Flexible T-DMB Antenna on windshield with meander dipole structure

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Abstract

In this paper, we designed detachable T-DMB receiver antenna on the windshield of the car. Designed antenna is composed of only copper and feeders. To escape completely from driver's sight, it exists edging of windshield. Proposed antenna by considering body of properties and characteristics of the antenna input impedance have T-DMB frequency band (174 ~ 216 MHz). Proposed flexible antenna with double line is satisfied characteristics less than -5 dB antenna input return loss regardless of installation position on windshield.

Keywords : Antennas meander T- DMB

1. Introduction

Recently depending on advances in the automotive industry, users want to provide information and entertainment content such as the car radio, television, navigation, mobile phone services in a moving car.[1] Depending on commercialization of T-DMB system, receiving antennas of vehicle has been focused on. The existing antennas for T-DMB have used various kinds of antennas such as helical antenna, Shark antenna, and pole antenna and so on. The antennas to install on the outside of the vehicle influence on the car's appearance. Some demand a high price due to the difficult of manufacture. On-glass antenna does not change the appearance of the car and have lighter weight and better reliability. So the earlier receiving antennas are being replaced On-glass antennas. Therefore, the automotive industry increasingly focused on broadband is On-glass antenna.[2~3] In this paper, The proposed antenna fabricated with the copper has a dipole structure to have detachability and ease of feeding. We proposed the antenna that has two paths of current distribution and meander structure to study that Currents between two paths of different length tend to lessen the overall length of the antenna.

2. Experiment Environment

The proposed antenna, as shown in Figure 1 is applied near the edge of the windshield of a vehicle. Because of this, the antenna can protect completely the driver’s view. There is the antenna inside the vehicle, it has no effect on wind noise, and has strong durability. Due to the existence of room mirror and other objects, the available space of T-DMB antenna on the front glass is limited to approximately dimension of 500 × 100 mm^2. The simulation results were successfully performed by Ansys HFSS. We set the simulation environment to consider only Vehicle windshield, the top frame and the frame of the passenger seat-side.

3. Design Procedure

Table 1 shows the design process of the proposed antenna. ‘2. Experimental environment’ was applied the simulation. Antennas are in the same position of the vehicle windshield. '01_basic Dipole 'and '02_basic double ' are a good bandwidth and a good minimum reflection coefficient

value. But the overall size of antennas exceeds the available space of T-DMB antenna. It is need to reduce the overall length of the antennas. '03_meander' applied to the meander shape on '01_basic Dipole' is the shortest antenna, but the reflection coefficient characteristics are not good. Therefore, the proposed antenna consists of a double line to have a good reflection coefficient characteristic and applies the meander shape to reduce overall size. As a result, '04_snake_double' has a operating bandwidth of 40.5 MHz and a minimum reflection coefficient of -20.93 dB. It is a good return loss characteristic. '04_snake_double' meets the T-DMB antenna band (175 ~ 216 MHz).

4. Proposed Antenna

Figure 3 shows the measured and simulated return loss for the proposed dipole antenna. The proposed antenna has a bandwidth of 63 MHz (166 ~ 229 MHz) and a minimum reflection coefficient of -11.4 dB in measurement result. When we had Experiment of T-DMB broadcasting receive condition in Gumi city, South Korea, the proposed antenna had the quality of the broadcast was received in the areas that the existing T-DMB antenna does not receive a good quality of broadcasting.

Figure 4 shows the proposed antenna's radiation pattern. When Phi is 0 deg, the proposed antenna has omnidirectional radiation pattern that is suitable for T-DMB broadcasting reception. When theta is 90 deg, the proposed antenna does not have more than -10 dB realized gain in all directions. But the antenna is suitable for T-DMB receiver antenna.

Figure 5 shows the fabricated antenna.

5. Conclusion

In this paper, we designed detachable T-DMB receiver antenna on the windshield of the car. An on-glass antenna applied double meander type is proposed for T-DMB applications. The proposed antenna's biggest advantage is shorter overall length than conventional dipole and similar return loss characteristics to conventional dipole antenna. It has a bandwidth of 63 MHz (166 ~ 229 MHz) based on -5 dB and a minimum reflection coefficient of -11.4 dB in measurement result. The antenna's radiation pattern is almost Omni directional characteristic. So it is suitable for T-DMB receive antenna.

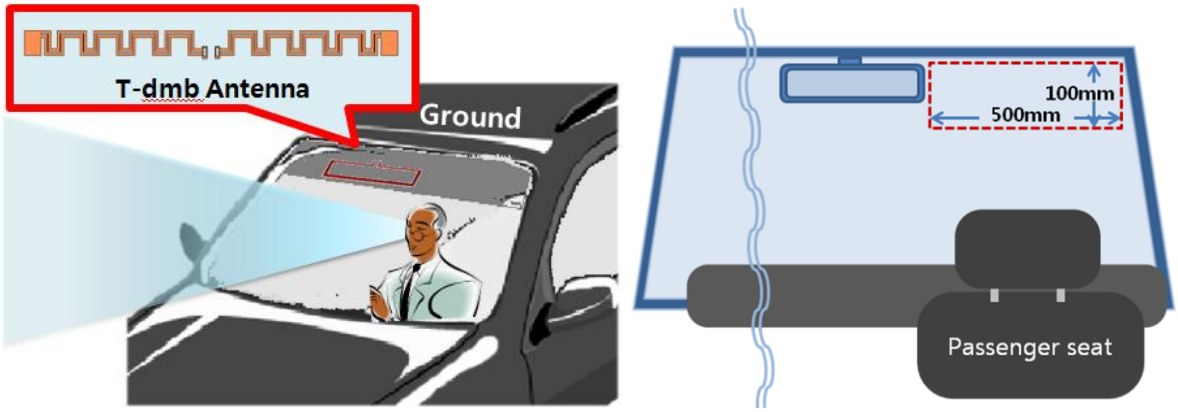

Figure 1: the available space of T-DMB antenna

Table 1: the design process of the proposed antenna

01_ basic dipole Total length : 517 mm
02_basic double Total length : 540 mm
03_meander Total length : 400 mm 
04_snake_double Total length : 437 mm 

