A Wide-Band CPW Patch-Slot Antenna for Telemetry Applications

JEYASINGH NITHIANANDAM
Department of Electrical and Computer Engineering
Morgan State University
5200 Perring Parkway, Baltimore, Maryland 21251, USA
Jeyasingh.Nithianandam@morgan.edu
http://www.soe.morgan.edu/academic_programs/electrical_eng/faculty.html

Abstract: This paper presents a small wide band printed antenna with a single feed that would be useful for L-band and S-band telemetry systems. The printed antenna consists of coplanar waveguide fed meandered patch radiator element. This antenna will also be useful for integrated network enhanced telemetry (iNET) program. We present our results on design of the wide band antenna and its evaluated performance by a full wave electromagnetic simulations with Ansoft HFSS software.

Key-Words: stacked patch antenna, single feed, electromagnetic coupling, INET, dual band.

1. Introduction

Several research work has been reported in the past few years on radar remote sensing, microwave radiometry and radio communication systems that operate at different frequency bands [1,2]. It is desirable to design compact and light weight antennas that would operate in multi-frequency bands. Currently there is a need for a dual band antenna for applications in integrated network enhanced telemetry (iNET) program. Our main objective is to design and develop printed antenna elements with broad band characteristics in the L- and S- frequency bands. In this paper, we present our design of a meandered patch antenna with a coplanar waveguide (CPW) feed and results from a full wave finite element electromagnetic simulations to evaluate the performance of this radiator element. We find that this CPW-fed antenna has a broad band performance and it would be useful for dual-band operation that is needed for aeronautical telemetry applications.

2. Antenna Description

A CPW-fed meandered patch antenna is shown in figure 1.

Figure 1. A schematic diagram of a CPW-fed meandered patch radiator element.

A FR4 substrate of thickness 1.6 mm is used in this design. The patch element is formed by widening the center signal metal strip of the
coplanar waveguide (CPW). A horizontal slot of width 25.37 mm and length 8 mm is cut in the patch as shown in figure 1. The rectangular patch radiator element width is 50.7 mm and its length is 48.9 mm. The slot is at a distance of 3 mm from the bottom edge of the patch. An aluminum nitride layer of width 5 mm, length 3 mm and height 0.018 mm is used to form a capacitor as shown in figure 1. The feed for the patch element is a short length of a coplanar waveguide with a characteristic impedance of 50 ohms. The width of the signal conductor of the CPW feed is 12.57 mm and the gap distance between the signal conductor and the ground plane of the CPW feed is 1 mm. The length of the signal conductor of the CPW feed is 12.7 mm. We used Ansoft Designer software in the design of the CPW feed. A coaxial connector is attached to the coplanar waveguide feed as shown in figure 2. The center signal conductor of the coaxial connector passes through the FR4 substrate and is attached to the signal conductor strip of the CPW feed and the feed position is at 3 mm from the bottom edge of CPW feed. A coaxial connector is often used to efficiently excite CPW quasi-TEM mode. Two conducting vias from the coaxial connector outer body is connected to the two sides of the ground plane of the CPW patch antenna. The two conducting vias also pass through the dielectric substrate as shown in figure 2.

3. Simulation Results

The geometrical model of the CPW-fed patch antenna without a meandering slit and aluminum nitride capacitor was implemented in Ansoft HFSS software platform. A full wave electromagnetic simulation was performed on this radiator element. The return loss in dB as a function of frequency is shown in figure 3(a). We also implemented the geometrical model of the antenna element shown in figure 1 with a meandered slit and an AlN capacitor in Ansoft HFSS software platform. The simulation results for return loss as a function of frequency is shown in figure 3(b). Figure 3(b) shows the improvement in the antenna return loss performance at lower frequencies due to meandering slit. It appears that the effect of AlN capacitor is not significant. The simulated results of H-plane radiation patterns of the CPW-fed meandered patch antenna are shown in figures 4(a) and 4(b). The simulated results of E-plane radiation patterns of this antenna are shown in figures 5(a) and 5(b). The simulated radiation pattern shapes for L-band and S-band frequencies are nearly similar.

Figure 3(a). Simulated return loss of a CPW-fed patch without a meandering slit.
Figure 3(b). Simulated return loss of a CPW-fed patch antenna with a meandering slit.

Figure 4(a). $E_\theta$ at $\Phi = 0^\circ$ for CPW-fed meandered patch antenna at 1.5 GHz (purple) and at 2.3 GHz (red).

Figure 4(b). $E_\Phi$ at $\Phi = 0^\circ$ for CPW-fed meandered patch antenna at 1.5 GHz (purple) and at 2.3 GHz (red).

Figure 5(a). $E_\theta$ at $\Phi = 90^\circ$ for a CPW-fed meandered patch antenna at 1.5 GHz (purple) and at 2.3 GHz (red).

Figure 5(b). $E_\Phi$ at $\Phi = 90^\circ$ for a CPW-fed meandered patch antenna at 1.5 GHz (purple) and at 2.3 GHz (red).

4. Conclusion

Full wave finite element computer simulations of a coplanar wave guide antenna with a meandered slot show that this antenna has wide band characteristics. This antenna would be useful for aeronautical telemetry applications in two frequency bands such as L-band and S-band.
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References:


