A Wideband Dipole Antenna Using a Impedance-matched Network*

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***Abstract*—An impedance-matched network is introduced in this paper, which is composed of two capacitors, one inductor, and one resistor, and is used to broaden its bandwidth in the feeding point of the dipole antenna proposed by N. Amani. The form of the impedance-matched circuit and the value of every element are optimized by Genetic Algorithm in the commercial software, Advanced Design System (ADS). It is quite easier to the method used in the N. Amani's paper and with smaller volume. The bandwidth (VSWR<1.5) of 30-512MHz is obtained which is better than the result in original paper.**

Keywords—impedance-matched, wideband, dipole

I. INTRODUCTION

Antennas are the sensors of wireless communication systems. The performance of the antenna is of great importance to the whole quality of the system. In the band of VHF and UHF, wireless equipment is widely used in the fields of military applications, fire protection area, emergence communication, and radio station etc.. However, as we all know, the size of the antenna, which is comparable to the wavelength in low frequency, will be several meters long. Therefore, the compactness is one of the interesting trends. Meanwhile, omnidirectional radiation is useful in portable applications.

Dipole antenna, which enjoys simple structure and omnidirectional radiation, has been widely studied. Whereas the bandwidth of dipole is extremely narrow due to its resonant characteristic. Widening the bandwidth of the dipole is a significant work. Many researchers have conducted such research. In [1], Yang proposed a log-periodic dipole, and bandwidth of 20-2200 MHz was obtained, yet with the large volume. In [2], Lee presented an antenna composed of three overlapping dipoles, and its width is 0.09 m which is too large for portable device. In [3], Ranasinghe designed a bow-tie antenna with a cavity back. Although bandwidth of 200-600 MHz was achieved, the structure is bulky and not convenient to carry. In [4], Fenn composed a dipole antenna array, with high gain but occupying a lot volume.

In this paper, an impedance matching network was conducted based on the work of N. Amani in [5]. In the original paper, a 1:4 impedance transformer was used in the feeding port, which occupies a lot of volume. Our work provides a much more simple way to achieve impedance matching and obtain better performance.

II. DESIGNING PROCESS AND RESULT

A. Structure Design in HFSS

As shown in fig. 1, the 1:4 impedance transformer, which transforms 50 Ω to 200 Ω, used in [5] which mentioned in [6], is bulky. Based on the dimensions mentioned in [5], the original model was built in the commercial software High Frequency Structure Simulator (HFSS). Fig. 2(a) shows the structure of the original antenna model. The impedance of the excitation port is 200 Ω, considering the effect of the impedance transformer. The result of VSWR curve, seen in fig. 2(c), shows good agreement with that in [5]. Then the helix, the capacitor and the resistor were removed, as shown in fig. 2(b). The impedance of the excitation port is 50 Ω. The value of VSWR in low frequency range is far higher than 1, showing that the antenna is not well-matched, seen in fig. 2(d). Then, the s1p file of the model in fig. 2(b) was exported to the ADS circuit design file to design the impedance matching circuit.

Fig. 1. The impedance transformer used in original paper.

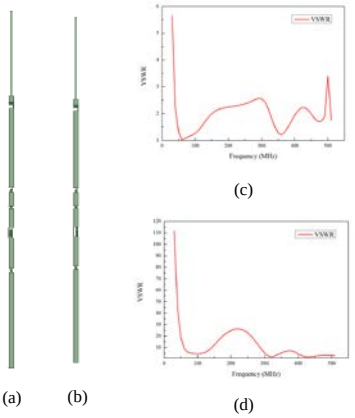

Fig. 2. (a)Original model with 200 Ω port impedance, (b)model with 50 Ω port impedance without elements in feeding point, (c)VSWR curve of (a), (d)VSWR curve of (b).

