Using Mmana simulator

By M. Pertus F5DQK

A couple of months ago, I was interested in spending time on yagi simulation and possible softs used for this.
Previously with PC computers, the choice was only restricted to DOS programs. Other Windows compatible simulators are now well known like EZNEC, Yagi Optimizer of K6STI (not free but not available any more .. would be interested !!), Yagicalc of John Drew WK5DJ directly calculating yagis derived from DL6WU designs (more intended to 200 Ohms).
All of them can only simulate yagis, but no HB9CV (with or without serial capacitor) or more complex examples drawn in three dimensions (quads, or yagis with traps like the Jaybeam DBM6/4 design).

Why did I choice Mmana ? It has all what you can want because it :

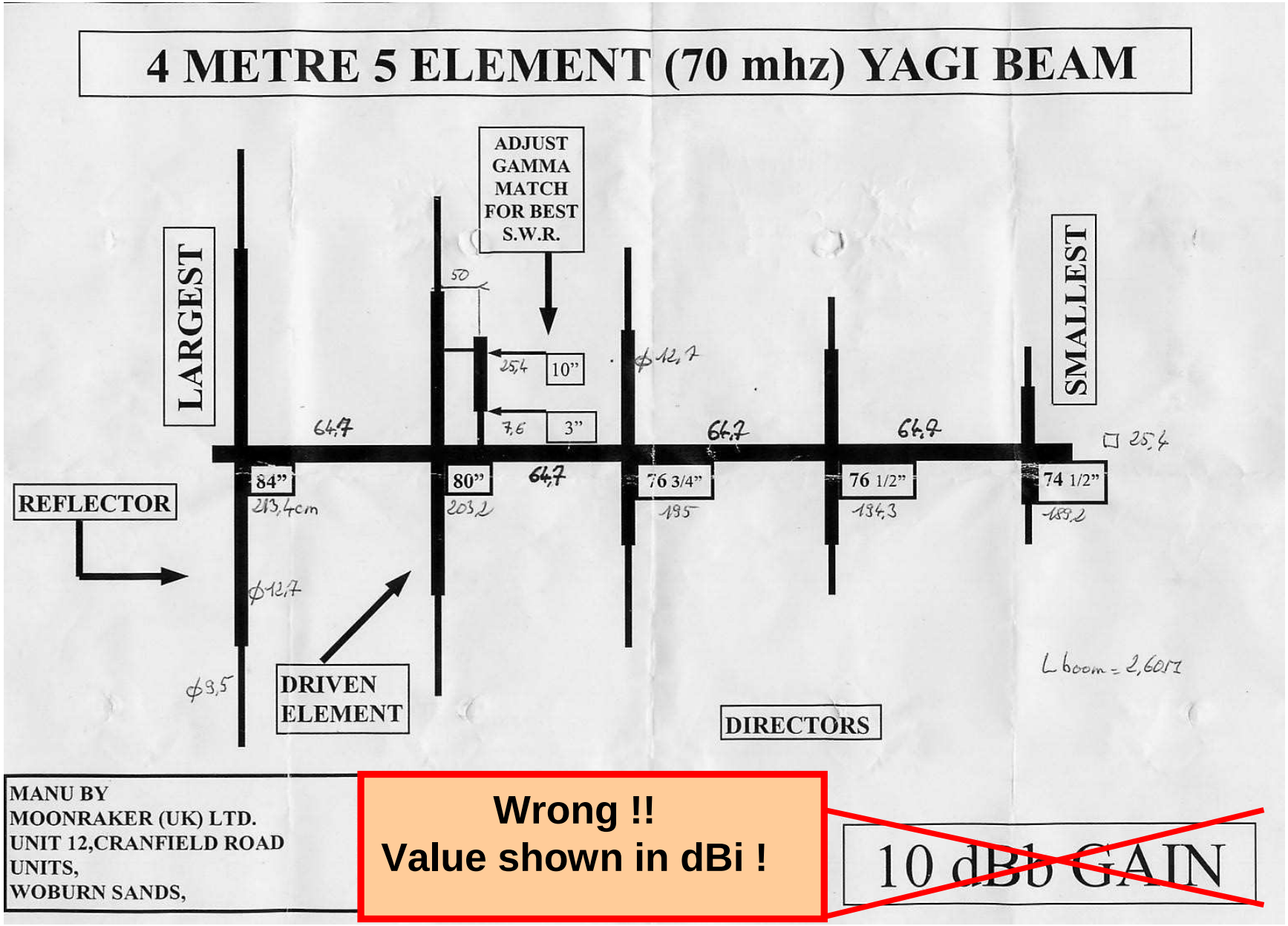
- is free, made by Gary DL2KQ/EU1TT a german/russian OM. Version 3 direct download is possible at ***dl2kq.de/mmana/4-7.htm*** and also on many other sites.
- is written with MININEC basis (Mini Numerical Electromagnetics Code). All hits and tips can be found on ***http://www.smeter.net/antennas/mmana.php***
- is really userfriendly to need and directly written for Windows.
- is possible to design a 3-dimensional graphical antenna (not only in a plan like a conventional yagi). You can also expect the mutual vertical influences between 2 horizontal polarised yagis versus vertical distance.
- can do a design at any other impedance as 50 Ohms (DK6ZB 12 and 28 Ohms designs with pretty F/B ratios).
- can be installed from the web on a Windows XP, 2000, XT, 98 ME, 98 SE, 98, or 95 computer (exe file only 713 kB with added library). And it doesn't mark anything in the register basis!!

