**Lab 6: Design & Analysis of a Loop Antenna**

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| **Introduction：**  In this experiment, we used HFSS to model and simulate a Loop Antenna. During the simulation, we modeled the antenna structural parameters according to the theoretical content we learned. Finally, after the modeling was completed, we optimized the performance of the antenna by utilizing the functions of HFSS to maintain good performance in the 11 GHz band.  **Lab results & Analysis：**  **Question: Design a Loop Antenna working at 11GHz band. The model is shown below:**  **20220329113423**  **Model diagram and Simulation Setup:**  Through calculation of relevant parameters, we can establish the following antenna model:  20220329113601  Figure 1 The overall model  20220329113745  Figure 2 Port configuration  20220329113827  Figure 3 Set the frequency sweep range  **Parameter list:** **(After Optimization)**  20220329113900  Figure 4 All parameters in the model (after optimization)  **Optimization:**  The S-parameter image is a key point of this experiment simulation. The antenna we designed should have the minimum S parameter image at the 11GHz frequency point. If the above parameter Settings are followed, we found that the minimum value (valley value) of the antenna we designed was slightly deviated from 11GHz. Therefore, we need to optimize the total length of the model (l) and the total width of the model(w). After simulation, The final optimization result is l = 32.66mm, w = 16.33mm.  20220329114507 | |
| Figure 5 The Optimization target of the model  **Simulation results:**   1. **S-parameter**   **20220329114722**  Figure 6 S-parameter image of this antenna  As can be seen from the above image, the S11 parameter of the antenna reaches a minimum value at 11GHz (probably exists a little small deviation), which proves that the working performance of the antenna designed by us meets the requirements of the question.  Of course, we found that the minimum value may not truly obtained at 11GHz (probably exists a little small deviation), which we suspect is due to the selection of antenna materials. Next, we change the antenna material from PEC to copper, and the results of S11 parameters are as follows:  20220331003422  Through this result, we found that the antenna does work at 11GHz, maybe there are some small deviations due to the software.   1. **Radiation Pattern**   **20220329115453**  Figure 7 The Gain total radiation pattern of this antenna (phi = 0deg)  20220329115551  Figure 8 The Gain total radiation pattern of this antenna (phi = 90deg)  20220329183216  Figure 9 The Realized Gain phi/theta radiation pattern of this antenna (phi = 0 or 90deg)   1. **3D polar plot**   **20220329120015**  Figure 10 The 3D polar plot of Gain total of this antenna  **Experience**  In this experiment, we deepened the modeling process of HFSS and designed a Loop Antenna by combining HFSS with theoretical calculation. Through the simulation of our model, we can get the images of various parameters of the antenna, and further deepen the understanding of the antenna properties with the theory. Finally, we should also know that there is always a little deviation between the software simulation and the theoretical calculation, so we need to further optimize the simulation results to achieve good performance at the specified working frequency point of our antenna. | |
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