YAGI-UDA ANTENNA

ELECTROMAGNETIC WAVES (EC 501)

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ELECTRONICS & COMMUNICATION ENGINEERING

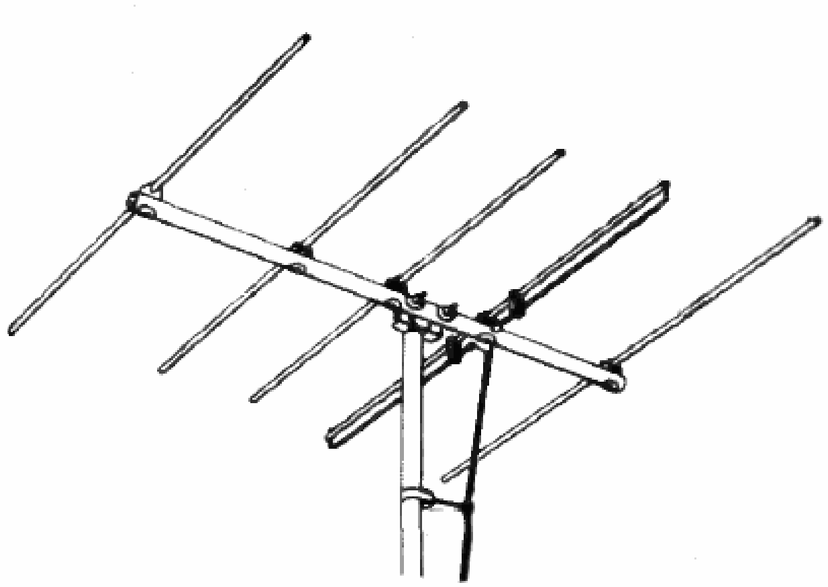
Contents

Origins

- The antenna was invented in 1926 by Shintaro Uda of Tohoku Imperial University, Japan, with a lesser role played by his colleague Hidetsugu Yagi.
- However, the "Yagi" name has become more familiar with the name of Uda often omitted. This appears to have been due to Yagi filing a patent on the idea in Japan without Uda's name in it, and later transferring the patent to the Marconi Company in the UK.
- Yagi antennas were first widely used during World War II in radar systems by the Japanese, Germans, British and US. After the war they saw extensive development as home television antennas.

Description

- Yagi Uda antenna is also termed as Yagi antenna which is a directional antenna that has either two or more parallel resonant antenna components acting as half-wave dipoles. This antenna is majorly formed by three components which are reflector, driven element, and directors, where the single driven component has a connection either with the transmitter/receiver via a transmission line or other parasitic components. In general, the parasitic elements are the reflector and a number of directors(longer element).