Also free, Gary maintains on his site a huge library of MMANA antenna files that he frequently adds to (principally on SW, but also up to 1296 MHz). Tonna yagis are also designed. All MMANA users should know about it, because it contains a wealth of antenna designs that can be used as-is or modified to suit individual needs and experimental curiosities.

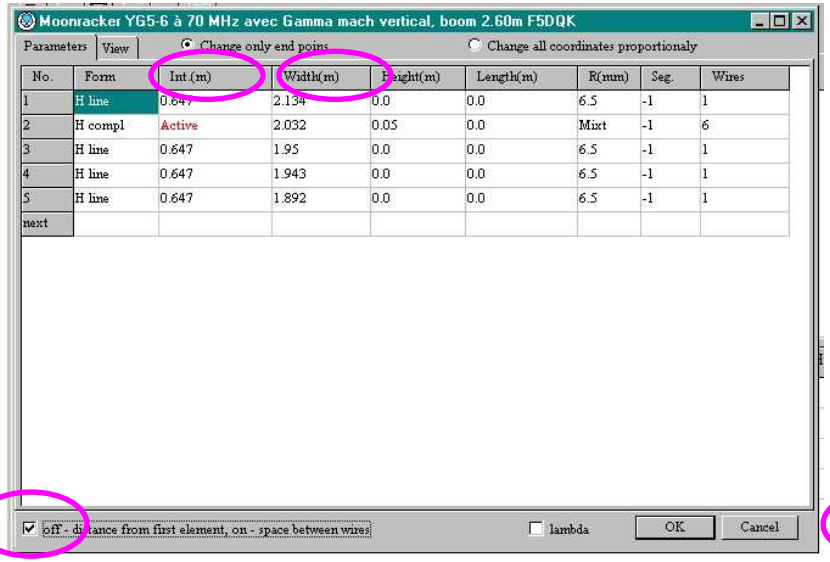
With the elements diameter, the yagi type (50 Ohms direct or gamma/hairpin), the whole boomlength and the element number, it is possible beginning to simulate it. The converging possibility, i.e. the possibility of getting best gain, front/back ratio compromise for a given boomlength is really not bad.

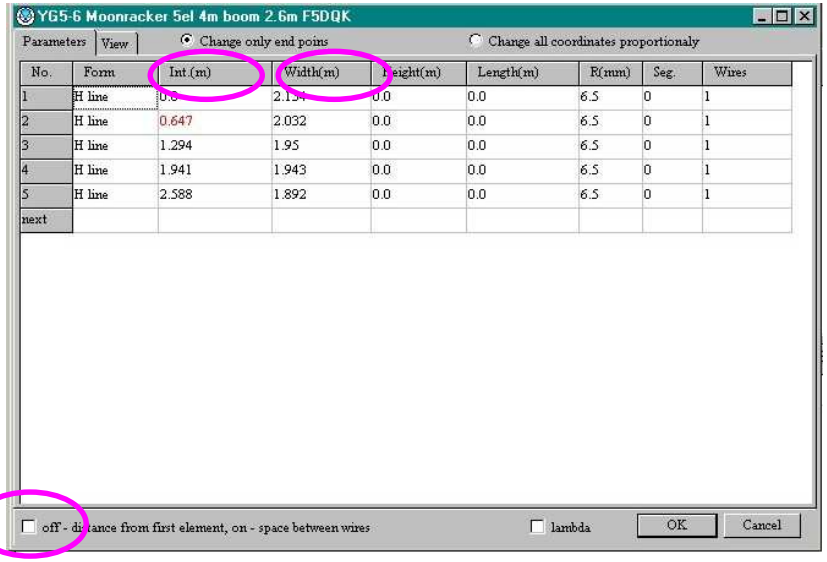
Three examples applicated to the MOONRACKER YG5-4, the TRIDENT 4M4L and the JAYBEAM DBM4-4/6 yagis are briefly explained using screen snapshots.

