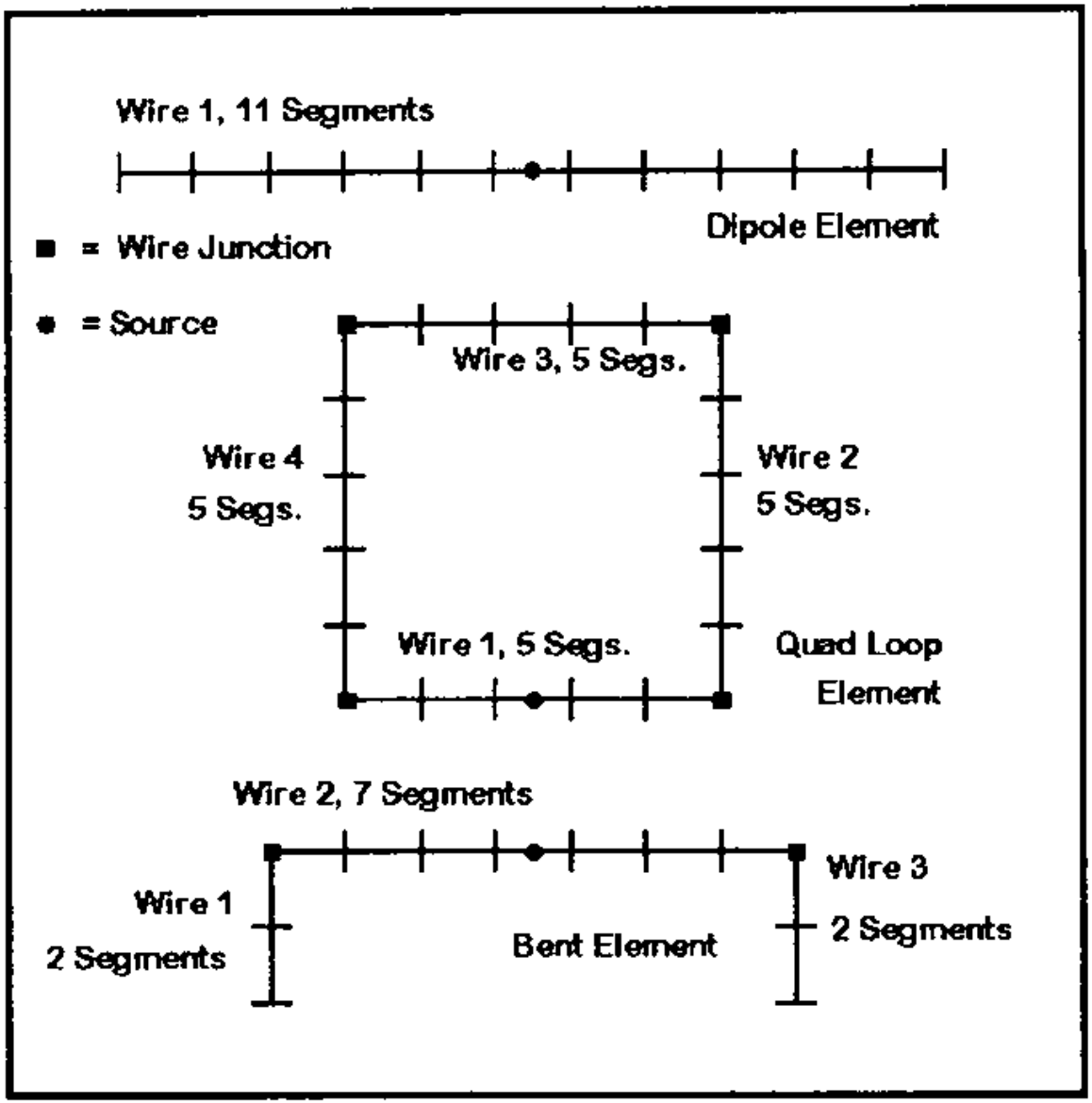
- Most popular antenna modeling *tool* (www.eznec.com)
- ARRL free version- unlimited use only on ARRL data files. Comes with the ARRL antenna hand book CD.
- Free trial version- unlimited use on any data file however limited to 20 wire segments.
- EZNEC v. 5.0- $89; EZNEC+ v. 5.0 $139; EZNEC Pro v. 5.0 $650+
- Other free modeling tools are available such as 4nec2 (http://www.qsl.net/4nec2/)

