Wideband Helical-Antenna Design For Wireless Communication In Remote Area

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Abstract – This paper presents the wideband helical-antenna that designed to increase low level signal in the remote area such as highlands, ridge, borderlands, etcetera. The proposed antenna is designed by using thin copper wire with spiral turn number of 8 for solving the problem of the low level signals. Proposed antenna operates at wideband frequency range and it is connected to the GSM modem associated with a laptop or PC device. The experimental result shows that the proposed antenna operate at frequency range of 1200 MHz to 2250 MHz and obtained gain upto 14.5 dB.

Keywords: *Helical antenna; Wideband; Wireless communications; Remote area*

I. INTRODUCTION

Commonly, the wireless communications as used in celluler communications need a continuous data stream reliably. However, in the remote area such as highlands, ridge, borderlands, etcetera it is a serious problem. The level signal is low level, which can not process data stream continuously. The reliability of data stream is very important in the wireless communications.

Recently, the celluler communications progressed fastly that initiated with 1G to 4G [1]. The 4G Long Term Evolution (LTE) technology is developed through UMTS (3G) and HSDPA, that only has a downlink speed of 7.2 Mbps to 14.4 Mbps. Meanwhile, LTE has a uplink speed of 50 Mbps and downlink speed of 100 Mbps [2]. The celluler communications need an access to the nearest Base Transceiver Station (BTS). However, at the remote area that has low quality of receiving signal due to not any BTS, the optional devices such as proposed antenna that connected to a GSM modem associated with a laptop or PC is required to increase the signal level in order to the client data can stream continuously.

Base on the case above, the helical antenna that designed using thin copper wire with spiral turn of 8 is proposed to increase the quality of receiving signal through improving the characteristic radiation of proposed antenna.

II. HELICAL ANTENNA DESIGN

A. Helical antenna as an overview

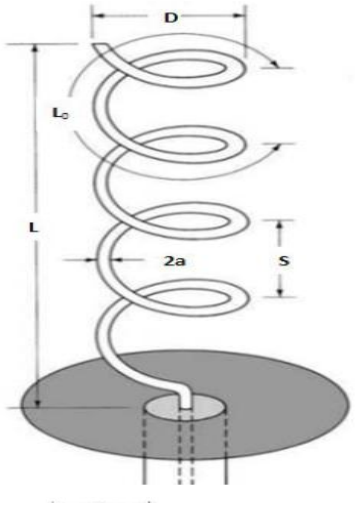

Fig. 1 Helical antenna

The dimensional parameters of helical antenna are [3]–[6]:

D_{helix} = antenna diameter
S = spaces between coil
L = axial length of helix
Lo = circumference of helix
2a = copper-wire diameter
n = number of coil

Each parameter can be calculated through the equations as:

$$D_{helix} = \lambda/\pi \quad (1)$$

$$S = 0.25\ Lo \quad (2)$$

$$Lo = \pi\ D_{total} \quad (3)$$

$$D_{total} = D_{helix} + 2a \quad (4)$$

$$L = n\ S \quad (5)$$

B. *Proposed antenna design*

In this paper, the proposed antenna is designed to increase the signal level through improving the characteristic radiation of antenna as shown in Fig. 2.

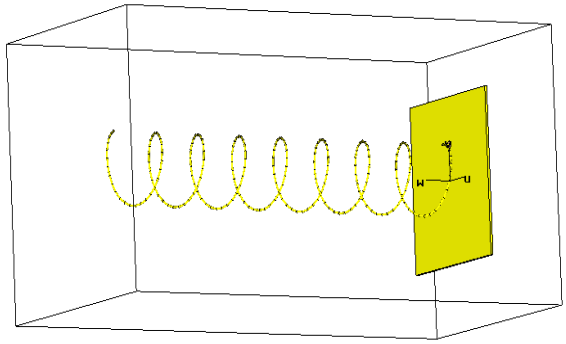

Fig. 2 design of proposed antenna

The proposed antenna is constructed with helical shape on single layer of aluminium metal as ground plane. The dimensional parameters of proposed antenna is calculated by using Eq. (1) to Eq. (5) as shown in Table 1.

Table 1 Dimensional parameters of proposed antenna

Calculated value for frequency of 1800 MHz		
Dimensional parameters	Symbols	Value (mm)
Wavelength	λ	166.667
Total diameter	D_{total}	54.742
Spaces between coils	S	42.972
Length of antenna	L	343.779
Circumference	Lo	171.889
Copper-wire diameter	2a	1.667
Ground Plane	GP	124.995 x 124.995

III. FABRICATION, RESULTS AND DISCUSSION

A. *Hardware Fabrication*

The proposed antenna that designed by using simulation software to obtain the radiation characteristics of antenna is verified by measurement. The proposed antenna is fabricated on single layer of aluminium metal as ground plane as shown in Fig. 3.