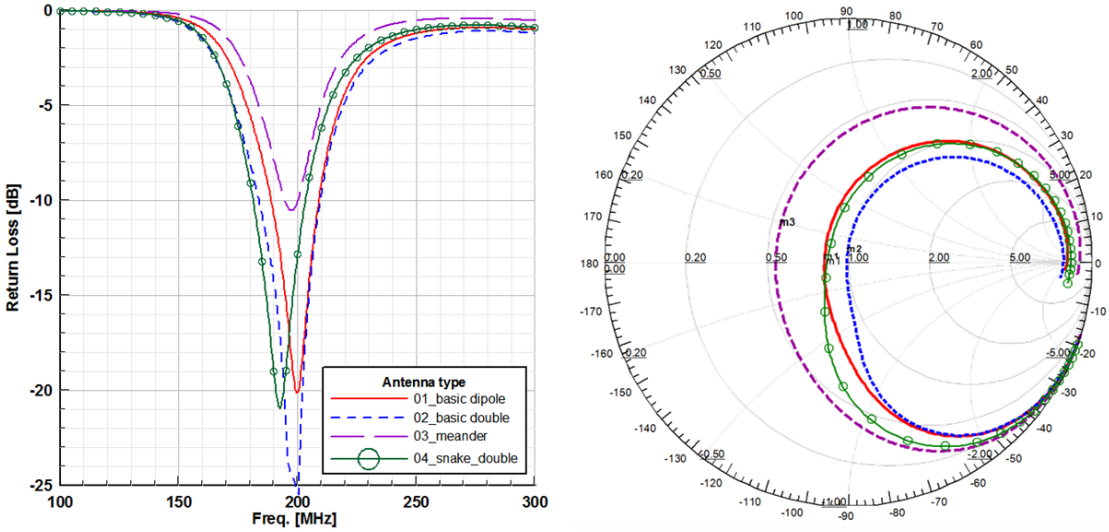

Figure 2: Impedance of Antennas.

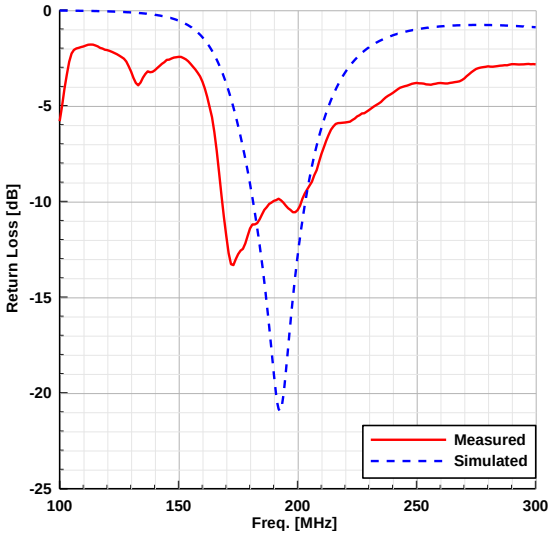

Figure 3: Measured and simulated return loss of the proposed antenna.

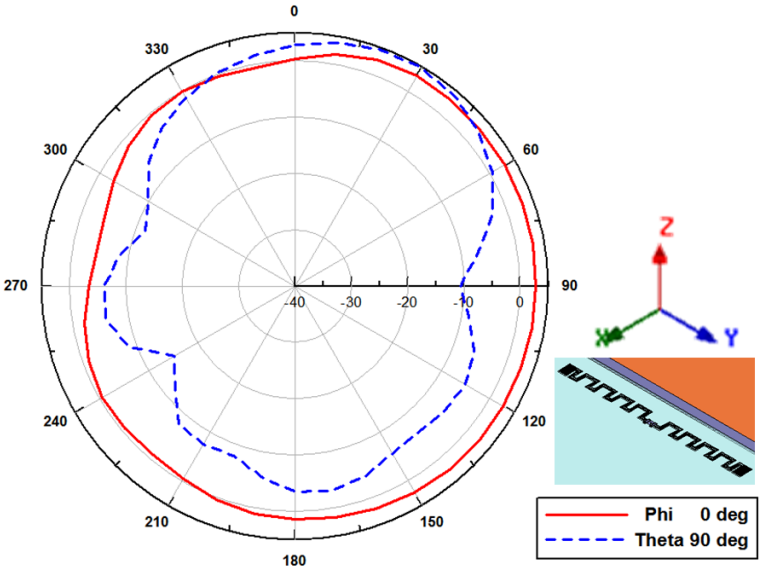

Figure 4: Radiation Pattern for the proposed antenna

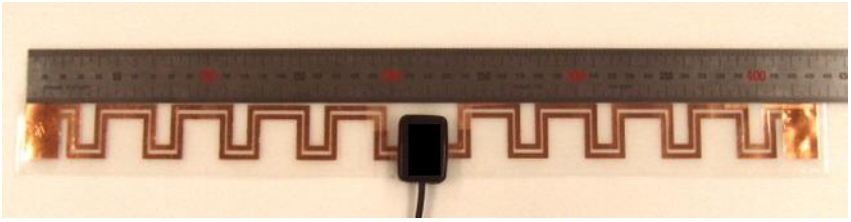

Figure 5: Proposed antenna

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