B. *Circuit Design in ADS*

As shown in fig. 3, the impedance-matched network is composed of five steps serises and parellel connections of capacitors and inductors. With many attempts, we can't make the value of VSWR below three. Then, a resistor is added in the circuit as shown in fig. 4. In addition, by removing the elements which are of unresonable value (e.g. extremely large or small that can't be achieved), the ultimate circuit is obtained as shown in fig. 5. Finally, the value of VSWR in the overall frequency range of 30-512MHz is below 1.5, seen in fig. 6, by the optimization of Genetic Algorithm (GA) in the ADS.

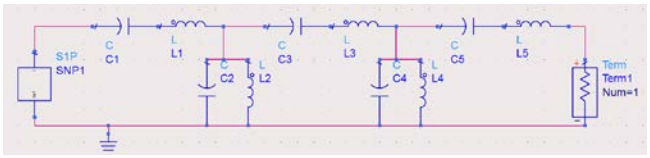

Fig. 3. The original impedance-matched network circuit in ADS.

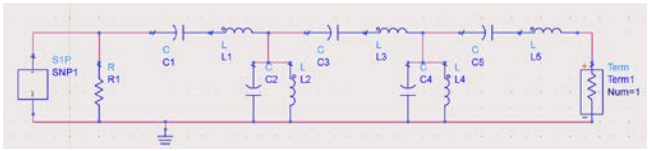

Fig. 4. The improved impedance-matched network circuit in ADS.

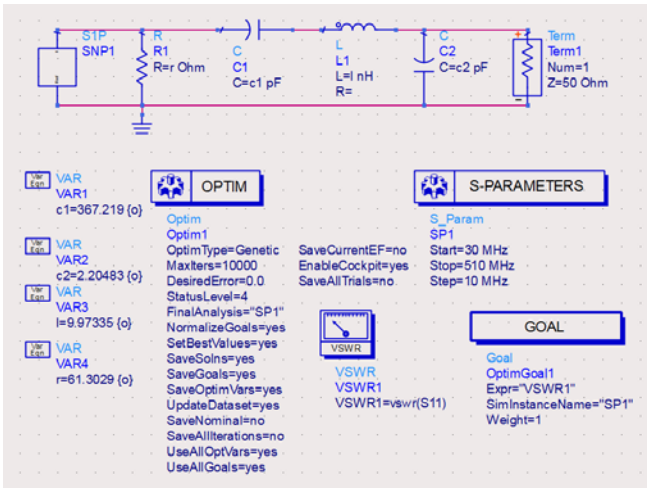

Fig. 5. The final impedance-matched network circuit in ADS.

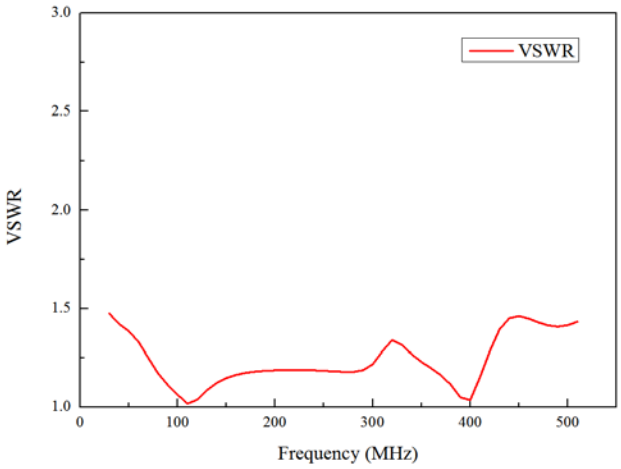

Fig. 6. The VSWR curve of the impedance-matched circuit..

III. CONCLUSION

An impedance-matched network is designed with the union simulation of HFSS and ADS, to replace the bulky 1:4 impedance transformer used in the original paper and to achieve broadband characteristic of dipole antenna. With the optimization of GA in ADS, the form of the circuit and the value of every element were obtained. The value of VSWR in the overall frequency range of 30-512MHz is below 1.5.

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