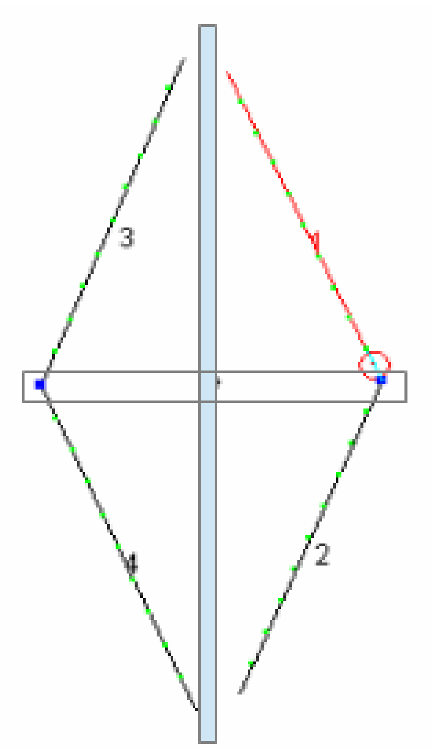
A 6 Meter 2 Element Direct Feed Beam – Waaay Cheaper than Frugal

Aside from the local hardware purchase of a 10’ 1/2” PVC pipe, you probably already have the makings of a dirt cheap, yet useful, 2 element beam requiring no fancy-schmancy impedance matching trickery.

This stems from the well know Vertical Dipole Array (VDA), and some ideas from the spiderbeam approach, and consists of using a horizontal orientation of a VDA, now perhaps the HDA or maybe a Bent Yagi. The VDA and spiderbeams both use wire elements that are basically a widely stretched V shape, yet rather less than straight. It turns out that a 4 foot boom and a 10’ cross member works very nicely giving wires and support that look like this:



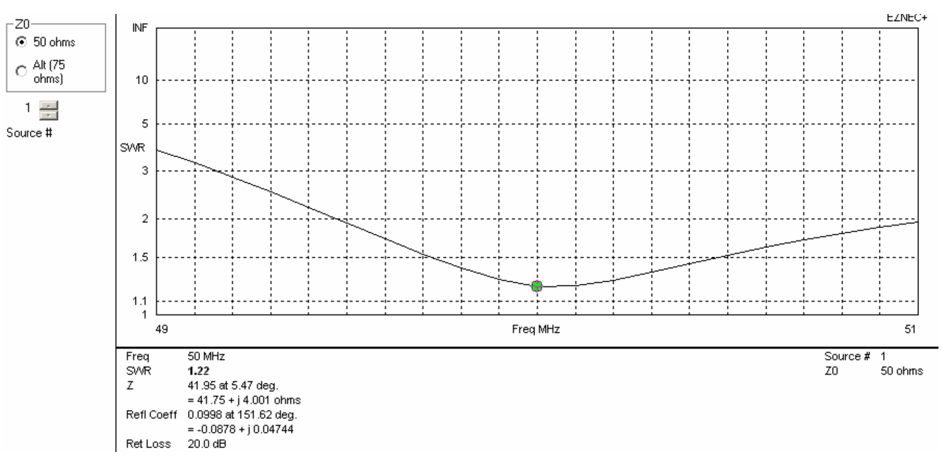
EZNEC is a powerful, though less than perfect, tool for antenna design. However so long as you avoid taking the dimensions as exact, much can be done. In this case numerical experiments with a range of wire lengths and spacing were tested. One major goal is make the raw (unmatched) impedance near 50 + j0 ohms to allow direct coax feed with a tolerable SWR. The principal dimension to control the real part of the impedance is the spacing, or boom length.

Since another mission was to use a single cross member to support the ends of both wire elements, the test cases always kept the wires “pointed” to the end of that center cross member to allow a simple support connection with cord. A cross member length that is fine for the needed wire lengths and also handy to purchase is 10’ which is a standard PVC length available.