Antenna Modeling Basics

EZNEC Basics

- Wires- antennas are modeled as a collection of *wires*, whether the actual antenna is made of wires, rods, tubing, solid surface, or towers. Anything that radiates need to be defined as a wire or collection of wires. A classic dipole could be modeled as one *wire.*
- Segments- tells EZNEC how to divide up the *wire* for its calculations. Each segment has equal current and other electrical properties in the model. Affects model accuracy.

EZNEC Basics

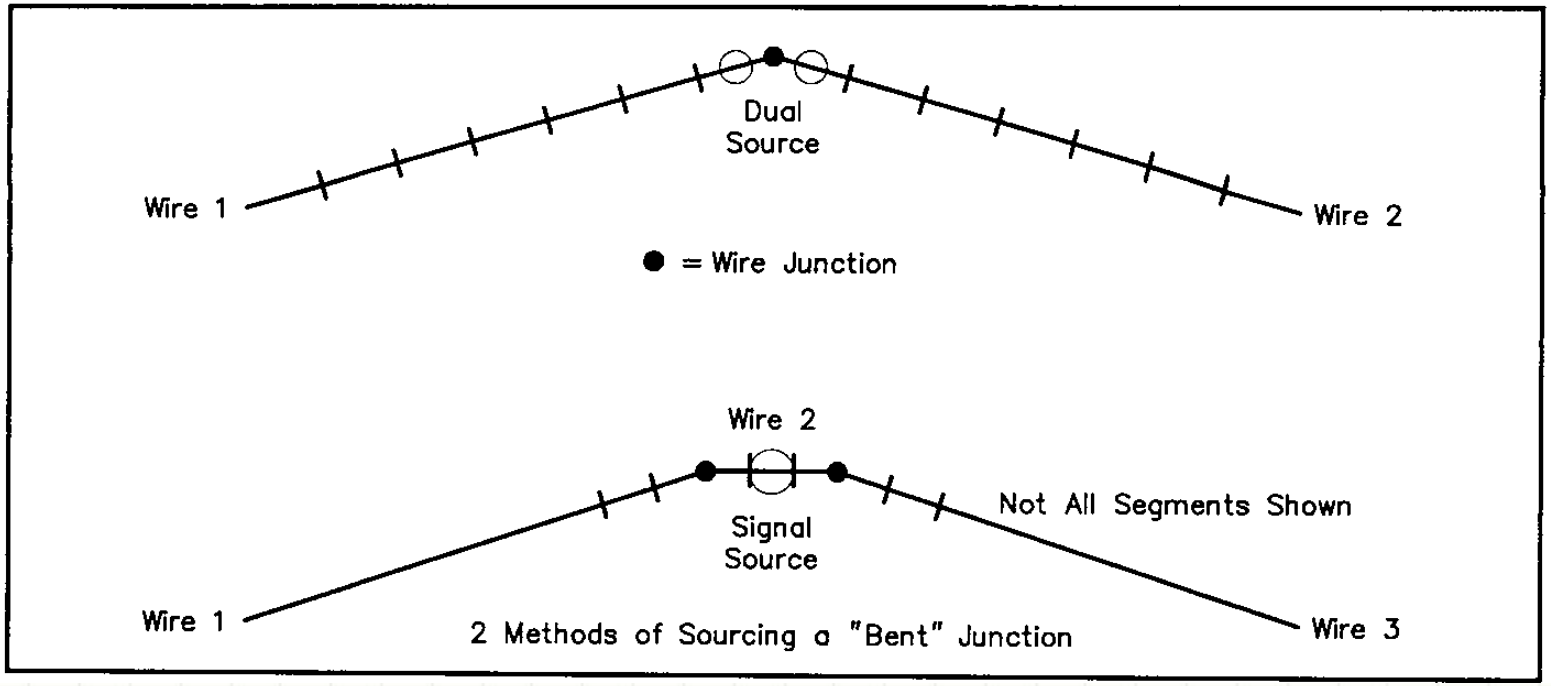


EZNEC Basics

- Wire loss- specify the wire resistance by selecting wire material (i.e. aluminum, copper, etc.)
- Wire diameter- potential impact on modeling output. Different wire diameters necessitates modeling each wire separately.