First example the (buyed) YG5-4 Moonracker dimensions

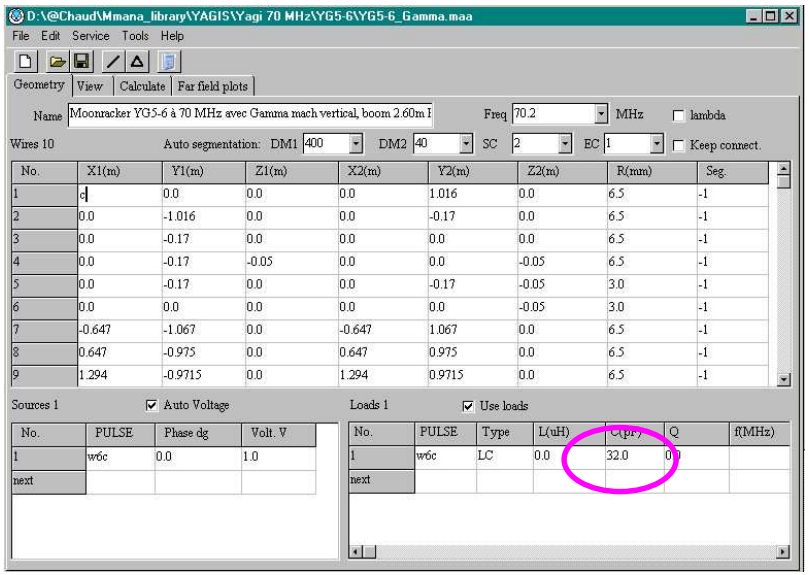


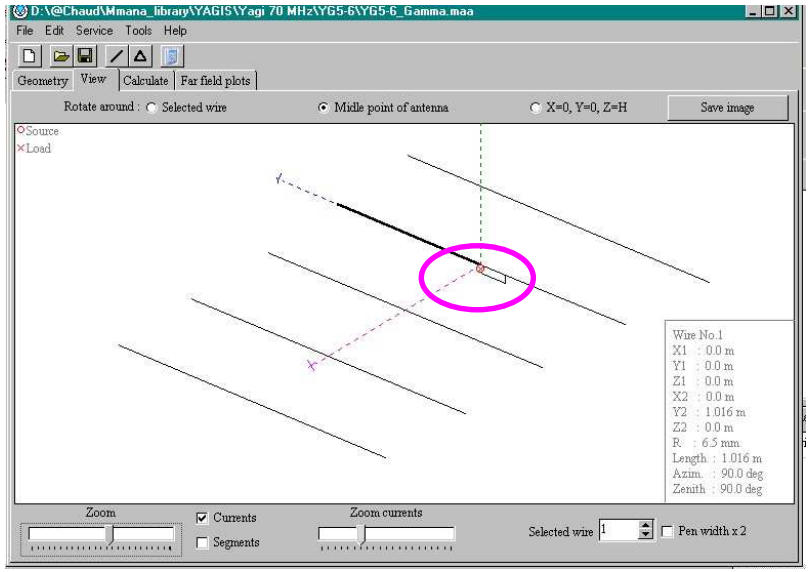
Enter dimensions (metric), either the space between elements or the element position on the boom. Its total length is 2.59M
Note that you must enter the element RADIUS, not its diameter. Then the Yagi drawing can directly be seen



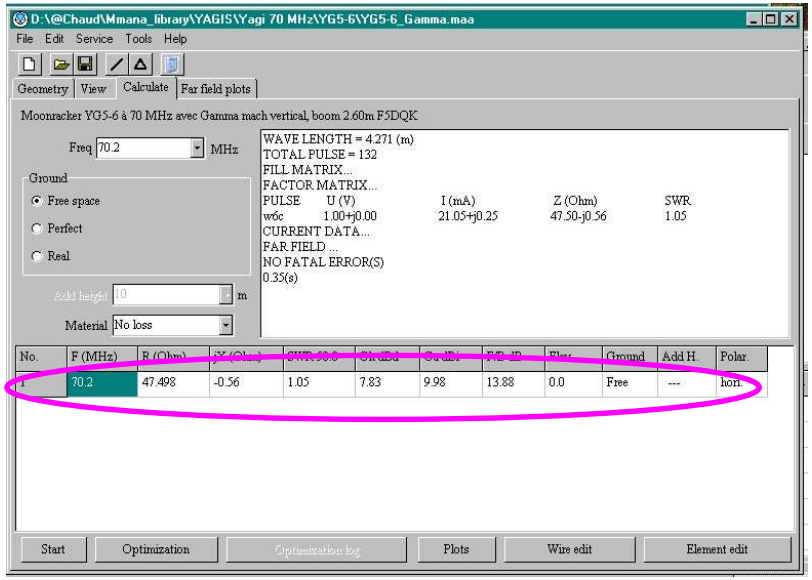


Gamma, té match, hairpin have to be hand drawn. In this case, you must also enter an equivalent serial capacitor. SWR 'll be affined by entering more times new values of C in pF, and adjusting the gamma diameter and spacement to the dipole



