

2022-01-31 Hamlet Net - Yagi Antennas

Announcements:

- Test Session Info
 - Next VE session is Saturday, February 25th. ARRL session, so \$15 fee to take test
- You can start earning your 2023 membership or future renewal by acting as NCS for at least 5 nets this year. You can run either this Tuesday night net or the Thursday night net (or both). We have scripts available for both, so all you need is a good connection into the repeater, and somewhere to keep track of names and call signs as people check in. If you're going to be on the net anyway, why not save some dough at the same time! There are four free memberships available for 2023, so don't wait to get started!
- If you didn't find what you wanted at the NCARC hamfest this past weekend, the next hamfest in this area is the ARA Swapfest on February 19th at the Adams County Fairgrounds from 9am to 1pm. More info at:
<https://n0ara.org/the-swapfest-info-and-directions/>
- Chuck has set a goal for the Club of running at least one activity a month. This can be a hands-on construction activity, an operating activity like Field Day a fox hunt, or a special event station. The goal is to get people together to have fun with amateur radio! We have multiple locations at our disposal, as well as lots of Club equipment, so if you have an idea for something you think others hams would like to do, please let us know, and if you're willing to run it, even better!
- The Club is also looking for presentation topics for 2023. If you have any ideas, or better yet, would like to present, please let Chuck know and we'll get you on the schedule!
- All club activities are open to anyone - members and non-members.
- Club breakfast Saturday mornings at 8am at the Hidden Cafe in Longmont
 - Come meet other Club members and discuss amateur radio

Presenter: Bryan, AF0W

Topic: Yagi Antennas

- There are many different types of antennas used in amateur radio
- Most of us have a few examples of vertical antennas on our HTs, or wire antennas for HF

- A very versatile antenna that you've probably heard of, if not owned, is commonly referred to as the "Yagi antenna," or sometimes a "beam"
- This is a directional antenna that consists of two or more parallel, resonant antenna elements
- The design of this type of antenna gives it a very strong directional signal off one end of the array of elements, and significantly reduced (or even nulls) in the opposite and side directions
- When you see an amateur radio tower with a big antenna on top, it's typically a Yagi antenna
- In addition to amateur radio, this type of antenna is frequently seen on rooftops where it receives terrestrial TV signals in the VHF and UHF ranges

History

- These antennas actually have a somewhat longer name - the Yagi-Uda antenna
- The antenna was invented by Shintaro Uda of Tohoku Imperial University, Japan, in 1926, along with his student Hidetsugu Yagi
- Numerous sources actually credit the initial idea of the antenna to Uda, but as he did not speak English, Yagi published the first article in English, and presented the idea in America, so perhaps that's why his name is more commonly associated with the antenna

Construction

- Yagi antennas are typically constructed with a rigid center support or boom
 - a. Depending on the design of the antenna, this boom may be made out of a conductive or an insulating material
- The antenna elements are attached to this boom parallel to each other and act as half-wave dipoles
- The pair of elements that are attached to the feedline comprise the driven element and are the only elements to which RF is directly applied
 - a. They are typically a dipole or folded dipole
 - b. There is frequently some sort of matching element such as a short piece of wire for a hairpin match, or something more complicated like a gamma match
- There is typically at least one slightly longer element located behind the driven element and away from the direction of antenna radiation called a reflector

- a. A single reflector will add around 4 to 5 dB of gain
 - b. Additional reflectors will only make small increases in gain, but are sometimes used to widen the bandwidth of the antenna
- There may also be one or more shorter elements in front of the driven element which are called directors
 - a. Each additional director will add roughly 1 dB of gain, although this level decreases as more directors are added
 - b. Multiple additional directors also increase the length of the antenna, which may make it unwieldy for handheld use
- These elements are referred to as parasitic elements, as they are not directly connected to the transceiver, but serve to reflect or direct the RF energy
 - a. The parasitic elements have zero voltage at their center, meaning they can be attached to a conductive support with no impact on the pattern
- The radiation from these parasitic elements interacts with the radiation from the driven element
 - a. The amplitude and phase of the signals radiated from the parasitic elements is controlled by the length and position of these elements
 - b. Signals that are in phase with those from the driven element reinforce the signal, while signals that are out of phase reduce the signal, resulting in the overall directional antenna pattern
- The Yagi design is inherently single-band, but some manufacturers use traps to adjust the electrical length of the elements for different bands
 - a. There is even a company called SteppIR that sells antennas which physically adjust the length of the elements to handle multiple bands
- Overall, Yagi antennas are relatively simple to construct - there are calculators available on the web to assist with the design which will tell you how long each element needs to be and where they should be placed along the boom
 - a. In fact, Chuck ran a LARC activity last year where participants constructed their own 2m handheld Yagi antennas using PVC pipe for the booms and tape measure blades for the elements
 - b. If there is enough interest, I'm sure LARC would put on another such event