EZNEC Basics

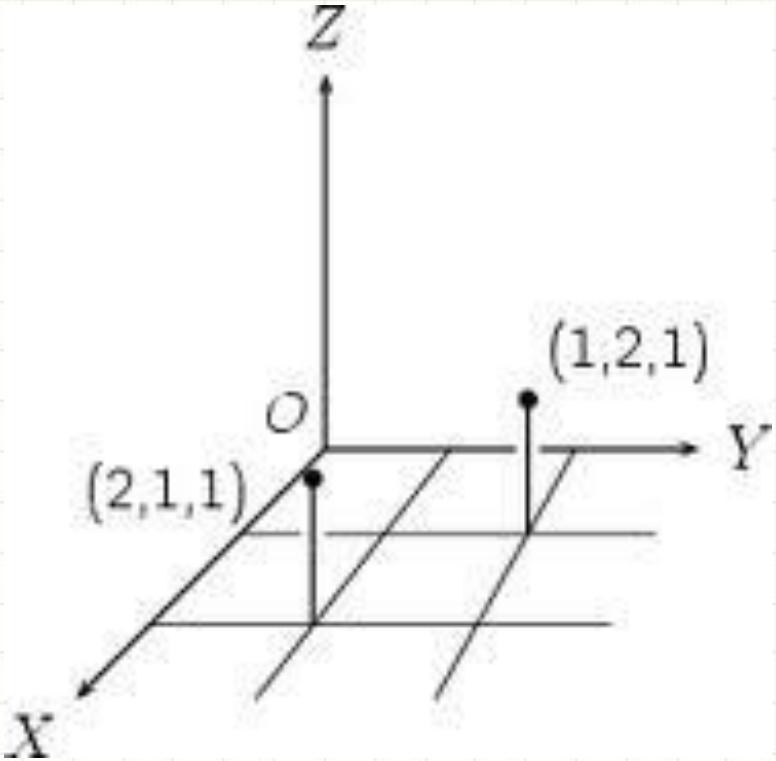
- Sources- bring voltage or current to the wire, aka as a feedpoint. Needs to be placed at the center of a segment.



