Moxon Antenna Modeling

The 4NEC2 Optimizer Function

You built a Moxon antenna but it is not resonant at the design frequency, or the gain seems low, or the front-to-back ratio is disappointing. You wonder what to do to improve things?

You have plans to build a Moxon antenna. You have combed through everything in the MoxonAntennaProject so how to build it is clearly in mind. You have the MoxGen program so you have the necessary dimensions. However, you have your own ideas for construction.
You wonder what will happen to tuning or performance if… ?

This is where antenna modeling can do in a short time what could take days or weeks to do experimentally.

There are numerous Moxon antenna models that I found based on the Numerical Electrical Code (NEC) simulation method. The problem was that each model provided only the final numerical values that the author had determined from his particular conditions of study.
No flexibility. No way to play "what if…?" games.

However, the free program 4NEC2 by Arie Voors www.qsl.net/4nec2 provides an Optimizer Function to do "What if… ? determinations.

Instead of feeding the program fixed numeric values like a wire length of 33.5 feet, you can use a variable: L = 33.5. Then, using Function key F12: "Start Optimizer", you can optimize L = ? for lowest SWR at say, 14.323 MHz. The program will run through many, many iterations to converge on the length that gives the lowest SWR value, then stop.

The 4NEC2 Moxon Antenna Model for Optimization

This model is based on the MoxGen dimensions of A, B, C, D, E. Of those, the gap C can be found by difference so I used only A, B, D and E and feedpoint height (hgh) for variables in 4NEC2 programming.

Applying the MoxGen program for 28.4 MHz and #12 AWG wire size,
the resulting dimensions in meters are:

A. 3.8379 m
B. 0.5734 m
C. 0.1105 m
D. 0.7186 m
E. 1.4025 m

Applying these dimensions to the 4NEC2 Model at a feedpoint elevation of 5 meters, we get:
Resonant frequency: 28.3 MHz, Z=55.8 ohms, SWR= 1.13, Effic.=66.3%, Gain=9.69 & -12 dbi
A bit off tune but very good.

Now optimize the A dimension (Radiator and Reflector) for 28.4 MHz. Get A=3.8223 m
Resonant frequency: 28.4 MHz, Z=51.6 ohms, SWR= 1.04, Effic.=66.51%, Gain=9.77 & -14 dbi
Spot on frequency. Better SWR, Effic. and Gain.

Now optimize the E dimension (Sides). Get E=1.4045 m
Resonant frequency: 28.4 MHz, Z=51.5 ohms, SWR= 1.04, Effic.=66.52%, Gain=9.77 & -14 dbi
Virtually no change. *Same with the D dimension (ends of Reflector).*

Now optimize the B dimension (ends of Radiator). Get B=0.5758 m
Resonant frequency: 28.4 MHz, Z=50.1ohms, SWR= 1.0, Effic.=66.62%, Gain=9.8 & -15 dbi
Perfect tune and even better values for Gain Front & Rear.

This is an example of the Optimizer Function using variables to find the best dimensions.

Note: The modeling program goes further. More than one dimension can be optimized, such as A and B. Even all four: A, B, D, E. Besides SWR, optimization can be in terms of Gain, F/R ratio, Efficiency, etc. at any frequency of interest. Advice: Optimize using A, B, D, E. Don't use Gain optimization because it puts you off frequency. F/R ratio is best because, at lowest SWR, it gives best back and rear signal rejection

You also can experiment with different size wires, tubes, metals as well as the effects of antenna mounting heights.

For those interested here is my antenna model.

CM Generalized 4NEC2 Moxon antenna model which allows optimization of the "MoxGen" A, B, D, E dimensions and wire size at any selected feedpoint height and frequency. C=E-(B+D) by hand calculation.
CM
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CE
SY hgh= x.xx 'Feed point height over average ground - meters
SY A=x.xx 'Radiator/Reflector dimension - meters
SY B=x.xx 'Radiator bent ends dimension - meters
SY D=x.xx 'Reflector bent ends dimension - meters
SY E=x.xx 'Side dimension - meters

GW	1	25	0	0	hgh	A	0	hgh	#12	
GW	2	7	0	0	hgh	0	B	hgh	#12	
GW	3	7	A	0	hgh	A	B	hgh	#12	C not used
GW	4	25	0	E	hgh	A	E	hgh	#12	
GW	5	9	0	E-D	hgh	0	E	hgh	#12	
GW	6	9	A	E-D	hgh	A	E	hgh	#12	
GE	1									
GN	2	0	0	0	4	0.003				
EK										
EX	0	1	13	01	1	0	0			
FR	0	0	0	0	28.4	0				
EN										

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