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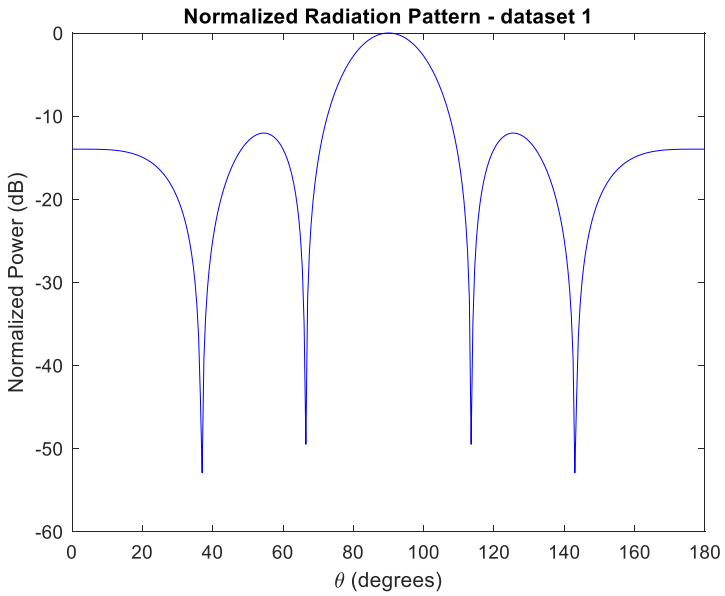
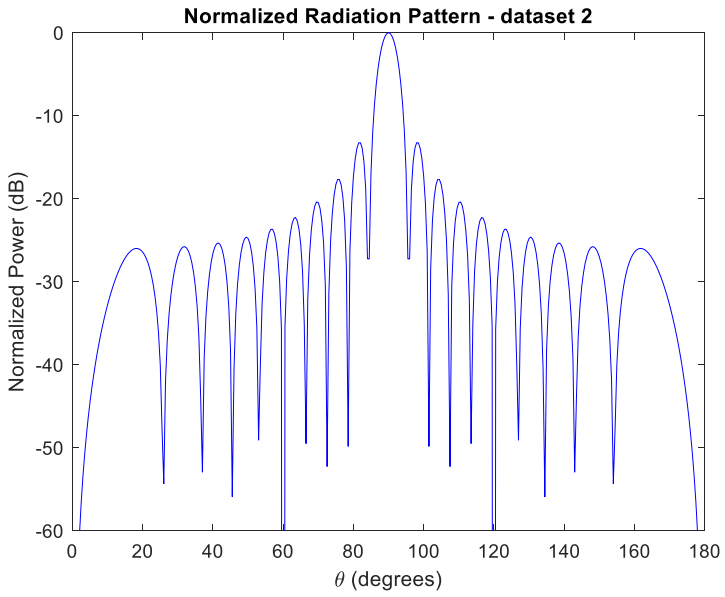
ECE584

HW02

1) Below are the graphic outputs for part 1.



