**Lab 5: Analysis of a 1x2 Circular Patch Antenna Array**

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| **Introduction：**  With the continuous progress of communication technology, the demand of multi-antenna array is more and more important. Because the directivity and intensity provided by a single antenna is not very well in many applications, in order to improve the performance of the antenna and make it more efficient in transmitting and receiving signals in a specific frequency band, people try to combine two or more antennas into an antenna array according to some special usages.  In this experiment, we used HFSS to model and simulate a 1x2 circular patch antenna array. 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 2.4GHz band.  **Lab results & Analysis：**  **Theoretical calculation:**  In this experiment, radius of the each array patch can be calculated using the below formula (Where, h = thickness of substrate, f = Frequency):    After doing the calculation, we know that: The radius of the each array patch is near 17mm.  **Model diagram and Simulation Setup:**  Through calculation of relevant parameters, we can establish the following antenna model:  **20220327093739**  Figure 1 The overall model  20220327094016Figure 2 Port configuration  20220327094155  Figure 3 Set the frequency sweep range  **Parameter list:** **(After Optimization)**  20220327094220  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 2.4GHz 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 2.4GHz. Therefore, we need to optimize the radius of the each array patch (r1). After simulation, The final optimization result is r1= 17.156656291808.  20220327094742 | |
| Figure 5 The Optimization of the dipole length  **Simulation results:**   1. **S-parameter**   **20220327094902**  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 2.4GHz, which proves that the working performance of the antenna designed by us meets the requirements of the question.   1. **Gain20220327095104**   Figure 7 Gain curve of this antenna  Through the gain image of the antenna, we can clearly see that the GainTotal/Realized GainTotal of the antenna reaches the peak value at 2.4GHz, which reflects that our designed antenna has good performance at this operating frequency.   1. **Radiation Pattern**   **20220327095604**  Figure 8 The gain phi / theta radiation pattern of this antenna  **20220327111007** Figure 9 The realized gain phi / theta radiation pattern of this antenna  **Experience**  In this experiment, we deepened the modeling process of HFSS and designed a 1x2 Circular Patch Antenna Array 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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