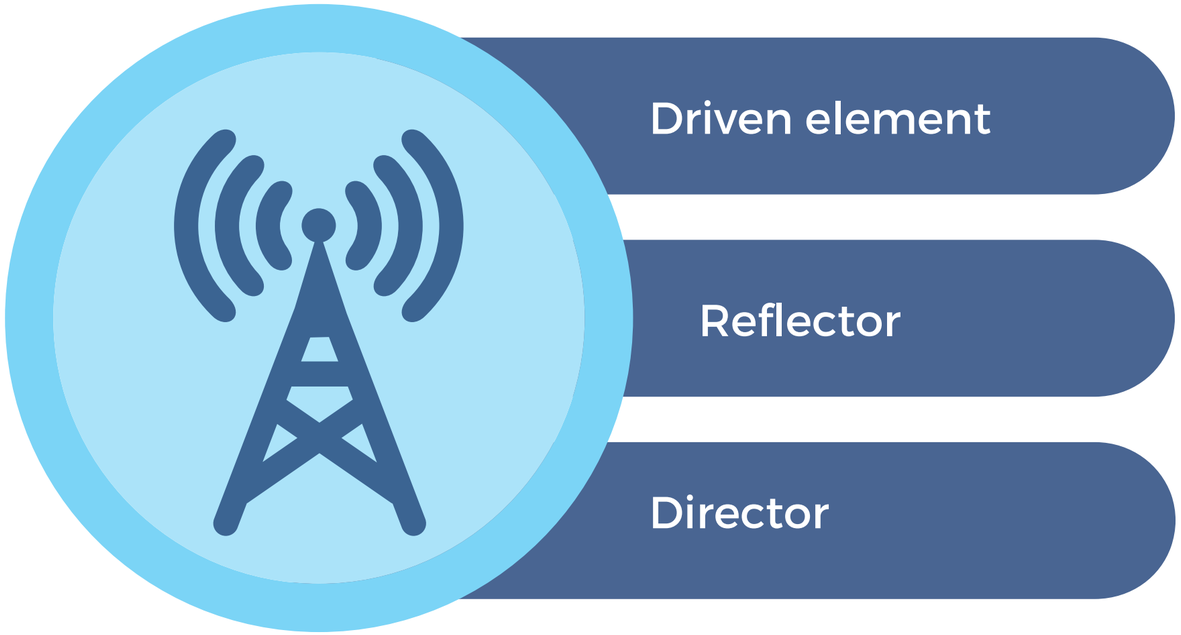


Yagi Uda antenna

- Yagi antennas are generally constructed to function in HF and UHF ranges and they provide the functional frequency between 30 MegaHertz to 3 GigaHertz, even when the bandwidth is very minimal. These antennas are uniquely designed to have good gain values which are more than 10dB.

Components

There are mainly three basic components



Driven element – The driven element provides the necessary current required for radiating electromagnetic energy into space and is usually the same length as a half wavelength at the intended operating frequency.

Reflector – The length of the reflector is generally 5% more than the driven element. Mostly, each Yagi Uda antenna consists of one reflector element which is at the back of the driven element which means sideways from where the maximum sensitivity happens.

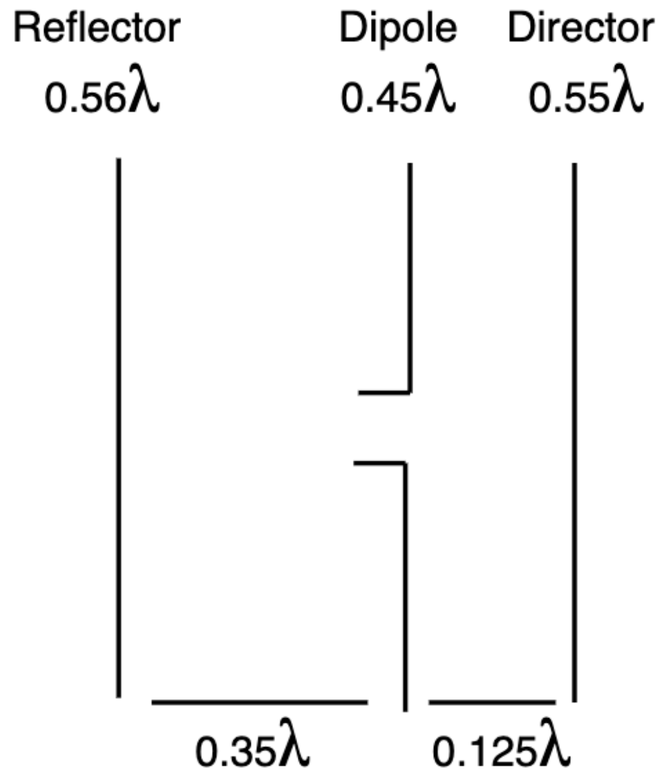
Director – Even when there is a single director or more directors, the length of directors is shorter than the driven component. The positioning of directors will be in front of the driven component which means in a direction that has a high level of sensitivity.

