Goddard Electro-Magnetic Antenna Anechoic Chamber

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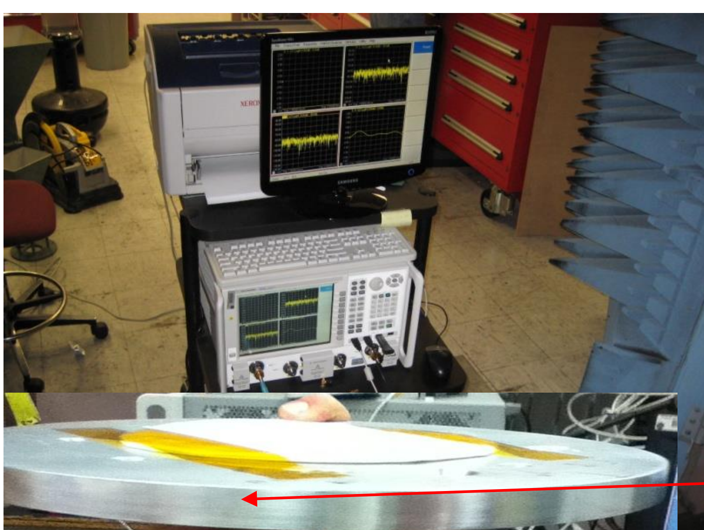
Abstract

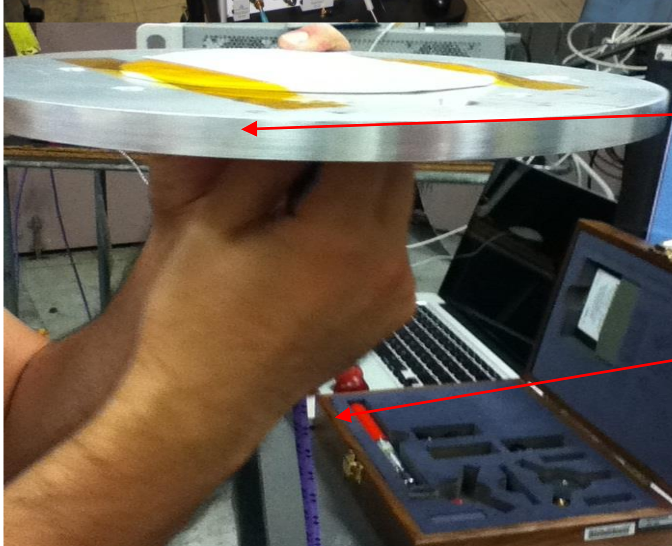
The Goddard Electro-Magnetic Antenna Anechoic Chamber (GEMAC) is a world-class facility for measuring radiation patterns of antennas and other microwave devices and instruments.. Anechoic means neither having nor producing echoes and is a shielded room whose walls have been covered with a material that absorbs so much of the incident energy that it can simulate free space. The anechoic chamber measures the isotropic (all directions) gain pattern of an antenna. These measurements are taken at different angles and frequencies. Goddard Anechoic chamber has been used for decades to test both prototype and flight antennas affiliated with Goddard missions and outside entities. This paper presents the procedure and findings to measure, record, and document data for antenna testing, which includes the procedures to set up the chamber, measure antenna patterns, finding gain, axial ratio, and half power beam width, and adding beta cloth over antenna patch to assess any performance degradation

Summary of Work/Results

I learned how to calculate input impedance and calibrate the PNA Analyzer. The cables needed to calculate the input impedance each were worth between $500 and $2,000. Each was used with delicate care. The calibrating process was a long process but once I finished that I had to put together components of a DPP 5.3 GHz antenna. When I was done I connected one cable end to the back of circular antenna figure and the other to the PNA analyzer. From here the process is too long to explain but I basically measured it and saved the data. Some of the images we saved in a certain file type on order for us to generate the codes for it to be used in MatLab When measuring this antenna on the PNA analyzer for its gain I had to make sure I kept it away from me since the antenna emits radiation.



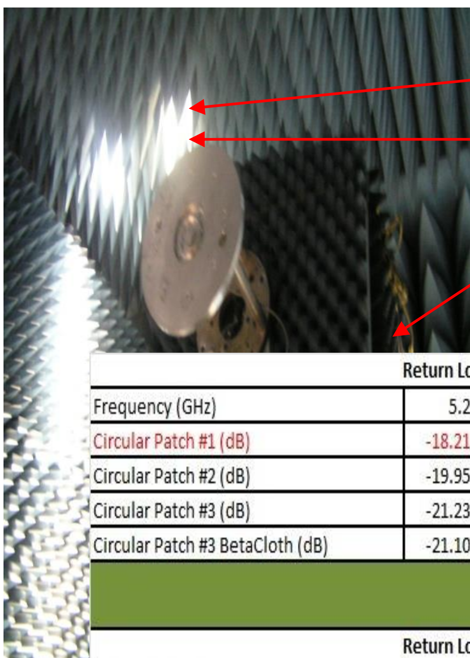
Here is a picture of the PNA Analyzer with the cable connected to the outputs.

