Optimization of Five-Element Nu-Dipole Yagi-Uda Antenna Using Genetic Algorithms

*Dauda Umar Suleiman**

The paper analyzes the radiation characteristics of an optimized five-element Nu-dipole Yagi-Uda antenna array. Integro-differential equation for the antenna array was formulated. Method of Moment (MOM) technique was then used to convert the formulated integro-differential equation into a matrix form in order to obtain current distribution on the array. Upon computing the current distribution on the antenna array, maximum directive gain, input impedance(Z_{in}) and far zone electric field ($E_q(\theta, \phi = 90°)$) were obtained for uniformly perturbed directors' element lengths and spacings. A combination of MOM and Genetic Algorithm (GA) was used to maximize directive gain as a single objective function for the five-element array. Directive gain and input impedance of 12.31 (dB) and $Z_{in} = 4.46 + j\,27.0$ (Ω) and 11.71 (dB) and $Z_{in} = 2.41 - j\,2.70$ (Ω) were obtained for Micro-GA and Conventional-GA, respectively. These results were better when compared to 11.00 (dB) and $Z_{in} = 2.94 + j\,7.20$ (Ω) for the uniform perturbation. Composite objective function comprising directive gain and input impedance produced values of 9.58 (dB) and $Z_{in} = 75.80 - j\,0.60$ (Ω) for Micro-GA and 9.60 (dB) and $Z_{in} = 75.48 + j\,5.35$ (Ω) for Conventional-GA, respectively.

Keywords: Integro-differential, Method of Moment (MOM), Current distribution, Genetic Algorithm (GA), Directive gain, Input impedance

Introduction

It has been shown that shaped dipole antennas tend to have higher directivity as compared to those of straight dipole (Landstorfer and Sacher, 1986 and Petkovic and Krstic, 2002). The Nu-dipole which is the varying act of the V-dipole (one among the types of shaped dipole) has only its lower arm taking the shape of an arc (Okereke, 1999).

Series of programs have been written and improved upon for the analysis of linear antenna arbitrarily shaped, mostly using Method of Moment (MOM). In Kuo and Strait (1972) a program was written in Fortran for the analysis of radiation and scattering of arbitrarily thin bent wires using matrix methods.

Okereke (1999) analyzed a single Nu-dipole antenna for input admittance and input power, and compared the results with that of a V-dipole. In a related development, analysis of the characteristics of six-element Yagi-Uda antenna array of

* Assistant Lecturer, Electrical/Computer Engineering Department, Federal University of Technology, Minna, Niger State, Nigeria. E-mail: usdauda@gmail.com