Radiation Pattern

- In the forward direction, the interactions of the signals from the driven element and parasitic elements result in gain or increased signal strength along the axis of the support beam in the direction of the directors and away from the reflector, creating the main lobe of this antenna type
- In the reverse direction, the signals interfere with each other, resulting in a reduction in signal strength
 - a. While reduction in signal strength in an antenna is generally a bad thing, in this case, the reduced signal level from the rear can be pointed toward a source of interference to reduce its impact
- The ratio of the gain in each direction is referred to as the front-to-back ratio, and can be as high as 20 dB
- There are also small side lobes on the Yagi antenna which can also be useful to null out interference
- The Yagi is polarized in the plane of the elements, and can be mounted for vertically or horizontally polarized signals

Uses

- Many large contesting stations will have multiple Yagi antennas at their disposal
 - a. This is both to operate on multiple bands, and also to allow for the operation of multiple stations simultaneously
- Since the Yagi is a directional antenna, they will also typically have some means of rotating the antenna in the horizontal plane
 - a. Smaller antennas, for example, 2 meter Yagis, can be rotated using antenna rotators meant for TV antennas
 - b. There are larger rotators designed specifically for amateur radio applications that can handle much larger antennas or even rotate the entire tower
 - c. Finally, there are dual-axis rotators designed for tracking amateur satellites that rotate on the horizontal and vertical axis
- Another common use for Yagis, and the main purpose of the antennas built in the LARC activity, is for hidden transmitter finding, or fox hunting
- In fox hunting, one or more hidden transmitters transmit signals either continuously or periodically while hams attempt to locate them

- Directional Yagi antennas are employed during the search as both the main signal lobe and the null areas off the back of the antennas can be used to determine a bearing for the transmitted signal
- One downside is that once you get close to the transmitter, the additional gain of the Yagi makes it difficult to pinpoint the exact signal direction, so amateurs may have to switch to different techniques
- That same fox-hunting Yagi can be used on a Parks on the Air or Summits on the Air activation to help get your signal out there - whether you use it in a vertical orientation for 2m FM voice work, or horizontal for weak-signal SSB.
- When selecting a Yagi antenna, characteristics include antenna gain, front-to-back ratio, beamwidth, frequency, bandwidth, weight and length.
- For example, a Hy-Gain TH-3MK4 HF beam antenna sells for \$770 and has the following specifications:
 - a. Covers 10, 15, and 20 meters using 3 elements with 3 traps each
 - b. Beam is 14 feet of 2 inch diameter aluminum tubing
 - c. The longest element is 27.5 feet, and the entire antenna weight 35 pounds
 - d. The antenna is rated at 8 dBi forward gain, with a 25 dB front-to-back ratio and will handle 1500 watts

Summary

- If you like building antennas and want to try something other than a wire dipole, why not try a Yagi?

Questions:

- **The question for the week is:** Do you have a Yagi antenna, and if so, what do you use it for? Are you interested in a club activity building your own 2m Yagi?
- **In my case,** I've got both a homemade 2m PVC Yagi and a commercially made Arrow dual band 2m / 70cm antenna. I've used these for communication with amateur radio satellites.

More Info:

- Yagi antennas:
 - <https://www.electronics-notes.com/articles/antennas-propagation/yagi-uda-antenna-aerial/basics-overview.php>

- https://en.wikipedia.org/wiki/Yagi%E2%80%93Uda_antenna
- Yagi antenna calculator: https://k7mem.com/Ant_Yagi_HF.html
- Tape measure antennas:
 - http://theleggios.net/wb2hol/projects/rdf/tape_bm.htm
 - <http://n5dux.com/ham/tape-measure-yagi/>
 - <https://nt1k.com/vhf-3el-tape-measure-yagi/>
- Wire Yagi for 40 meters:
<http://www.arrl.org/files/file/QST/This%20Month%20in%20QST/June2018/Siegel.pdf>

Notes:

- If you have ideas for net topics or general meeting topics / presenters, please let us know! Tell us on a net, or send email to k0itp@w0eno.org

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