TEAM 13

SIGNAL PROCESSING

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AN ACCURATE METHOD FOR FREQUENCY ESTIMATION OF A REAL SINUSOID

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INTRODUCTION

We do frequency calculation by windowing approach in many software like in Matlab many functions return frequency of that signal but that frequency is not accurate, for example, you entered a signal with frequency 0.1917 Hz but what windowing will do it will give you a coarse freq. approx result as 0.2 Hz which is harmful in the further calculation. We will take a moreaccurate path

OBJECTIVE

As we saw earlier we need a better approach to find the actual frequency of the signal which is not the coarse frequency, so our aim is to reduce the error in freq. to the order of 10^-6 , and find more accurate frequency.

RESULTS

We get a frequency value that differs from original frequency by 10^-4% which was 1% earlier.

As the SNR value increases the RMSE values remains unchanged for both of the algorithms of AM method it implies that there is no much variation is seen after increasing the SNR value after its threshold.

CHALLENGES

A signal consists of both negative and positive components so what happens is the negative component in frequency interact with the positive component and the resultant spectrum thus obtained gives the peaks of frequency at the slightly moved position.

APPLICATIONS

1. DENSITOMETERS TO LIQUID MEASUREMENT (t = 1/f and it calculate vibrations)
2. Microcontrollers and oscillators, we have many devices which won't function properly if the frequency is too off.
3. Medical equipment and some scientific equipment where the precise frequency is needed.

METHODOLOGY

- 1. We used filtering of the negative component of frequency by using coarse frequency obtained after windowing the signal.
- 2. We use a High pass filter to filter the remaining negative component.
- 3. Aboutanios-Mulgrew (AM) iterative algorithms (2 algos) for frequency estimation of exponentials.
- 4. We used FFT for fine frequency estimation.
- 5. The concept of Dft is also used.

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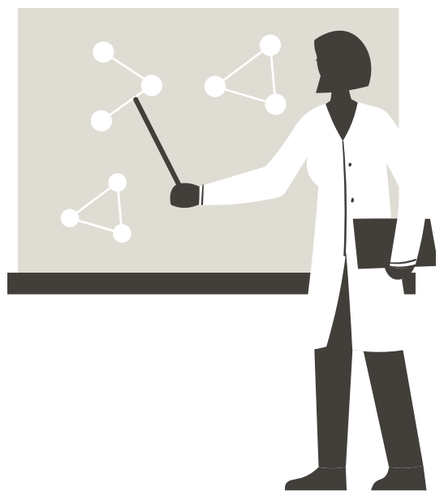
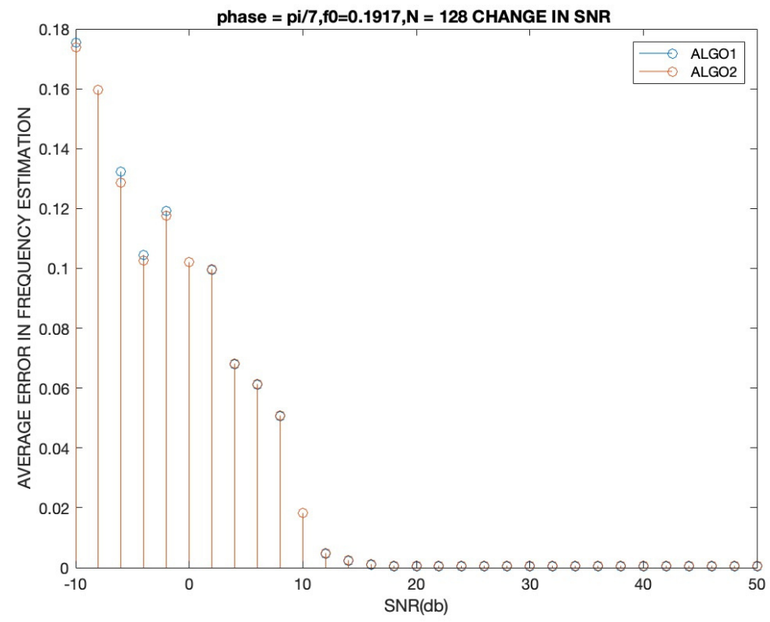
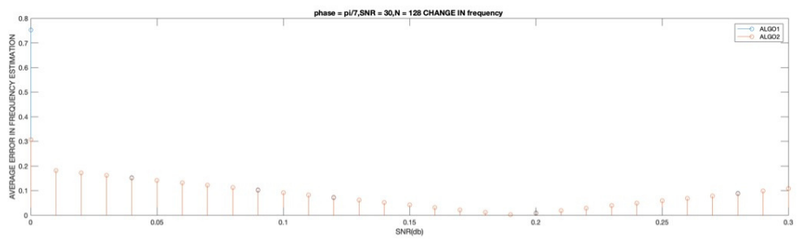
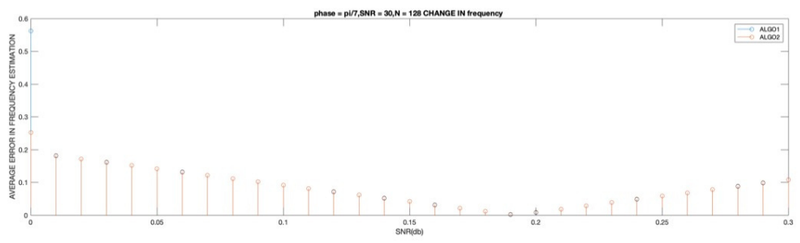
ANALYSIS AND OBSERVATION

We propose to overcome the problem of bias and improper results due to coarse freq. by filtering out the negative-frequency component and using high-precision estimators, with the filtered signal. A simple analytical form of filtering out the negative-frequency component, or a complex sinusoid in general, has been proposed and supported by numerical examples. The proposed method is characterized by low complexity.









REFERENCES

[1] E. Aboutanios and B. Mulgrew, “Iterative frequency estimation by interpolation on Fourier coefficients,” IEEE Trans. Signal Process., vol. 53, no. 4, pp. 1237–1242
[2] R. J. Kenefic and A. H. Nuttal, “Maximum likelihood estimation of the parameters of a tone using real discrete data,” IEEE J. Ocean. Eng., 1 vol. 12, no. 1, pp. 279–280,