

A NON SUPERREACTIVE ANTENNAS MAXIMUM DIRECTIVITY BOUNDING AND ITS RADIATION APPERTURE

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ABSTRACT

Antennas are key components of any wireless system. An antenna is a device that transmits and/or receives electromagnetic waves. Most antennas are resonant devices, which operate efficiently over a relatively narrow frequency band. An antenna must be tuned to the same frequency band that the radio system to which it is connected operates in, otherwise reception and/or transmission will be impaired. The receiving antenna as a part in the system is responsible of turning the electromagnetic waves into its original form (electrical signal in wire).

Speaking of dipole antenna is speaking of omnidirectional antennas which radiates in all directions. Directed antennas are another category of antennas. The term directional antenna is used for antennas which radiates power in focused and specific direction. Directional antennas can be fixed in a specific location and directed towards the receiver (or transmitter) such as in microwave communications, or it can require rotation facilities as in radars. The ability of the antenna in focusing power in one direction more than other directions is a measure of quality of the antenna and it is often expressed by the terms gain, directivity, front to back ratio, half-power beam width HPBW, and many other factors and parameters of the antenna.

When combining two or more elements to build an antenna with a specific defined distance and specific defined phase shifters, we can obtain the desired radiation pattern. A very common type of antennas is Yagi-Uda antenna uses this principle. It can be seen in most households to receive UHF and VHF TV signals. Yagi-Uda antenna uses the principle of radiation coupling, in which the feeding is to one element and other elements will be activated by it.

The parabolic reflector dish is the most common type of antennas when high gain is required. It has been used since the early of 1900s. It became very popular under the World War II in radar applications and in the present time it can be seen in almost household. The main advantage of the parabolic antenna is the large gain and directivity; however the main disadvantage is the big size dishes which are not easy to mount and have large windage. The principle is the same as the optical mirror reflector, when the source of beams is at the focus on the axis of the parabola, the reflected beam from the parabola will be parallel to the axis of the parabola.

The horn antenna is very widely used in microwave applications since the early of 1900s. The name horn antenna comes from the appearance of this type of antennas. The flare of the horn antenna can be square,

rectangular, cylindrical, or conical. Horn antennas are very easy fed with waveguide, but it can be fed also by a coaxial cable and a proper transition. Horn antennas are widely used as the active element of the parabolic reflector antenna where the horn is pointed towards the center of the parabolic antenna. The principle of how it works is very simple. If a waveguide is terminated it will radiate energy producing a broad radiated pattern.

The Microstrip Patch Antenna is a single-layer design which consists generally of four parts (patch, ground plane, substrate, and the feeding part). Patch antenna can be classified as single – element resonant antenna. Once the frequency is given, everything (such as radiation pattern input impedance, etc.) is fixed.

Because of the antenna is radiating from one side of the substrate, so it is easy to feed it from the other side (the ground plane), or from the side of the element. The most important thing to be considered is the maximum transfer of power (matching of the feed line with the input impedance of the antenna), this will be discussed later in the section of Impedance Matching. Many good designs have been discarded because of their bad feeding. The designer can build an antenna with good characteristics and good radiation parameter and high efficiency but when feeding is bad, the total efficiency could be reduced to a low level which makes the whole system to be rejected.

II STATEMENT OF THE PROBLEM

The current study is done to analyze the non super reactive antennas maximum directivity bounding and its radiation aperture.

III DELIMITATIONS

1. The study was delimited to the non super reactive antennas.
2. The study was also de-limited to micro strip antenna arrays.

IV LIMITATION

The facts discussed in this study were based entirely on the responses to the questionnaire therefore, ascertaining the genuineness of the responses was identified as the limitation of the study.

V HYPOTHESIS

On the basis of research finding, literature reviews, expert opinion and scholar's own understanding of the problem, it was hypothesized that the micro strip antenna arrays is efficient.

VI DEFINITIONS AND EXPLANATION TERMS

Microstrip Line Feed

This method of feeding is very widely used because it is very simple to design and analyze, and very easy to manufacture.

Coaxial Feed (Coplanar Feed)

Coupling of power to the patch antenna through a probe is very simple, cheap, and effective way. If the designer adjusts the feed point to 50Ω , so he just needs to use a 50Ω coaxial cable with N-type coaxial connector.

VII SIGNIFICANCE OF THE STUDY

There are many methods of microstrip antenna analysis; the most popular are transmission line (in which we assume that the patch is a transmission line or a part of a transmission line) The second method is the cavity mode (here we assume that the patch is a dielectric – loaded cavity). The transmission line method is the easiest way of studying the microstrip patch antennas.

The transmission line method is the easiest way to study the microstrip antenna. In this method the transmission line model represents the microstrip patch antenna by two slots, separated by a low-impedance transmission line of length L . Results we get are not the best accurate compared with other methods but it is good enough to design the antenna.

