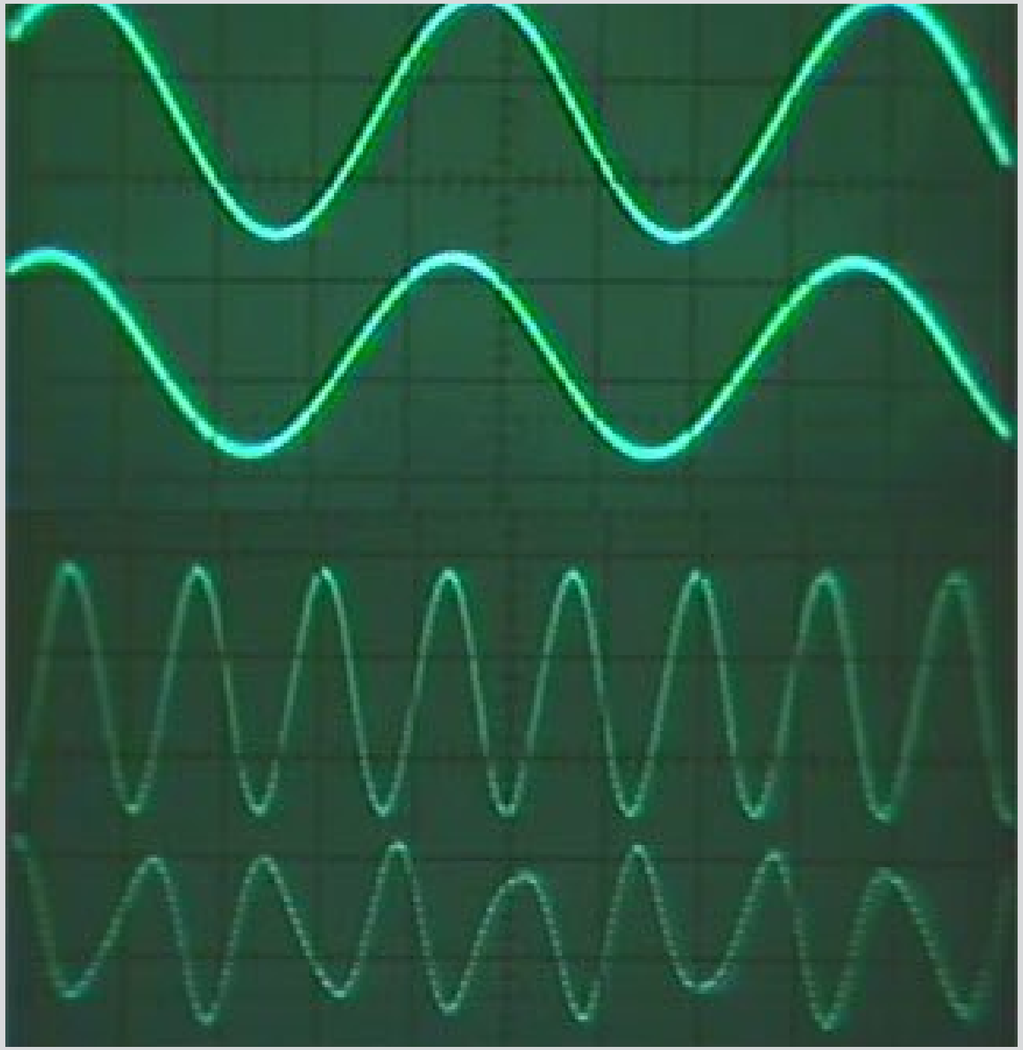
TECH CLUB 2023 - 2024

ZENITH SP

SIGNAL PROCESSING SESSION 1

09 FEB 2024



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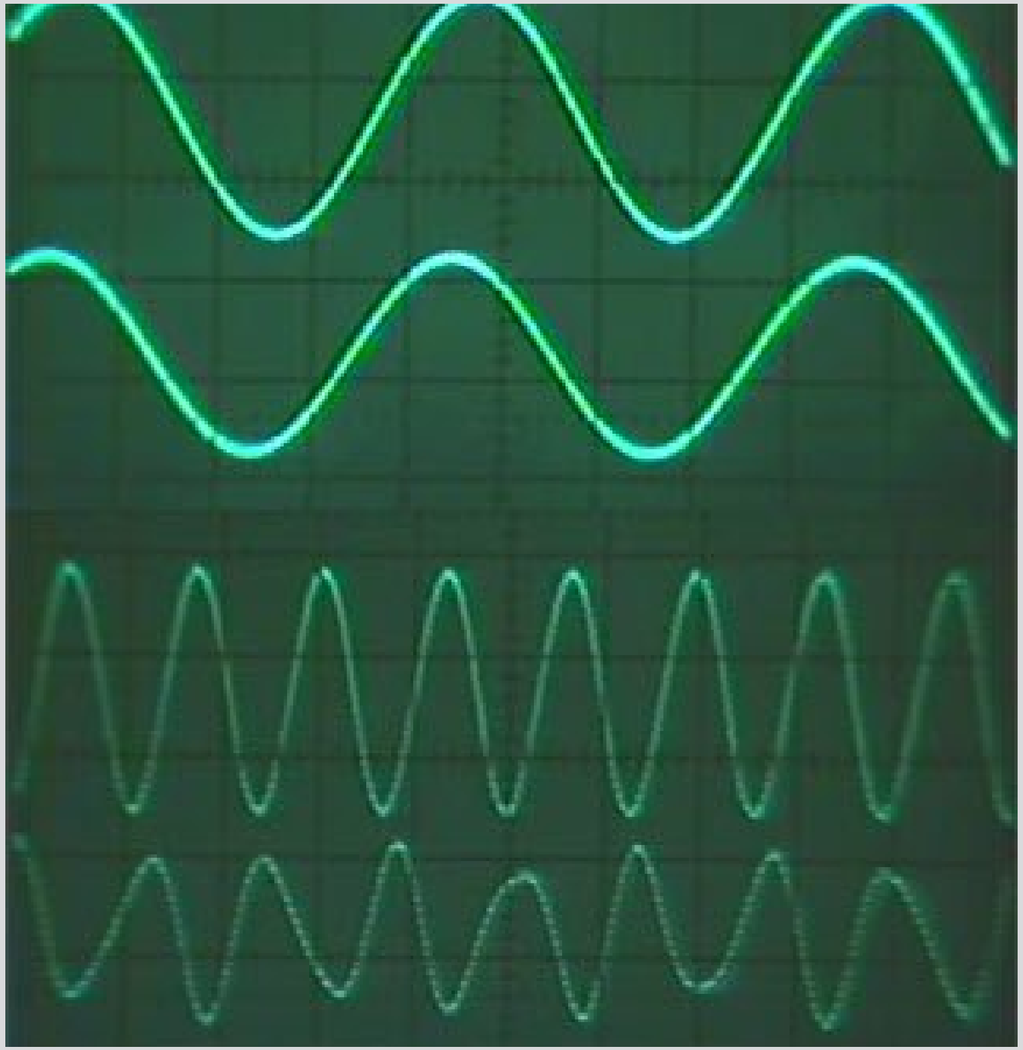