Side Lobes: 3 Nulls: 4

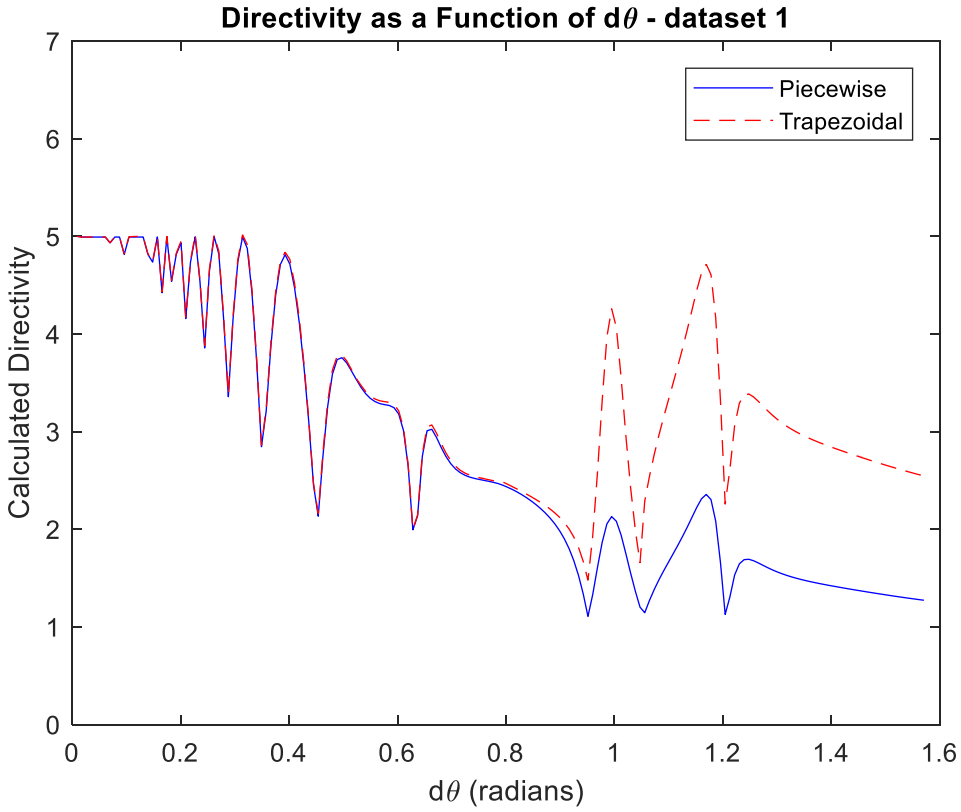


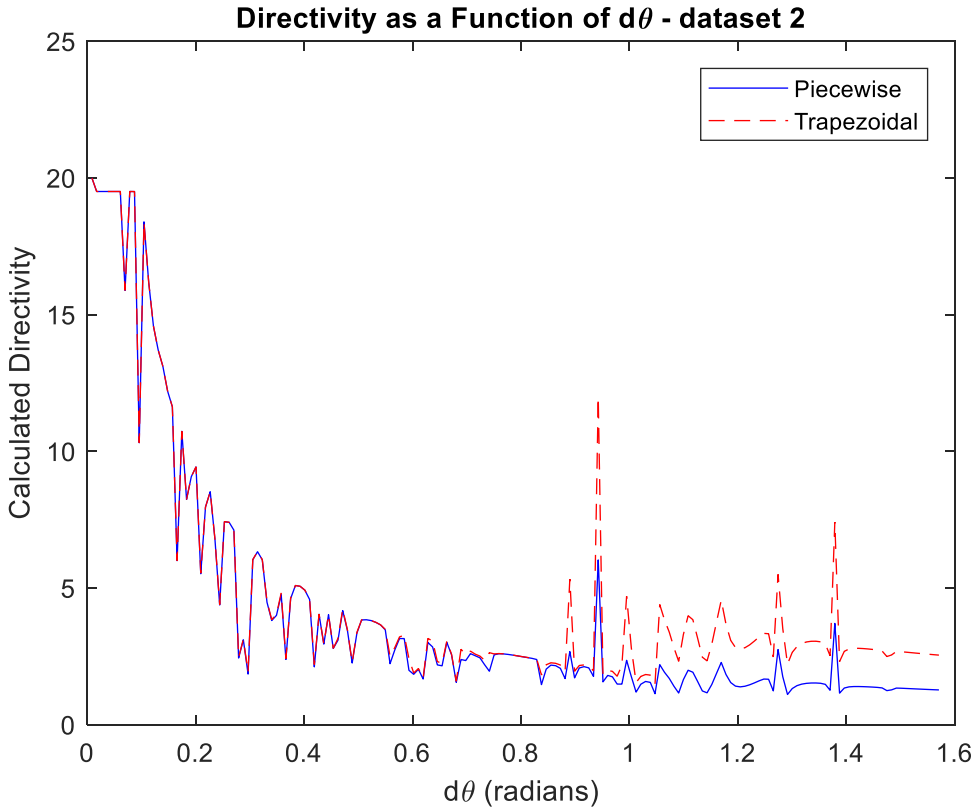
Side Lobes: 18 Nulls: 20

2) See included MATLAB file for modifications and output
    a. Values Calculated Using Piecewise Numerical Integration
        - Dataset1 → P_{rad} = 2.5133, D_0 = 5.0000
        - Dataset2 → P_{rad} = 0.6283, D_0 = 20.0000
    b. Values Calculated Using Trapezoidal Numerical Integration
        - Dataset1 → P_{rad} = 2.5133, D_0 = 5.0000
        - Dataset2 → P_{rad} = 0.6283, D_0 = 20.0000