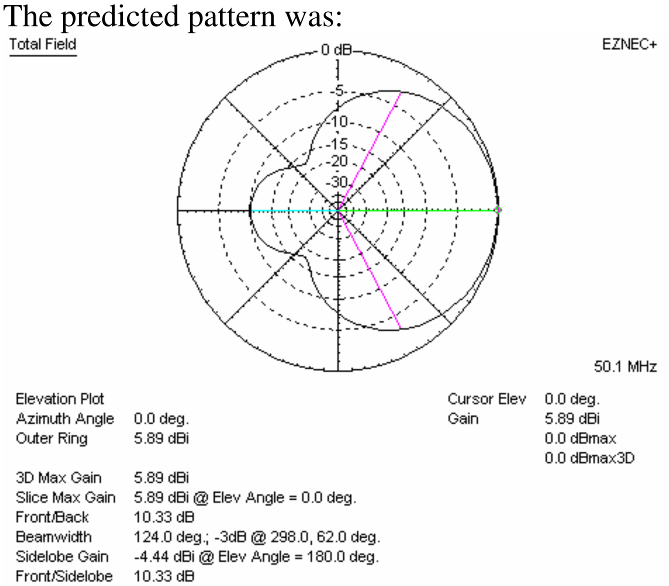
It was found that a 4’ boom is pretty good for the impedance so taking that as fixed, the wire lengths were numerically experimented with. With the boom fixed, the gain of the antenna (at a given frequency) is in large part determined by the length of the reflector element. (It is also possible to have the parasitic element be a director but that is a different design requiring, generally, a different boom length for direct feed.)

So after arriving at a nominal boom length, EZNEC was run with an approximately resonant driven element (when used alone) and the antenna pattern with gain observed while changing the parasitic reflector length. Conventional wisdom is the reflector will be ~ 5% longer than the driven element. When a gain near optimal is found, the driven element length is numerically adjusted to get the best match at the desired operating frequency. Obviously it is possible to iterate on this with a different boom length but modest changes hardly matter.

For this case the EZNEC SWR was about 1.2 at the nominal frequency of 50.1 MHz.:



The predicted pattern was:



with the peak signal being opposite the reflector as designed. There is a F/B of about 10 dB but that is of little benefit on 6 meters. However, the gain of nearly 6 dBi is comparable with that expected for a more optimized 2 element yagi which is typically over 6 dBi. For this EZNEC geometry with the “bent” elements, the driven element (DE) length is 8.92’ and the reflector (REF) length is 9.28’. The DE alone is resonant near 53.3 MHz but the length that would be needed to make that element alone resonant at 50.1 MHz would be 9.47‘. Note that this is not quite what you would expect for a standard yagi with parallel elements.

What would NOT be recommended at this stage to make the physical antenna would be to cut wires to 8.92’ and 9.28’ and just put it up.

Rather the suggestion would be to first to cut the driven element wire somewhat long and put it in place (after cutting in two) without the reflector wire, then raise the partial antenna to a sufficient height (say 10’ or more) and measure the SWR at the TX end of the feed line. Next trim the wire ends to get to the target minimum SWR at 53.3 MHz. (Note that the SWR at the TX end of the coax is (nearly) the same as that at the antenna feed point but the impedance from your antenna analyzer is certainly not.) The DE equivalent length turned out to be 8.90’ (after accounting for insulated wire foldback and the routing to the connector) – essentially the EZNEC value.

Next take the ratio of the REF/DE calculated lengths, 9.28/8.92, and fabricate the longer REF wire length to in proportion to the physical DE length just found. (Or you could determine the REF resonance in EZNEC as a single wire and then feed the REF wire as a test and trim it to that EZNEC resonance frequency, finally reconnecting the two halves.)

With some luck you are now done. Put it up and verify that the SWR minimum is in the neighborhood expected.

Testing for gain is ugly business but you can make some estimate of the F/B or F/Side to verify directionality. For this you can use your antenna analyzer as a source by placing it at several wavelengths away with just a simple wire “antenna.” The relative RX signal strength at different orientations of the new antenna can provide comforting verification of a successful project – subject to actual over the air activity.

For the particular antenna built here the F/B (and F/Side also) turned out to be ~ 12dB (2 S-units) as crudely measured on the RX S-meter and the SWR at 50.1 was 1.1 with the antenna at 20’ but just above the garage roof yet below the peak.

It is not exactly a thing of beauty with no actual insulators on the ends of the wires (just dacron cord flapping in the wind) and a wood 2X2 as the boom - yet contacts have been made easily at the final height of 25’ just above the peak of the garage roof. Duct tape holds the PVC pipe between two pieces of 2X2 so some mechanical upgrades are due soon.

One beauty of the direct feed is higher power is not an issue as it can be for less robust matching methods. You could add a choke ("balun") but experience teaches that with this quality of match and equal wire lengths on the two sides of the DE, it probably doesn't matter much.