Constructions

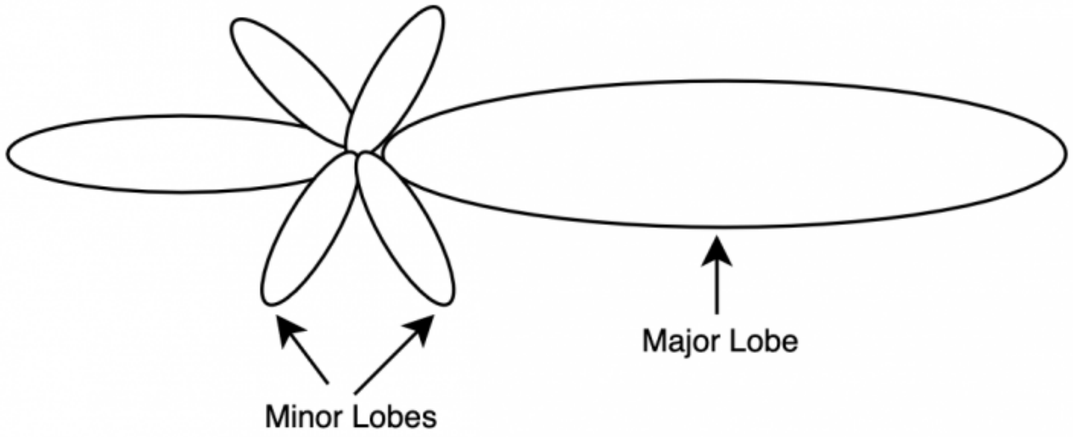
In order to design a Yagi UDA antenna, there are a few parameters to be considered which are:

- Driven component length – 0.458λ to 0.5λ
- Reflector length – 0.55λ – 0.58λ
- Director 1 length – 0.45λ
- Director 2 length – 0.40λ
- Director 3 length – 0.35λ
- Distance between the directors – 0.2λ
- Spacing between reflector to dipole – 0.35λ
- Spacing from dipole to director – 0.125λ

When the above-mentioned design parameters of the yagi uda antenna are met, one can easily construct it.



Radiation Format



Radiation Pattern

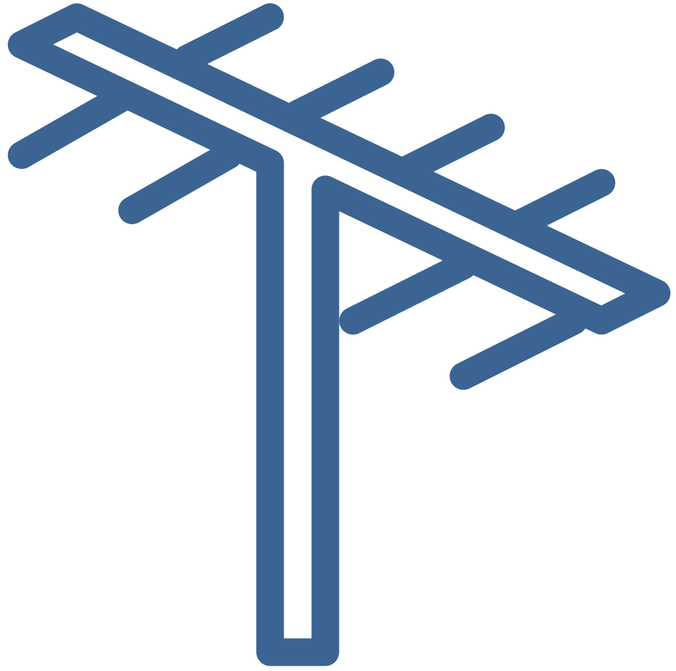
The radiation pattern of the Yagi UDA antenna is highly directive and it is shown below:

- In this radiation pattern, the major lobe corresponds to the forward radiated wave and there are many minor lobes at the rear and sideways. The foremost minor lobe is the reverse one that happened by the radiation in the reflector's direction.
- There is a chance of antenna optimization so that it minimizes the radiation in the reverse path. This happens by varying the length and distance of the reflector or it can also be optimized to generate a high level of forwarding gain. But, there is no perfect coincidence for the above scenarios which makes a person compromise on the performance of the antenna based on the application. So, it is required to select either a high level of front-to-back ratio or else more forward gain.

Applications

A few of the applications of the Yagi UDA antenna are:

- Yagi UDA antennas are employed in TV signal reception as this antenna holds good receiving capability.
- Used in defense applications.
- Employed in the astronomical domain.
- Also used in radio astronomy.



Thank you!