The SCALE Program

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Let's say that you have been using YW to analyze a particular Yagi, and that you like the response characteristics of this particular antenna over a frequency band. SCALE is a utility program that uses the same data files used by YW.

Note that an earlier N6BV Yagi program called BVYAGI also used the same basic YA file format, as did the YO (Yagi Optimizer) program. With the introduction of YW (Yagi for Windows), we have standardized on a filename extension of YW to distinguish the formats. An updated BVYAGI program is included with the CD-ROM for the 19th Ed. of The ARRL Antenna Book so that people who do not use the Windows 95 or later operating system can still evaluate YW files.

As the name implies, SCALE will scale a YW design to a new frequency or to a new taper schedule. It saves the scaled design to a new disk file whose name you specify. You may then run YW to evaluate this new Yagi over the new frequency band. SCALE can also scale YW designs to create disk files compatible with MN or AO (Antenna Optimizer) by K6STI, or with NEC2, NEC/Wires, or NEC-4, the mainframe-like method of moments program.

USING SCALE TOGETHER WITH YW

When you first bring up SCALE, you will first be asked for an input file name. Let's say that you want to create a new YW file on the 2-meter band from an existing YW 6-element 20-meter design on an 80 foot boom called 620-80H.YW. Type in 620-80, followed by [Enter].

After this, the Main Menu will appear on-screen. You will choose option number (2) [Enter], since you want to scale the 20-meter antenna to 2 meters. A submenu will now appear, and you

will again choose item (2), since you want to scale to a new frequency and new element taper.

SCALE will now ask for a new frequency. Type in 146.0, followed by [Enter], to place the new Yagi design in the center of the 2-meter band. You will now be queried whether you want a auto-taper or not. Since this design will be used with YW, you will answer N [Enter]. (The monotaper concept created using the auto-taper function in SCALE will be covered later in the section dealing with outputs from SCALE for other programs. Auto-taper can be used with earlier versions than 7.0 of the more sophisticated K6STI program called YO, for Yagi Optimizer.)

SCALE will now ask you to specify the first element by asking how many tapered segments you will want. Let's assume for now that you want to use 0.188" o.d. rods for your 2-meter elements. You will type 1, followed by [Enter], and then .188, followed by [Enter]. Follow this procedure for the other five elements. SCALE will automatically compute the required length for each element.

After you have entered .188 for the last element, number 6, SCALE will finish its calculations, and then show on-screen the length of the resulting boom, just for reference, asking you to give a filename for the new, scaled design. In our example, SCALE would compute the new 2-meter boomlength at 7.7 feet. An appropriate filename for the new 2-meter Yagi would be 602-8.YWG, meaning that it has 6 elements on 2 meters, and occupies an 8-foot boom. SCALE automatically gives the filename the proper extension (*.YW, *.ANT, or *.NEC) depending on the program for which the file will be used.

Next, SCALE will prompt you to enter a comment-line description of the Yagi that it just scaled. You might type in something like: "602-8.YW, scaled by SCALE from 620-80H.YW," or something like that. As you can see, I usually use the original disk filename, with a comment about the scaling that was done. There is

room for a description 50 characters long. Note that if you simply hit the [ENTER] button rather than entering a label, SCALE will automatically use the disk filename for the label in the resulting file.

After SCALE has saved the file to disk, it will go back to the Main Menu. You will probably wish to exit SCALE and then run the resulting data disk file through YW to verify that the automatic scaling is reasonable, and that the frequency response is appropriate. You will find that the taper schedule used for a Yagi has a subtle and not always intuitive effect on the pattern as a function of frequency, especially the F/R Ratio and the backlobes. In general the bigger the o.d. of the resulting element the less the "Q" of that element.

You may have to run SCALE several times to compensate for these subtle effects. SCALE seems to shift the response in frequency more for severe taper schedules. Usually however SCALE produces designs for new frequencies that are very close to the desired results if a reasonable taper is used.

Now, let's try another example, scaling a 5-element 20-meter beam to 15 meters. We'll use the 520-40M.YW design as the input file. Again call up SCALE and enter the file 520-40M when prompted to do so. From the Main Menu choose option (2), and then option (2) from the submenu. Use a center frequency of 21.225 MHz, and answer "N" to the prompt asking whether you want a monotaper or not.

Let's assume that you want to use some aluminum tubing you've been hoarding in the basement for just such a moment. You have a stockpile of 6 foot lengths of 0.875", 0.750" and 0.625" diameter tubing, each having a 0.058" wall thickness so that they will telescope together nicely. The center section of each element will be a single piece of 0.875" O.D. tubing laid across the boom, so that 36" sticks out on either side of the boom. Into

this will go the 0.750" O.D. tubing, with 6" inserted into the larger tubing to create a strong joint. This means that 66" out of the total of 72" of the 0.750" tubing sticks out of the 0.875" tubing. Into the end of the 0.750" tubing will telescope whatever length of 0.625" O.D. tubing is necessary for each element.

Section	1	2	3
Diameter	0.875"	0.750"	0.625"
Length	36"	66"	variable

Enter the data above as prompted for each element. SCALE computes the overall boom length as 26.378 feet, so an appropriate filename for the scaled design would be 515-27.YW, and an appropriate label might be "515-27.YW, scaled from 520-40M.YW." Quit SCALE and call up YW to analyze 515-27.YW. You should find that SCALE has produced a very nice design that covers the whole 15-meter band well.

Note: if the overall length of the segments making up an element adds up to a length that is longer than that necessary for resonance, SCALE will make the end segment a negative number. Obviously, this indicates that the next-to-last segment should be made shorter than originally specified, or that the operator had better pay more attention to his taper schedule. YW will also object to such a physically impossible designs!

CREATING DISK FILES FOR OTHER MODELING PROGRAMS

With SCALE you can also convert a tapered yagi design to an equivalent "mono-taper" file that can be used directly by K6STI's MN or AO version of the MININEC3 antenna evaluation program, or by the NEC2 or NEC-4 antenna program.

The output files created for MN, AO or NEC2 or NEC-4 will give

an equivalent diameter (radius for NEC-2 or NEC-4) for each element. This diameter will usually be different for each element of a tapered design. This is because the program is creating for each element an equivalent monotaper that has the same reactance at the new frequency as the corresponding tapered element does at the original frequency.

SCALE will also center the boom of a scaled Yagi design at the mounting mast point, 0.000" on the X axis. This allows a program like MN, AO or NEC2/4 to evaluate "Christmas Tree" arrangements, such as when a 15-meter Yagi is stacked 5 feet over a 20-meter beam. Such "short stacks" can cause severe interactions, usually altering the performance of the higher frequency Yagi, sometimes quite drastically.

YW is designed to evaluate strictly single-frequency Yagis, rather than stacks of Yagis. On the other hand, the MN or AO or NEC2/4 programs are more general-purpose modeling programs, although they operate considerably more slowly than does YW.