VIII OBJECTIVES OF THE STUDY

The objectives of the current research work are as follows:

1. To study the non super reactive antennas maximum directivity bounding and its radiation apperture.
2. To study the role of non super reactive antennas.
3. To study the significance of non super reactive antennas.

IX REVIEW OF RELATED LITERATURE

Ahlfeld et al. (2012)¹ described that the directivity is the ability of an antenna to focus energy in a particular direction. The definition of the directivity according to IEEE Standard 145-1983: "Directivity (of an antenna)

(in a given direction) is the ratio of the radiation intensity in a given direction from the antenna to the radiation intensity averaged over all directions”.

Barlow et al. (2010)² described that the directive gain (according to IEEE Std 145-1983) is “the ratio of the radiation intensity, in a given direction to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropically”.

Mulligan et al. (2010)³ described that the Gain is always less than directivity because efficiency is between 0 and 1. The directivity increases with increase in substrate thickness h and patch width W . Conversely the beamwidth is expected to decrease with increasing of h & W .

Mulvey et al. (2012)⁴ described that the theory of maximum power transfer states that for the transfer of maximum power from a source with fixed internal impedance to the load, the impedance of the load must be the same of the source.

Peralta et al. (2011)⁵ described that the for a microstrip patch antenna, efficiency can be defined as the power radiated from the microstrip element divided by the power received by the input to the element.

Becker et al. (2012)⁶ described that the factors that affect the efficiency of the antenna and make it high or low are the dielectric loss, the conductor loss, the reflected power (Voltage Standing Wave Ratio VSWR), the crosspolarized loss, and power dissipated in any loads in the element.

Chang et al. (2012)⁷ described that for a microstrip antenna, the electric field E within the patch is normal to the patch and the ground plane, and the magnetic field H is parallel to the strip edge.

Culver et al. (2010)⁸ described that Polarization of a rectangular patch antenna for the dominant mode is linear and directed along the patch dimensions.

Dougherty et al. (2011)⁹ described that the width W of the patch must be less than the wavelength in the dielectric substrate material so that higher – order modes will not be excited.

Duran et al. (2013)¹⁰ described that as a part of the antenna, the ground plane should be infinite in size as for a monopole antenna but in reality this is not easy to apply besides a small size of ground plane is desired.

Fletcher et al. (2013)¹¹ described that length of ground plane should be at least one wavelength, it means as the length of the patch is equal or less than half wavelength.

Goldberg et al. (2009)¹² described that the repulsive force is between the like charges tends to push the charges from the bottom of the patch around the edge of the patch to the top of the patch, this will create the current density.

Gorelick et al. (2013)¹³ described that when the microstrip antenna is connected to a microwave source, the charge distribution will be established on the upper and the lower planes of the antenna

Mehta et al. (2010)¹⁴ described that the charge distribution is controlled by two mechanisms; attractive and repulsive. The attractive force is between the opposite charges on the patch and on the ground plane, it creates a current density inside the dielectric.

Agarwal et al. (2010)¹⁵ described that the cavity model in analyzing the microstrip antennas is based on the assumption that the region between the microstrip patch and ground plane is a resonance cavity bounded by ceiling and floor of electric conductors and magnetic walls along the edge of the conductor.

Mehra et al. (2010)¹⁶ described that working in high frequencies makes the microstrip line behave more homogeneous line as it is only one dielectric (one substrate under and above the transmission line), and the effective dielectric constant is closer to the actual dielectric constant.

X PROCEDURE

Procedure & Statistical Analysis

The performance and advantages of microstrip patch antennas such as low weight, low profile, and low cost made them the perfect choice for communication systems engineers. They have the capability to integrate with microwave circuits and therefore they are very well suited for applications such as cell devices, WLAN applications, navigation systems and many others

In this work; a compact rectangular patch antennas are designed and tested for GPS devices at 1.57542 GHz, and for a satellite TV signal at 11.843 GHz and 11.919 GHz. The final part of this work has been concentrated on studying an array antenna with two and four elements. The antennas of the design examples of this work has been manufactured and tested in laboratory

SPSS statistical package of data analysis will employ to analyze the quantitative data.

This study will cover title of the study, significance of the study, aims and objectives of the study, research hypothesis and research design. This research has designed based upon descriptive study as it aims to identify and elaborate the objectives of work.

The research design contains the following steps:

- Literature review
- Theoretical and experimental analysis.

This study combines both primary and secondary research methods. Thus, gathering and analyzing the data will be done on the basis of existing research.

SPSS statistical package of data analysis will employ to analyze the quantitative data.

XI SELECTION OF SUBJECTS

It was finally decided to select a sample of 300 respondents.

XII CRITERION MEASURE

Secondary data: The secondary data has been collected from various journals, books and policy documents of the government.

Primary data

Stratified random sample technique has been followed to identify the respondents. A Structured Questionnaire was designed, tested and administered for collection of data.