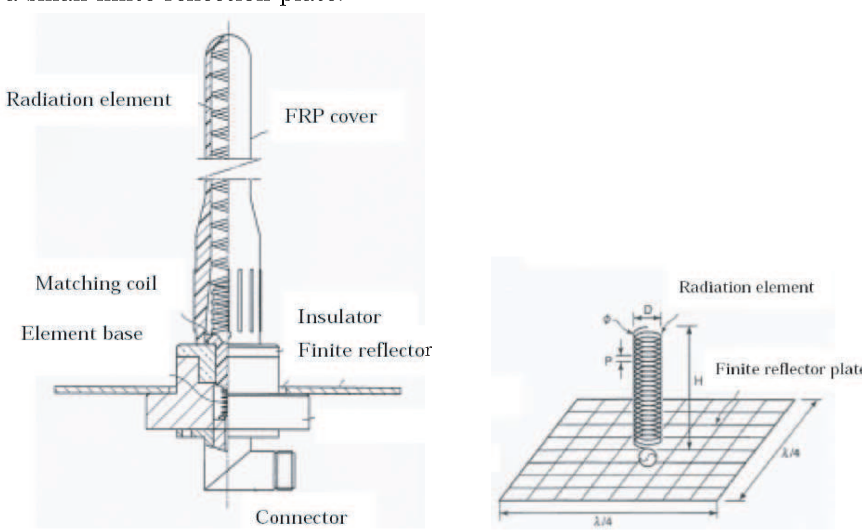
Mobile Wireless Communication System Antennas for 260 MHz-band

H. Kawakami
Antenna Giken Corp., Japan

1. Introduction

Automotive mounted antennae are often vertically orientated 1/4 wave antennae because the body of the car can be used as an effective reflective infinite ground plane. This ground plane permits the radiation pattern of a mounted 1/4 wave antenna to behave like that of a 1/2 wave antenna. The 1/4 wave antenna has a low cost and is also compact in size. This compact quality is important in automobile mounted antennae because it reduces the risk of antenna damage and also does not create difficulty when restrictions on the height of a car's profile are present. This paper presents a design of an antenna that is compact like a 1/4 wave antenna but can behave as closely as possible to a 1/2 wave antenna without the presence of an effective infinite ground plane.

The 1/4 helical antenna is well known, but this paper presents the design of a helical antenna that meets our height design requirements. Specifically, a monopole antenna with a height of under 300 mm is desired. The standing wave ratio must be under 2.0 in the frequency band of interest. The height of the helical element must remain at some constant so the pitch and diameter of the spiral were optimized. An improvement in gain was obtained by using a small finite reflection plate.



(a) Structure. (b) Helical on finite reflector plate.

Figure 1: Mobile wireless communication system antennas for 260 MHz-Band.

2. Antenna Structure

As mentioned earlier, 1/4 wave antennae are usually used in mobile radio devices when a large ground plane is available. The efficiency of an antenna depends on the loss due to the mismatch between the impedence of the receiving antenna and the transmitter. The impedence of any portable receiving antenna can be quite variable depending on how it is mounted: for example, carried by a human or affixed to a car. Also of concern is the unpredictability of the height of the antenna above a ground plane. This creates an unstable state because of the high frequency current flowing within the standard antenna. Our antenna has been designed to deal with this instability and is more efficient than a standard 1/4 wavelength antenna.

Figure 1(a) shows the basic structure of our helical antenna as detailed in [1]. The figure shows a finite reflected plate. Figure 1(b) is the simplified model of the antenna with a helical antenna above a finite reflector plate. The center frequency was chosen to be 265 MHz. With the height H of the helical element fixed to be 220 mm, we adjust pitch P and diameter D of the spiral. Shown in Figure 2 is a 2D plot of the horizontal gain as a function of P and D. There is a region where 2 dBi gain is realizable.