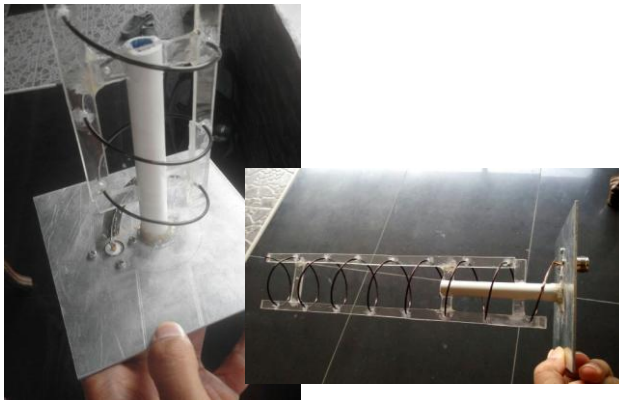

Fig. 3 Realized proposed antenna with helical shape

Figure 3 shows a picture of fabricated helical antenna with spiral turn number of 8 that constructed on single layer of aluminium metal as ground plane. A female N-type connector is soldered at the feeding port of fabricated proposed antenna for experimental characterization. The characterization is focused on wide-bandwidth and antenna gain improvement.

B. *Results and Discussion*

The measurement results of S_{11} for helical antenna with spiral turn of 8 is shown in Fig. 4. The results show that the proposed antenna operates at wideband frequency range of 1200 MHz to 2250 MHz. The value of S_{11} is up to –23 dB for the frequency of 1860 MHz; –34.5 dB for the frequency of 2040 MHz; and –31 dB for the frequency of 2190 MHz. From Fig. 4 It can be observed that the impedance bandwidth for $S_{11} \leq$ 10dB of the proposed antenna through measurement is 1050 MHz (1200 MHz to 2250 MHz).

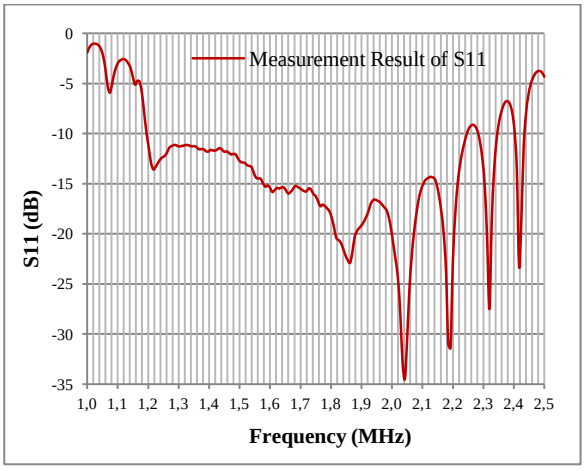

Fig. 4 Measurement result of S11

Moreover, the measurement result of antenna gain is shown in Fig. 5. From Fig. 5, it can be observed that the result of antenna gain is up to 13.5 dB at the frequency of 1860 MHz; 14.5 dB at the frequencies of 2040 MHz and 2190 MHz.

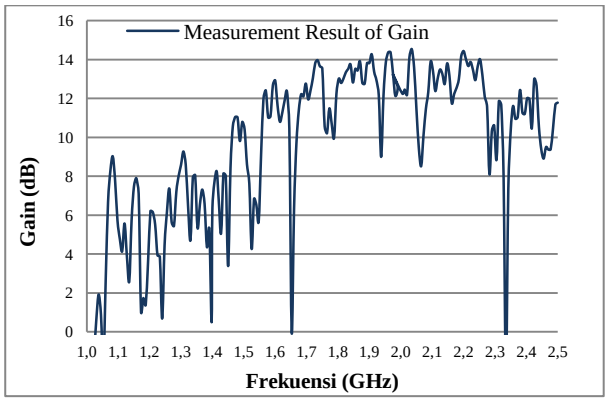

Fig. 5 Measurement results of antenna gain

IV. CONCLUSIONS

The wideband-antenna design has been presented and implemented using helical–shaped with spiral turn number of 8. The proposed antenna has been simulated and fabricated to demonstrate the feasibility of helical–shaped antenna in wide impedance-bandwidth. It has been shown that the proposed antenna could increase the antena gain up to 14.5 dB with wide impedance bandwidth of 1050 MHz.

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