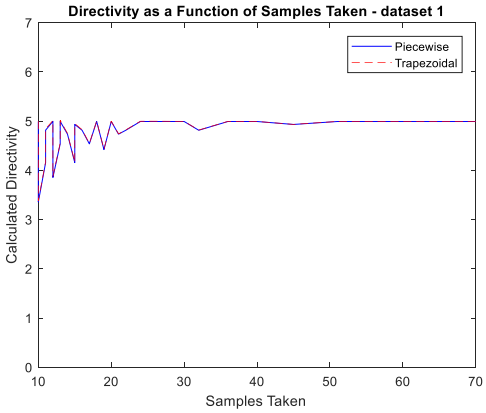
3) The algorithm I wrote in MATLAB to solve this has two iterative loops that create a matrix of values for directivity with their corresponding delta theta in radians and number of samples taken. The loop iteratively divides the existing data into temporary arrays used for calculating directivity by a gradually increasing divisor. For example, the first element in the directivity array would be with a divisor of 1 and therefore would have 361 samples used in its calculation. The second element in the directivity array would be with a divisor of 2 and therefore would have 180 samples used in its calculation with a delta theta nearly twice that of the last directivity calculation. This iteration was done up to a divisor value of 180 with just 2 samples.

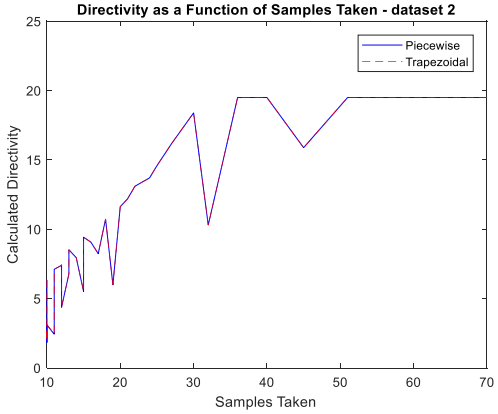
Below is a graph of the two datasets in relation to the change in delta theta values:





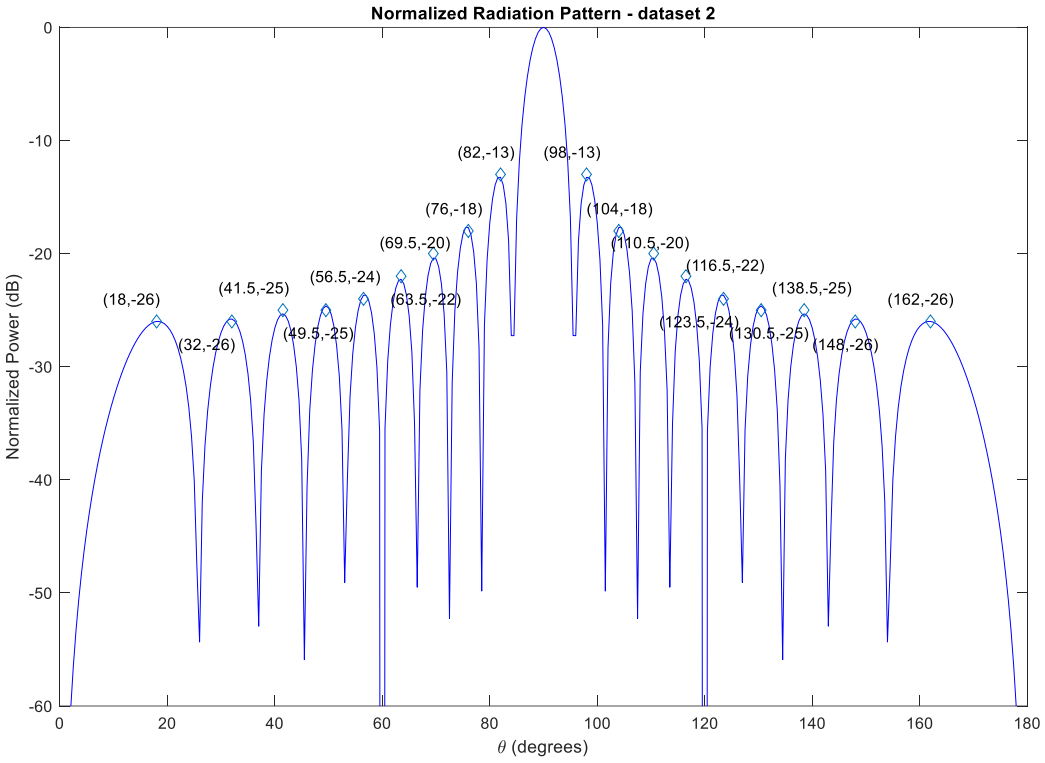
Clearly there exists a point at which the sample size ceases to provide a reliable valuable. As we look at the relationship between sample size and directivity and zoom in on the location where the proverbial wheels fall off, we can see that the increase in lobes requires an increase in the number of samples taken. Also keep in mind that the graph, showing all values maintains its steady state value up to 361 samples. (The number of samples in the first part of this homework) Below are the graphs of this data:





This data indicates that the ***first dataset*** requires at least ***40 samples*** taken and the ***second dataset*** requires at least ***50 samples***.