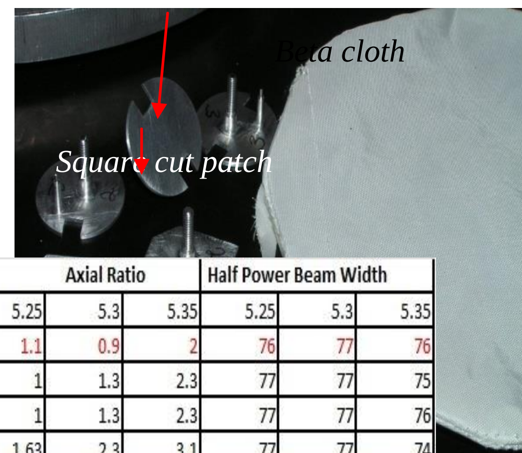


In this image the calibrated cable is connected to the back of the antenna figure. The antenna radiates so must be kept away from the body. The results are viewed on the computer.

Calibrated Cable

I used the antenna that I had constructed and mounted it on the test fixture of the chamber. My objective here was to run test sweeps of the antenna with different antenna patches on the one I had constructed. There were 6 antenna patches. 3 circular cut patches and 3 square patches each with different serial numbers. I would place one antenna patch on the ground plate then mount it on the chamber. Then I closed the chamber door and went over to the test station where I would use the computer to activate the sweep process. This took about 2 hours for each antenna patch to finish sweeping around in the chamber. When each was done I went back to the computer station to view the output result on the GAAMS software. This is a certain antenna software by Goddard used to work with the chamber simultaneously to view a graphical plot of the results. I was taught by both Victor and Steve on how to read the results and what exactly we were looking for. I was looking for the gain of the antenna, axial ratio, and for any inconsistencies.

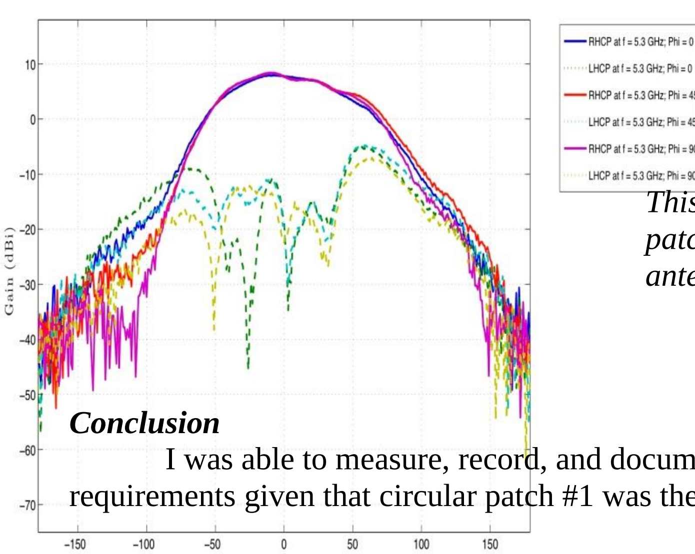




	Return Loss			Gain			Axial Ratio			Half Power Beam Width		
Frequency (GHz)	5.25	5.3	5.35	5.25	5.3	5.35	5.25	5.3	5.35	5.25	5.3	5.35
Circular Patch #1 (dB)	-18.217	-18.173	-18.072	8.02	7.94	8.01	1.1	0.9	2	76	77	76
Circular Patch #2 (dB)	-19.958	-19.899	-19.76	7.99	8.01	7.95	1	1.3	2.3	77	77	75
Circular Patch #3 (dB)	-21.238	-21.315	-21.378	7.93	7.93	7.91	1	1.3	2.3	77	77	76
Circular Patch #3 BetaCloth (dB)	-21.108	-20.735	-20.123	7.93	7.93	7.93	1.63	2.3	3.1	77	77	74

	Return Loss			Gain			Axial Ratio			Half Power Beam Width		
Frequency (GHz)	5.25	5.3	5.35	5.25	5.3	5.35	5.25	5.3	5.35	5.25	5.3	5.35
Square Cut Patch #1 (dB)	-27.882	-28.403	-28.202	8.01	7.99	7.91	0.85	1.7	2.7	77	77	75
Square Cut Patch #2 (dB)	-26.257	-26.135	-27.329	7.91	7.88	7.89	0.7	1.45	2.4	77	77	75
Square Cut Patch #3 (dB)	-28.814	-28.692	-29.381	7.93	7.92	7.87	1.1	1.25	2.2	77	77	75

This table shows the return loss, gain, axial ratio, and half power beam width results from both circular and square cut patches that I measured in the chamber. Each test was run with either a circular patch or a square patch that had different serials. The one that was the best was the circular patch #1 because it met the requirements that were called for in this project.



This graph shows the measured radiation pattern of circular patch #1. It shows the principal cuts at each angle as the antenna is being rotated in the anechoic chamber.

Conclusion

I was able to measure, record, and document data for six antennas and concluded based on the requirements given that circular patch #1 was the best. It was noted that the beta cloth degrades the axial ratio of the antennas when applied to the ground plate. It was also noted that the circular patch #1 at 5.3 GHz proved to meet the requirements needed and was thus the best out of all. The data and results will be recorded and tested one more time for flight usage.