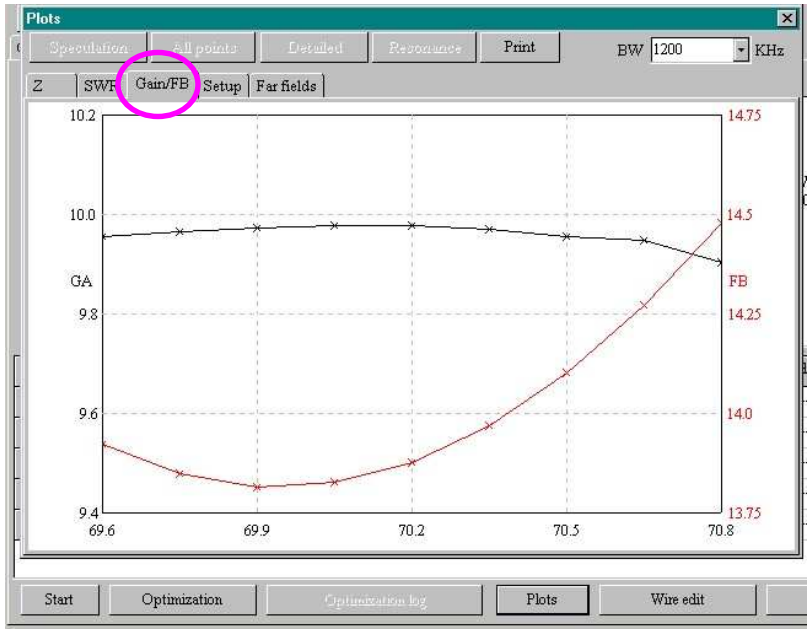


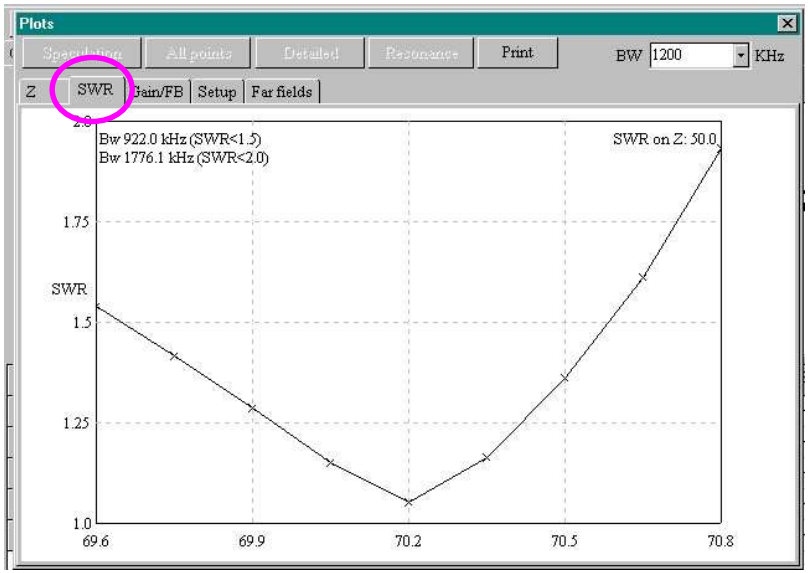
Making a first calculation directly gives all the wanted caracteristics



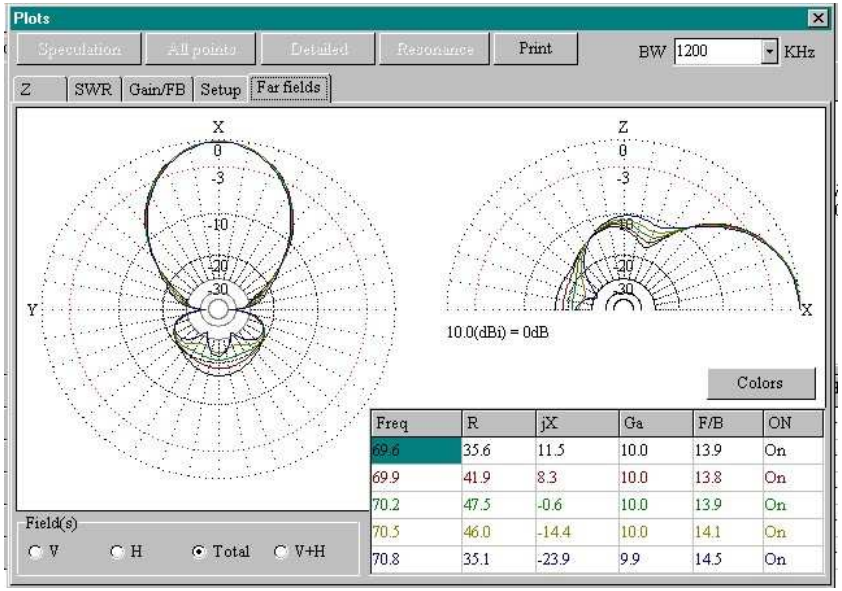
Best gain obtained **7.83 dBd** or **9.98 dBi** (right, according to the optimistic value given by Moonracker)
Front/back ratio 13.9 dB (bad because of equal elements spacement … it's sure a TV translated design !!!

Asking plots gives you either gain/jx couple versus frequency, and the required SWR.
Any impedance different from 50 Ohms can be selected





Antenna diagram is given at 4 frequencies in free space. It can also be given in real heigth conditions above ground.



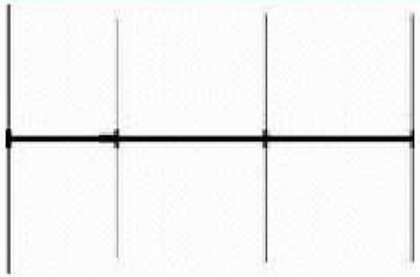
Gain shown here is in dBi (utopic and not exploitable). That's the dBd value + 2.15 dB
The F/B ratio becomes better with a higher frequency .. Look at 70.8 MHz !!

SWR'll be then affined :
- by entering manually other C values or gamma tube diameter and spacement changings to dipole.
- then automatically with the optimisation button. While looking the antenna drawing, you can see the element spacement or gamma length and position changings. That's the converging way, with targed beeing the best gain / front to back ratio compromise (with some limitations).

Second example, the Trident 4M4L with hairpin adaptation

Looking at Nevada add in eBay.co.uk gives following details

PICTURE



TRIDENT antennas

DESCRIPTION

As the 4 metre band is so quiet, it was decided that this antenna should be designed with forward gain as a priority over front to rear.

However, with a long boom this antenna still achieves a very useful 19 plus dB. F/R.

The band is also very narrow, so any trading of gain to obtain bandwidth was unnecessary.

With a gain of nearly 11 dBi at 12 metres (11.5 dBi free space), this antenna is a great performer.