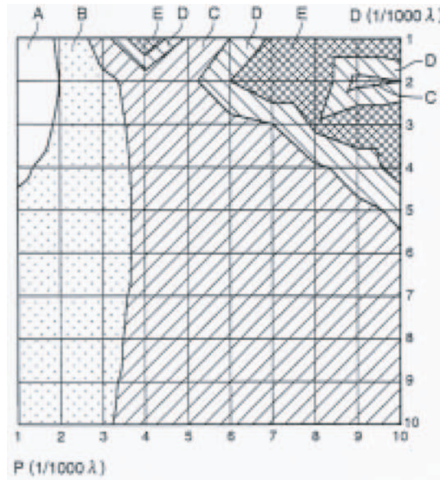


Figure 2: Horizontal gain of mapping for helical antenna.
A: 2 dBi more than B: 1.5 2 dBi C: 1 1.5 dBi D: 0.5 1 dBi E: 0 0.5 dBi

3. Experimental Result

The antenna can be adjusted to a particular resonant frequency to create the VSWR pattern shown in Figure (3). A good impedence match is found between 262 to 275 MHz where the VSWR is lower than 2.0 which corresponds to -9.5 dB. The vertical radiation pattern of this antenna is compared with the pattern from a 1/2 wavelength antenna in Figure (4). The actual gain was about -1 to -2 dB but the horizontal radiation pattern is omni directional.

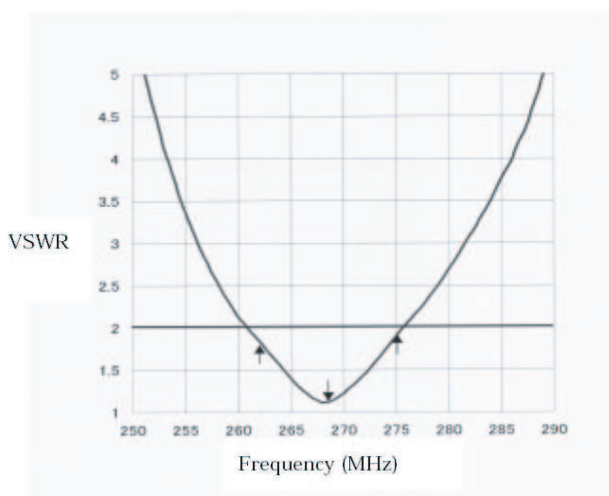


Figure 3: Characteristic of VSWR.

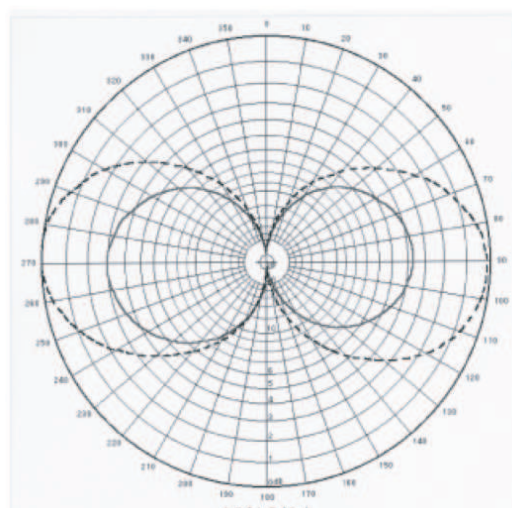


Figure 4: Vertical Radiation Pattern. (Dotted line: 1/2 wavelength, Solid line: this antenna)

4. Conclusion

The effectiveness of a finite reflector plate with a helical antenna is examined. There is an increase of gain in the horizontal direction and a reduction in antenna size. This type of antenna is more immune to the effects of the surrounding environment. This antenna is very practical and may be used when it is necessary to mount antennae on cars with plastic outer bodies such as ambulances. Changes in the shape of the radiating element and simplification of the feed line will be the future work on this project.

REFERENCES

1. Kawakami, et. al, *Patent No. 3093712.*