4) See graph below:



5) See problem 3 and 6 answer

6) As can be seen in the table below, there is not much difference between the results of trapezoidal and piecewise numerical integration on the data until the point of divergence from acceptable values for directivity. However, once the divergence occurs, the two end up having drastically different results. This can also be seen in the earlier graphs in this assignment.
The first dataset diverges at a dθ of 14 deg and the second dataset diverges at a dθ of 5.5 deg. Clearly the increase in the number of lobes results in the smaller dθ required to get acceptable data. **Please note that the entire data set of dϑ up to 180 deg was not used in the table but was used in the figures in part 3.*

Piecewise Dataset 1		Trapezoidal Dataset 1		Piecewise Dataset 2		Trapezoidal Dataset 2	
Directivity	dθ (degrees)	Directivity	dθ (degrees)	Directivity	dθ (degrees)	Directivity	dθ (degrees)
5.000	0.5	5.000	0.5	20.000	0.5	20.000	0.5
4.992	1	4.993	1	19.505	1	19.505	1
4.992	1.5	4.993	1.5	19.505	1.5	19.505	1.5
4.992	2	4.993	2	19.505	2	19.505	2
4.992	2.5	4.993	2.5	19.505	2.5	19.505	2.5
4.993	3	4.993	3	19.505	3	19.505	3
4.992	3.5	4.994	3.5	19.505	3.5	19.505	3.5
4.933	4	4.934	4	15.888	4	15.888	4
4.993	4.5	4.994	4.5	19.505	4.5	19.505	4.5

4.993	5	4.995	5	19.503	5	19.503	5
4.815	5.5	4.819	5.5	10.314	5.5	10.314	5.5
4.993	6	4.996	6	18.394	6	18.395	6
4.993	6.5	4.998	6.5	16.180	6.5	16.180	6.5
4.993	7	4.999	7	14.585	7	14.585	7
4.993	7.5	4.998	7.5	13.711	7.5	13.711	7.5
4.815	8	4.822	8	13.105	8	13.105	8
4.736	8.5	4.742	8.5	12.200	8.5	12.201	8.5
4.994	9	5.000	9	11.631	9	11.631	9
4.422	9.5	4.428	9.5	6.001	9.5	6.003	9.5
4.994	10	5.002	10	10.734	10	10.734	10
4.538	10.5	4.547	10.5	8.242	10.5	8.244	10.5
4.815	11	4.827	11	9.073	11	9.074	11
4.934	11.5	4.950	11.5	9.433	11.5	9.434	11.5
4.158	12	4.167	12	5.524	12	5.545	12
4.736	12.5	4.751	12.5	7.961	12.5	7.963	12.5
4.995	13	5.018	13	8.524	13	8.526	13
4.538	13.5	4.555	13.5	6.781	13.5	6.786	13.5
3.857	14	3.877	14	4.380	14	4.397	14
4.643	14.5	4.664	14.5	7.424	14.5	7.430	14.5
4.997	15	5.013	15	7.405	15	7.406	15
4.816	15.5	4.843	15.5	7.118	15.5	7.122	15.5
4.157	16	4.176	16	2.440	16	2.466	16
3.357	16.5	3.382	16.5	3.108	16.5	3.125	16.5
4.157	17	4.184	17	1.853	17	1.924	17
4.736	17.5	4.762	17.5	6.037	17.5	6.043	17.5
4.994	18	5.016	18	6.329	18	6.331	18
4.877	18.5	4.916	18.5	6.036	18.5	6.041	18.5
4.421	19	4.453	19	4.481	19	4.504	19
3.707	19.5	3.730	19.5	3.812	19.5	3.848	19.5
2.846	20	2.860	20	4.001	20	4.038	20
3.211	20.5	3.242	20.5	4.758	20.5	4.820	20.5
3.879	21	3.914	21	2.389	21	2.420	21
4.398	21.5	4.433	21.5	4.619	21.5	4.642	21.5
4.712	22	4.744	22	5.092	22	5.095	22
4.812	22.5	4.838	22.5	5.064	22.5	5.065	22.5
4.715	23	4.764	23	4.921	23	4.925	23