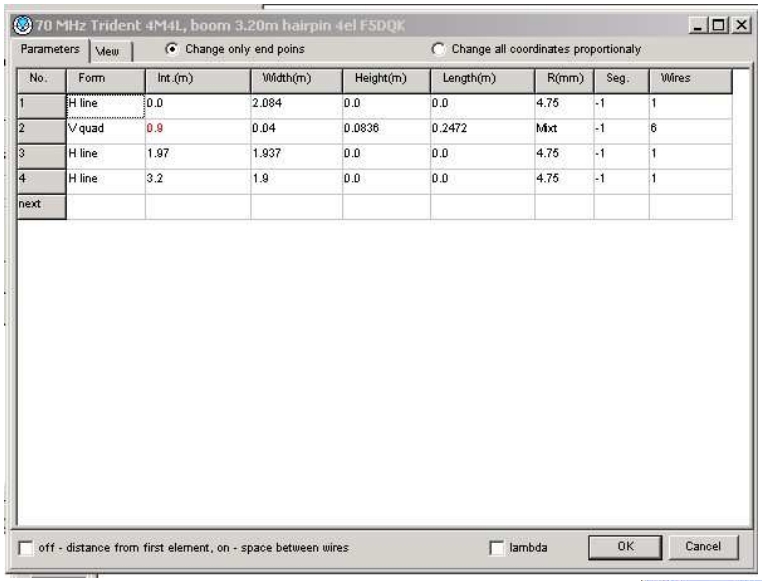
Right

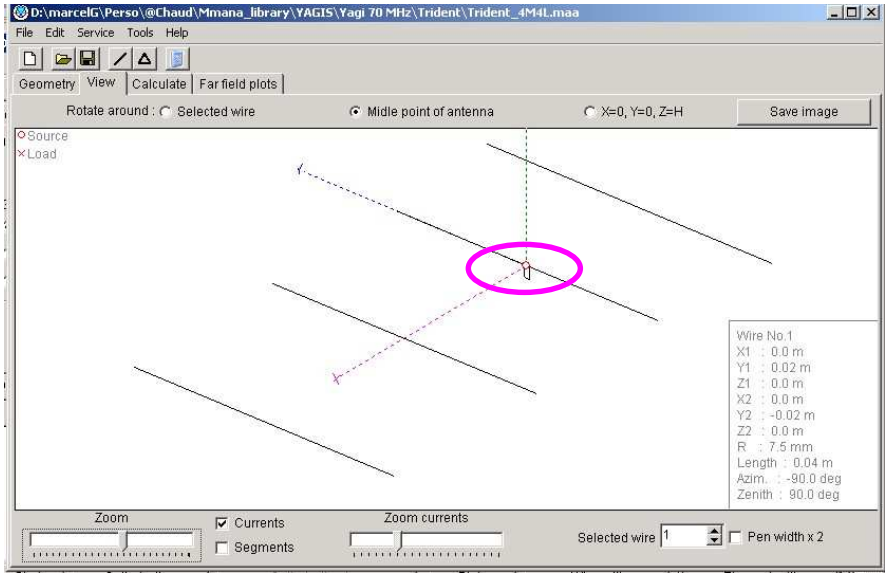
FEATURES

- Trident 4m 4 element beam
- Frequency range 70.0-70.5 MHz
- Gain, typical 11.02 dBi
- Front to rear, typical 19.09 dB
- Feed impedance 50 ohms
- Connector: 4 mm threaded terminals
- Power handling 1.5 kW
- Matching Hairpin
- Boom length: 3.2 metres
- Boom dia. 44 mm
- Element diameters 13 & 9.5 mm
- Weight 4.5 kilos

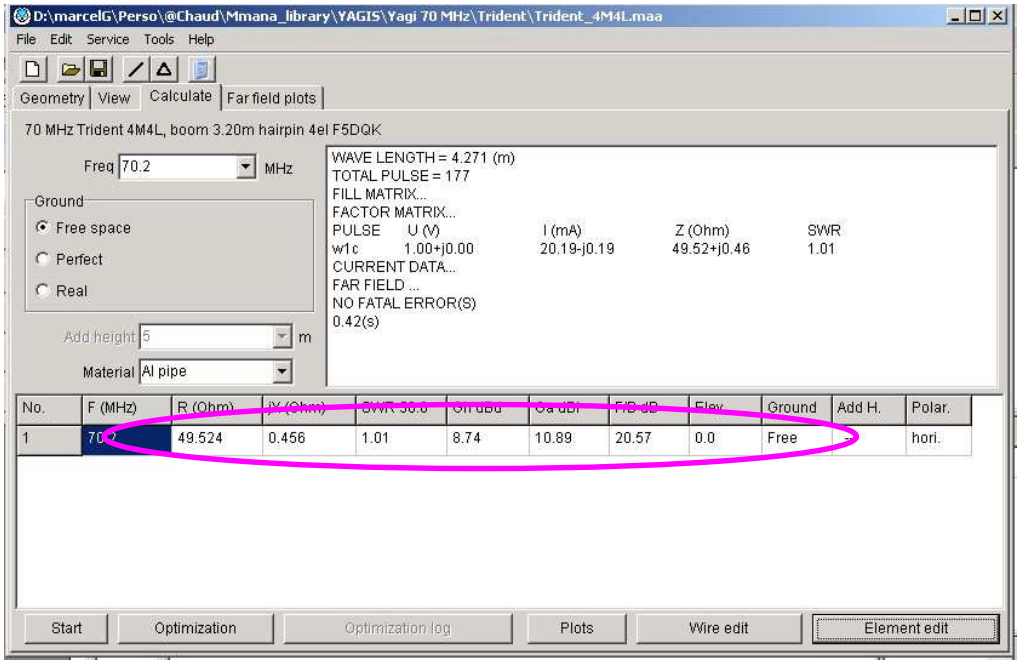
Right

Both most important parameter are its boomlength and element diameter. Then the Yagi drawing can directly be seen
Enter the element RADIUS (dipole 6.5 and elements 4.75 or 5), then an approximated space between elements or the element position, giving a total length boom of approximately 3.20M.
Don't forget to draw manually the hairpin