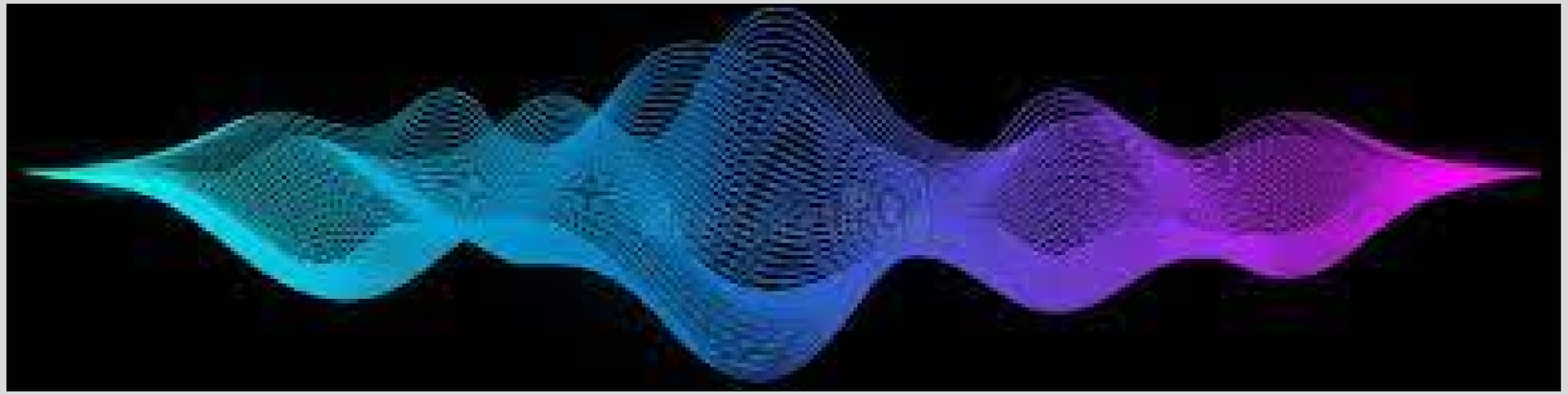


SOME CORE CONCEPTS - INTRODUCTION

A signal refers to changes in some real-world quantity or measure that conveys some information.

