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Comparisons between 2D and 3D Uniform Array Antennas

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***Abstract*—For any wireless communications antenna system becomes indispensable. In this paper we analyzed linear array, planar array and three – dimensional (3D) array antennas. The array systems are simulated in Matlab based on uniform linear array antennas. Comparisons between planar array antenna and 3D array antenna are provided take into account different phases of currents injected in antenna elements. Also we propose to use the array antenna in WSN due to the advantages in signal to noise ratio and power consumption.**

I. Introduction

A radio antenna, transmitting or receiving, is an independent and yet integral component of any wireless communication system. An antenna acts as a transducer that converts the current or voltage generated by the feeding-based circuit, such as a transmission line, a waveguide or coaxial cable, into energy field propagating through space and vice versa. Each radio signal can be represented as an electromagnetic wave that propagates along a given direction. The wave field strength, its polarization and the direction of propagation determine the main characteristics of an antenna operation [1].

Antennas can be divided in different categories, such as wire antennas, aperture antennas, reflector antennas, frequency independent antennas, horn antennas, printed and conformal antennas, and so forth. When applications require radiation characteristics that cannot be met by a single radiating antenna, multiple elements are employed forming "array antennas". Arrays can produce the desired radiation characteristics by appropriately exciting each individual element with certain amplitudes and phases.

Over the last decade, wireless technology has grown at a formidable rate, thereby creating new and improved services at lower costs. This has resulted in an increase in airtime usage and in the number of subscribers. Recently, smart antenna systems have been widely considered to provide interference reduction and improve the performance of wireless mobile communication. The term "smart antenna" reflects the antenna's ability to adapt to the communication channel environment in which it operates. Smart antenna arrays with adaptive beamforming capability are very effective in the suppression of interference and multipath signals. One practical solution to this problem is to use spatial processing. Spatial processing is the central idea of adaptive antennas or smart-antenna systems [2].

In this paper we are focused on changing of the phase of currents injected in antenna elements in order to conclude relating to position control of the radiation pattern characteristic and directivity.

II. Antenna Array Radiation Pattern

An antenna *radiation pattern* or *antenna pattern* is defined as "mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates. In most cases, the radiation pattern is determined in the far-field region and is represented as a function of the directional coordinates." [3] The radiation property of most concern is the two- or three-dimensional spatial distribution of radiated energy as a function of the observer's position along a path or surface of constant radius.

Antennas with a given radiation pattern may be arranged in a structure (line, plane, three – dimensional) to yield a different radiation pattern. Given an antenna array of identical elements, the radiation pattern of the antenna array may be found according to the pattern multiplication theorem [4]:

Array pattern = Array element pattern x Array factor

where *Array element pattern* is the pattern of the individual array element and *Array factor* is a function dependent only on the geometry of the array and the excitation (amplitude, phase) of the elements.

A. Linear Array

The array factor (AF) is independent of the antenna type assuming all of the elements are identical. Thus, isotropic radiators may be utilized in the derivation of the array factor to simplify the algebra. The field of an isotropic radiator

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