SIMPLE ACOUSTIC ARRAY
DSP PROJECT 1
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1. Part 1

Consider the following:

$$f(n) = sin(2\pi f T_s n) = sin(\omega T_s n)$$

where $\omega = 2\pi f$.

Provide plots of the signal, for what values of T_s will the signal be unaliased. If the signal is critically sampled (just above the Nyquest rate) what is the maximum uniquely discernable frequency in Hertz and in terms of radians/ second?

2. Part 2

Given $s_1(n) = sin(\omega T_s n)$ and $s_2(n) = sin(\omega T_s n - phi)$ calculate and plot $s_3(n) = s_1(n) + s_2(n)$.

For $N = 1000$ calculate

$$u(\phi) = \sum_{n=0}^{N-1} \mid s_3(n) \mid$$

.

plot $u(\phi)$, when does the maximum (s) occur?

3. Part 3

Analyze the case of a two element array, with the microphones separated by l and a distant sound source at distance d perpendicular from the base line. If θ measures the angle of the sound source with the mid line of the microphones, relate θ to ϕ above. Does d figure into the equation?

Hint: You will need to look up the speed of sound in air and look at the difference in arrival times at the two microphones. Assume that the sound source is far enough away to have the signal reach the microphones as a plane wave.

4. Part 4

Simulate the array gain $\frac{2u(\theta)}{u(0)}$ (where did this formula come from?) What is the effect of the sound source frequency on the results?

5. Part 5

Apply the above to the setup in the lab. Design an experiment and compare your observed results to simulation.

6. Documentation Requirements

- Provide a detailed discussion of each of the 5 parts.
- Research the problem and provide citations.
- You can use either a laboratory report format or a laboratory notebook format.
- Plan to use this report as part of your portfolio.