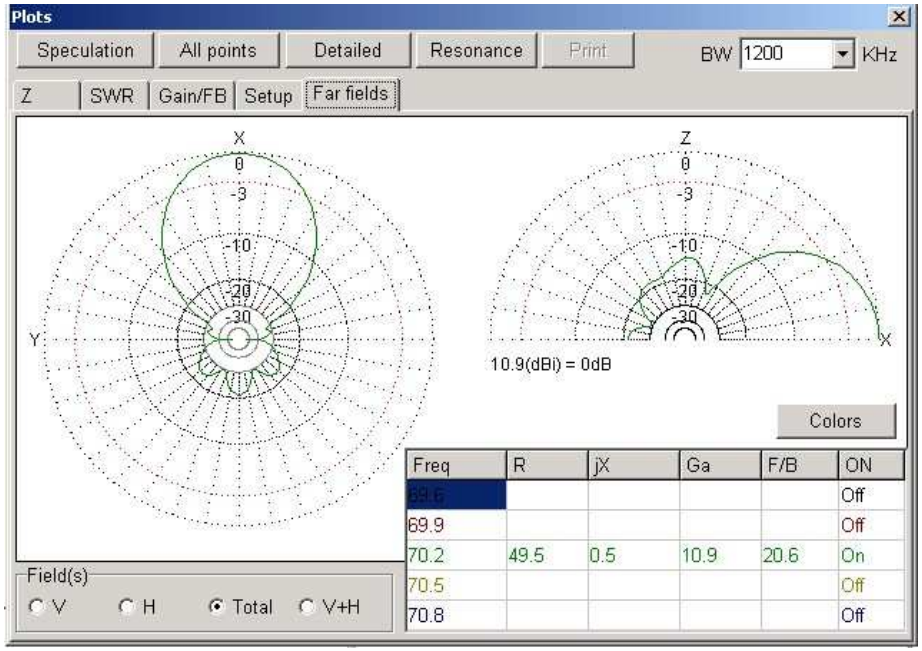


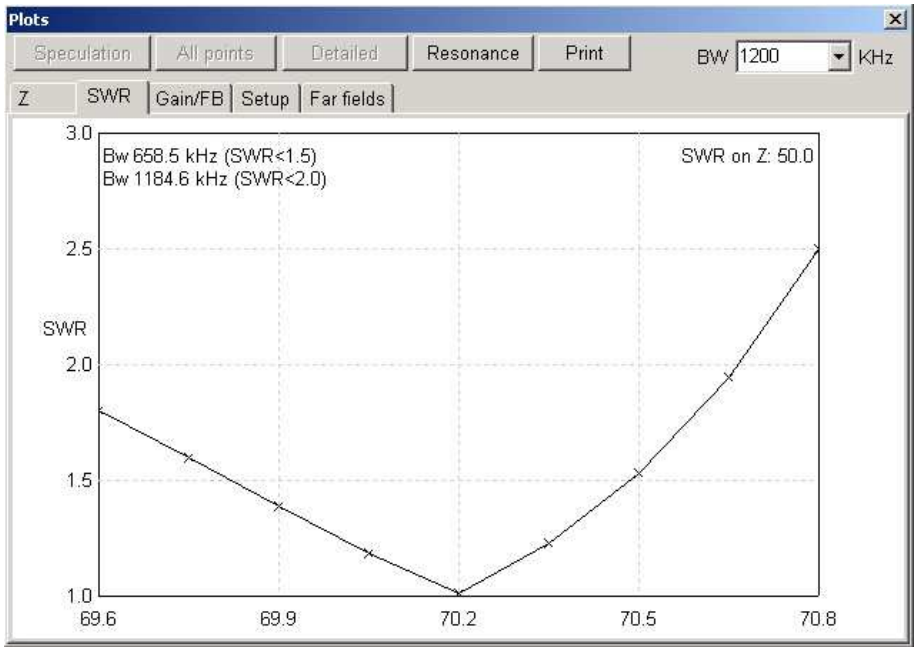
- Making a first calculation gives a first approach
- Then the automatically optimization button'll give the best compromize



It gives 8.74 dB, that's to say roughly 1 dB more gain, with a boomlength of only 60 cm more (or 10.89 dBi) ! That's the best compromize between best gain and acceptable boomlength.
I would prefer an SO239 connector than the 4 mm terminals feeding, but it's the life !

