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Modeling of the Koch-type wire dipole

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ABSTRACT

Regression and functional models of the main electrodynamic parameters for a family of balanced wire dipole antennas having arms similarly to the Koch first-order pre-fractal are developed. Each dipole differs from the remaining dipoles only in coordinates of the central vertices of arms. Conclusions on an influence of the wire's diameter of the antenna on characteristics of the antenna are drawn. It is shown that a connection of electrodynamic parameters with the geometry of the antenna increases with an increase in the order of the pre-fractal. Algorithms for developing the antennas having preset characteristics are described. Examples describing an application of the algorithms to the modeling of the well matched Koch-type antennas to achieve some desired characteristics are provided.

1. Introduction

Antennas of various types are widely used in modern telecommunication systems. Among most studied and widespread antennas are wire antennas [1]. Of all wire dipole antennas, the simplest half-wave dipole antenna is the antenna, which has been studied very intensively for a rather long time [2]. Therefore, the antennas are no longer of a special interest nowadays. However, antennas with a more complex geometry are still underexplored and still worth of investigation. Besides, antennas with a complex geometry are believed to be most efficient and perspective of all wire antennas. In fact, by making the geometry more and more complicated, it is possible both to minimize the sizes of the antenna and to improve its electrodynamic characteristics [3].

In practice, various forms of the broken balanced dipoles can be used [1,4,5]. However, the most widespread method of minimization or improvement of the given properties of antennas is through their fractalization [6–11]. The most well explored fractal antenna represents a dipole designed on the basis of the Koch fractal. A sufficiently large number of works have been devoted to studying and analyzing the main characteristics of the Koch dipole and monopole [12,13] as well as its various modifications [14–16]. For the simplest half-wave dipole, interrelations between various parameters are already well-known [17].

For analyzing and synthesizing antennas with a complex geometry, various methods were used and described in the literature. For example, the method of investigation of wire dipoles through deriving the system of two integral equations,

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