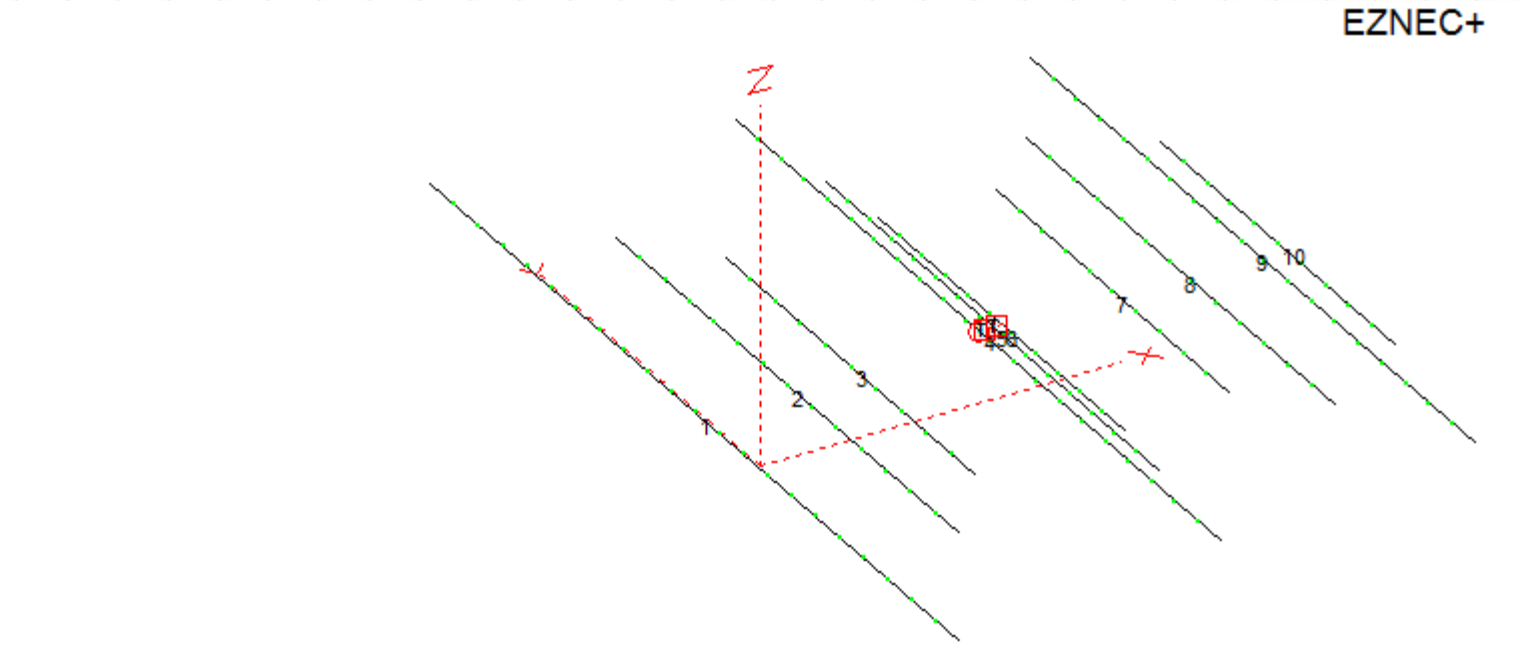
EZNEC Basics

- Ground types- free space, perfect, or real ground
- Loads- lumped impedance (i.e. loading coils, traps, etc.) Three types- R + jX, RLC, and Laplace transform polynomials.

Cartesian Coordinates



Cartesian Coordinates



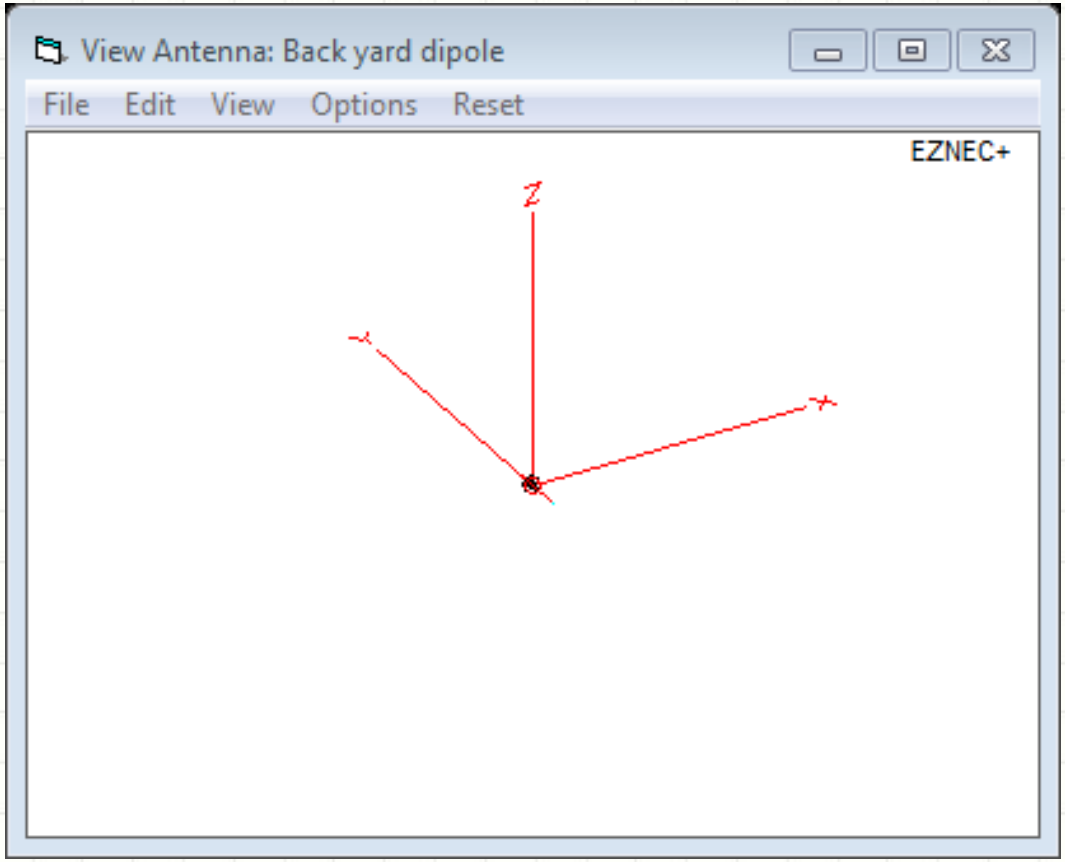
- Modeling convention- on directional antennas keep the firing end along the positive X-axis. Keep the reflector at X=0. The boom at Y=0. Z = height of the antenna.

