Yagi-Uda
simple constructive notes

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In these brief remarks, I have summarized some simple guidelines to design and build Yagi-Uda antennas for the HF, VHF and UHF. I used this information for the construction of an antenna system at low cost to be coupled with some prototypes of HF receivers used for the study of solar radio bursts and Jupiter decametric frequencies.

It is often necessary to optimize the performance of the receiving systems, especially in applications of amateur radio astronomy in the frequency bands from HF up to UHF. Where they are not required high requirements in terms of directivity, but it is very important for the simplicity and economy constructional, appear attractive and irreplaceable arrays of Yagi-Uda antenna, since they are easily achievable by any investigator with a minimum of practice (and of passion) in the self-construction. One case is the study of the decametric radiation from Jupiter and the Sun: a station dedicated to this type of research involves the installation of a suitable receiver equipped with a simple directional antenna, preferably adjustable in azimuth and elevation. The following notes will still be useful in all cases be sized, then build with the criteria of economy, Yagi-Uda antennas for any type of radio application.

The Yagi antenna structure is of the traveling wave type (end-fire array), with directivity (and therefore gain) that increase with the number of elements: it is composed of a reflector element (in the rear of the antenna), an active element powered (a dipole), and one or more directors elements (in the direction of maximum reception / transmission). The basic version includes all the elements of length equal to half the wavelength and spaced by a quarter wavelength.

These notes present two project ideas (a structure composed of 3 elements, the other with 6 elements) that adopt non-uniform length and spacing between the elements in order to optimize system performance. Each design parameter (element lengths and spacings reciprocal) is expressed in terms of wavelength, so you can easily calculate the data for any operating frequency. It is important to note that these details are the result of theoretical calculations: the benefits actually obtained may be slightly different (often lower) than indicated values, mainly because of the effects of parasitic parameters (mainly related to how to install the system) are unlikely to predictable in the design phase.

For both projects is supposed that the diameter of the conductors with which the elements are made is equal to 0.003369 λ.

The first set of data refers to a 3 elements Yagi structure. Adopting power through standard coaxial cable at 50 Ω, the gain is 7.6 dB, with a ratio of forward / backward of 18.6 dB and input impedance of the order of 33-j7.5 Ω. The bandwidth is broad about 15% of the working frequency.

Reflector:	0.500 λ
	0.2 λ
Active element:	0.460 λ
	0.2 λ
Director:	0.419 λ

The second project concerns a Yagi antenna with 6 elements, with a gain of about 14.73 dBi and report back / forward 4.10 dB. The width of the antenna beam (HPBW) is equal to 37 °, with maximum amplitude of the side lobes 10.9 dB lower than that of the main lobe.

Reflector:	0.476 λ
	0.250 λ
Active element:	0.452 λ
	0.289 λ
1° director:	0.436 λ
	0.406 λ
2° director:	0.430 λ
	0.323 λ
3° director:	0.434 λ
	0.422 λ
4° director:	0.430 λ

Regarding the construction, we will point to a relatively simple, inexpensive and robust, method. As conductor material immediately available (over that very cheap) for the elements of the antenna is recommended that the hollow tube of suitable diameter in aluminum, available in any hardware, cut to size. The support boom is made on a beam of wood cut to the right length, suitable section and drilled (preferably with a drill press to ensure perfect perpendicularity of the holes) at the distances required for the spacing of the elements (which will later be forced in their holes). The structure can be protected from the elements by applying several coats of exterior paint. The system will be installed on a support structure, preferably equipped with rotors for pointing at a distance.

Some attention must be paid to the fuel system of the antenna. Using a folded dipole as the active element (with characteristic impedance equal to approximately 277 Ω) is possible to adopt a two-wire 300

Ω transmission line from symmetric for the descent of antenna that connects to the receiver ensuring, however, a good coupling with the line of transmission. In this case a balun is not necessary, given that the flat wire is a balanced transmission line. And it is possible to use standard coax cables for the descent of antenna of 50 Ω or 75 Ω (the type for TV) as long as you insert between the dipole active and the coaxial cable impedance adapter transformer-balanced-unbalanced (balun): this device can be easily self constructed (see the extensive literature about) or retrieved from the box of the connections of some Yagi antenna for unusable TV.

Bibliography:

[1] Todd Nichols – BUILD A YAGI-UDA ANTENNA – University of Colorado (Spring 1992).

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