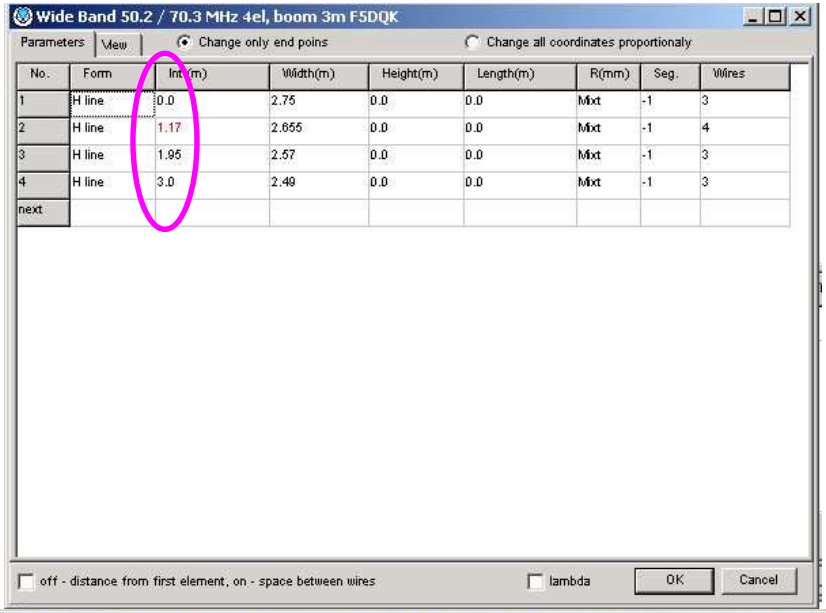
The F/B ratio is now really marvellous.
Its SWR curve obtained in practical conditions is always better than the one simulated shown !

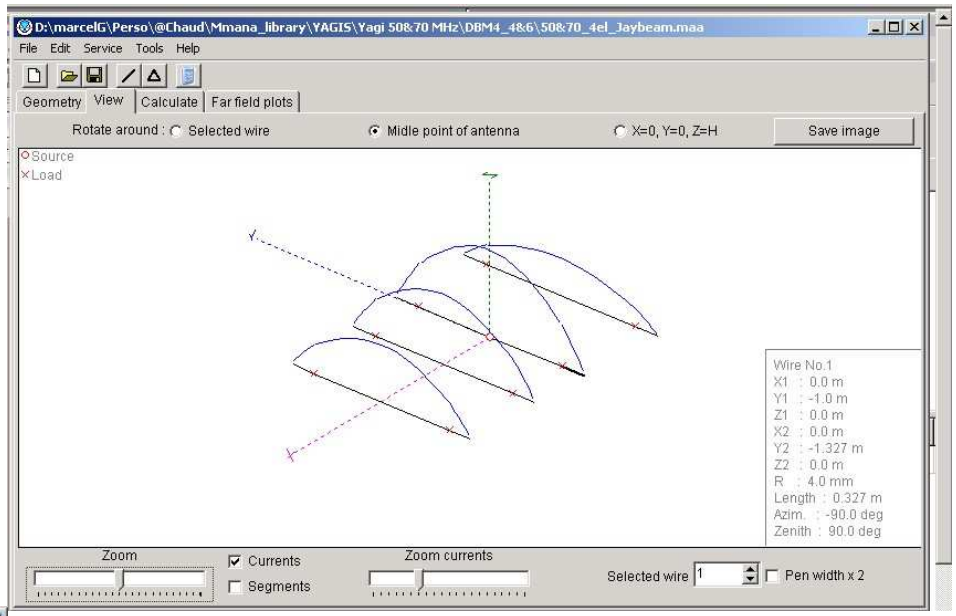


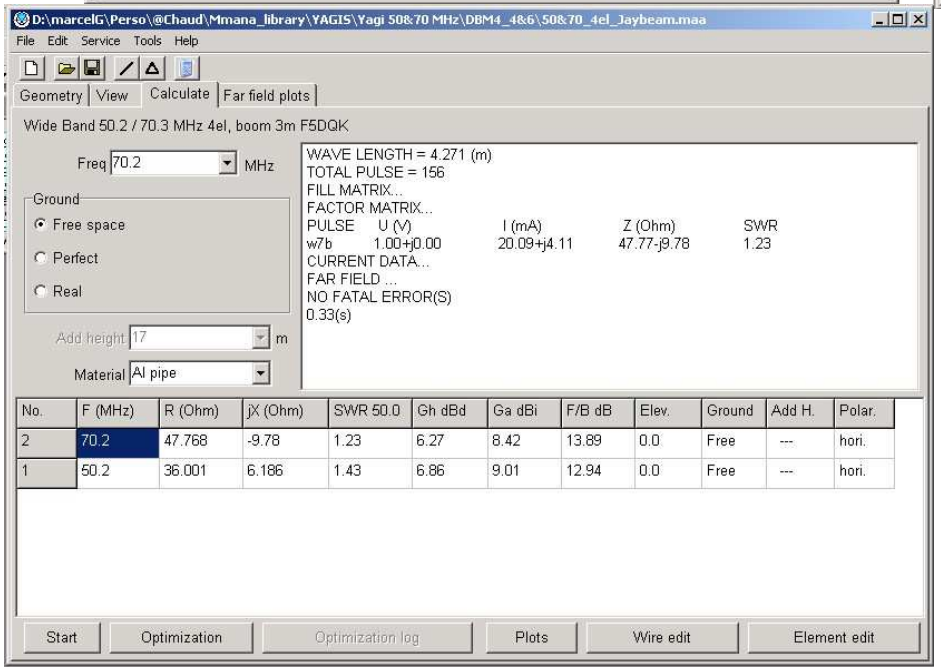


You can also try to lengthen or straighten the boomlength in order to see its influence on gain while keeping at 50 Ohms impedance, but the ***best gain compromise is only obtained with 3.60 M total boomlength*** !!!