Interpreting the Results

- Currents- checking antenna's operation and to validate the model
- Source data- impedance, SWR, RMS V/I
- Far field plots- 2D azimuth (aka polar plot), 2D elevation, 3D.
  - Gain, beamwidth, F/R, F/S, lobes.
- Antenna efficiency- calculates radiation efficiency
- SWR sweep

Modeling a 20m Dipole @ 30’

- L (length in feet) = 468 / f (frequency in Mhz) = 468 / 14.2 = 32.96’.



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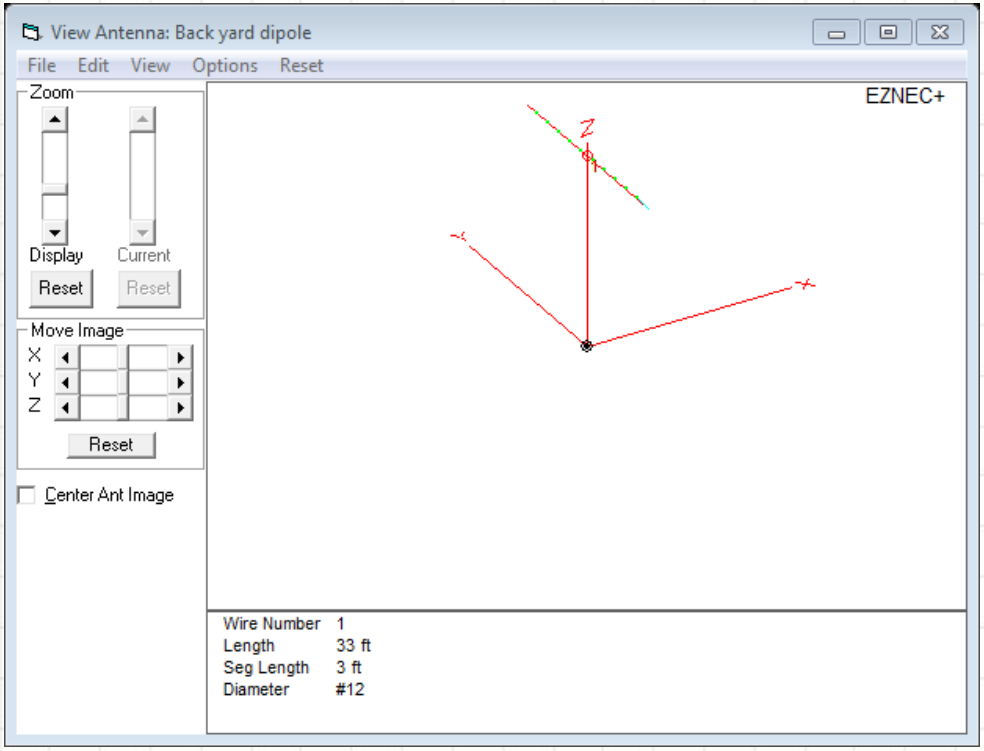

Wires

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	-16.5	30		0	16.5	30		#12	11
✳											

Live demo