Third (very) brief related example, the Jaybeam 50 & 70 MHz DBM4-4/6, 4 element yagi with traps



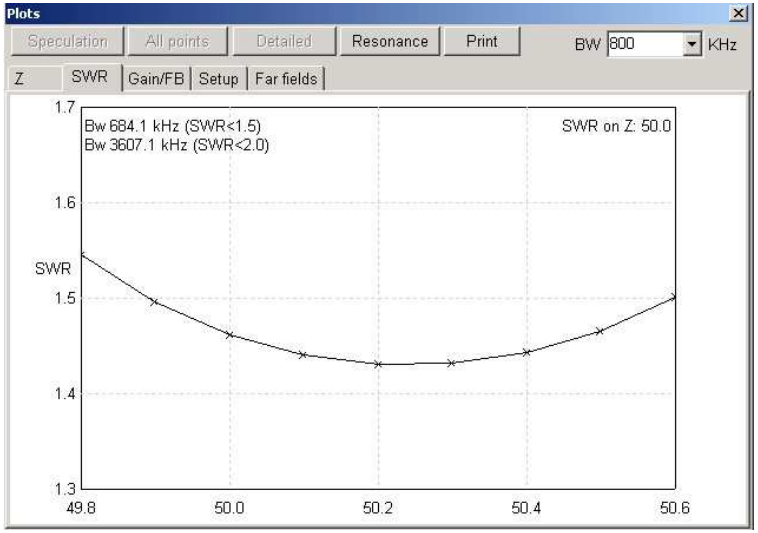




- It is very difficult to stay near 50 Ohms on both bands, together with max gain, SWR min and principally F/B ratio !
-But every four meter freak knows it works not bad !!

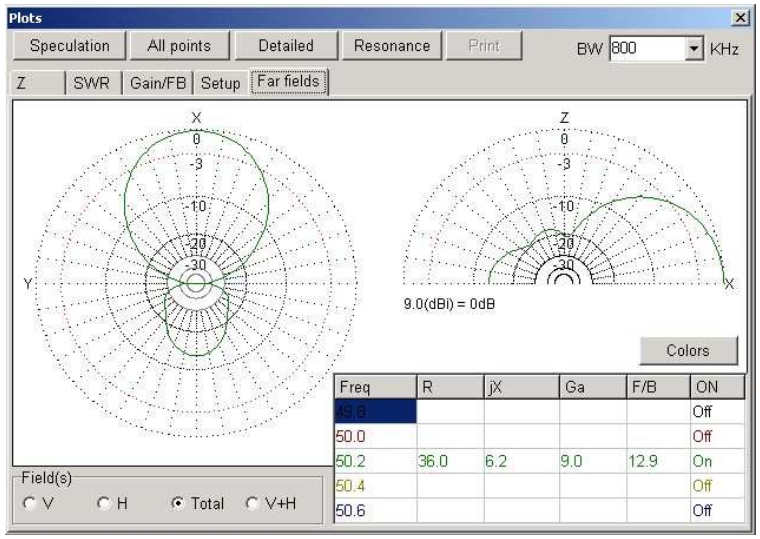
- Again the best compromise for a double band yagi design

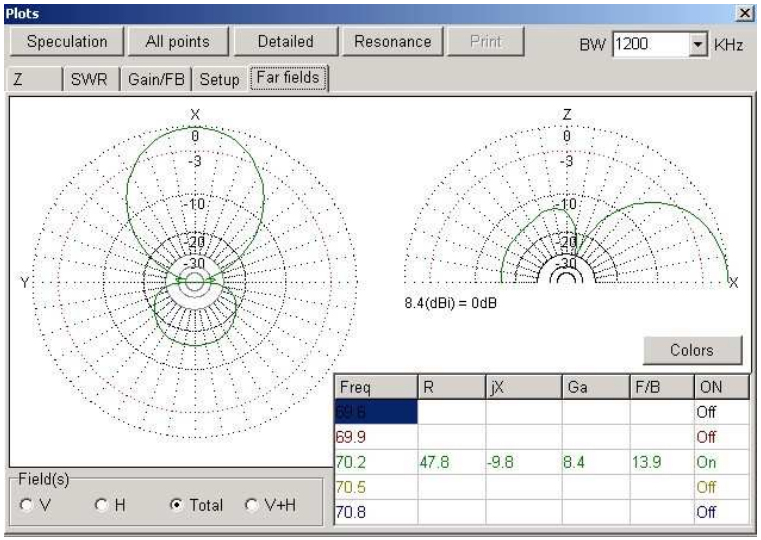
- A five element with this conception doesn't work !!



Frequency 50.2 MHz

Frequency 70.2 MHz





SWR and F/B ratio at both frequencies

I’d do about 500 designs, the target beeing principally six and four meter ones (HB9CV’s up to 5 elements, with and without serial capacitor, quads, quagis, yagis also with traps like the Jaybeam DBM4/6, etc).
Results can be asked free

Want to know more ?? Find all hits and tips using MMANA on ***http://www.smeter.net/antennas/mmana.php***
Many softs and ideas can be seen in ***http://website.lineone.net/~g4kqu/Software.htm*** page