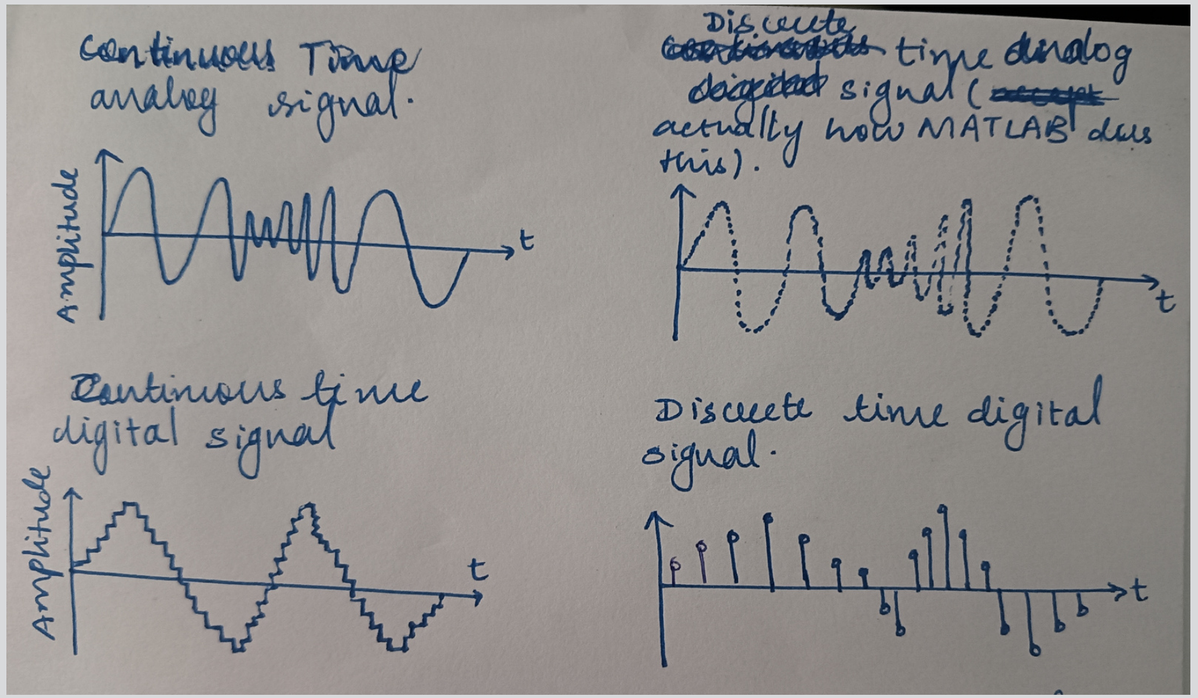
Eg., hand gestures, images, videos, speech, audio, stock prices, physiological measurements etc.

KEY WORD: A better definition - related values that depict some progression or trend or have underlying *information we are interested in.*



TYPES OF SIGNALS

Signals can broadly be considered continuous or discrete. And so concepts of **analog and digita**l signals come up.



CORNERSTONES IN SIGNAL SAMPLING AND REPRESENTATION

TWO CLASSIC PAPERS:

Nyquist – “Certain Topics in Telegraph Transmission Theory” (1928)
Shannon – “Communication in the Presence of Noise” (1949)

A function containing no frequency greater than wHz is fully determined by sampling it at 2wHz

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In order to resolve all the frequencies in a signal, sample at two times the highest frequency present

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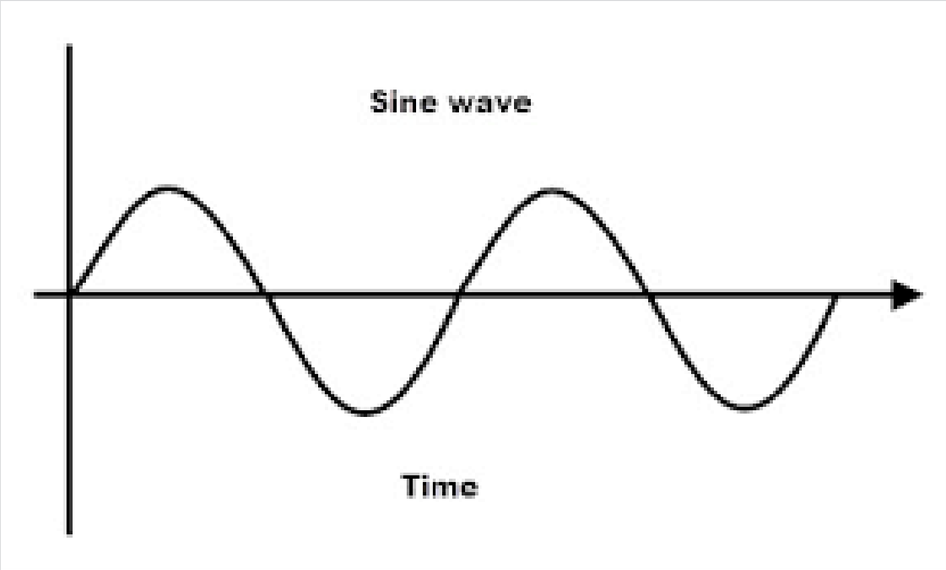
Nyquist frequency = 2w Hz

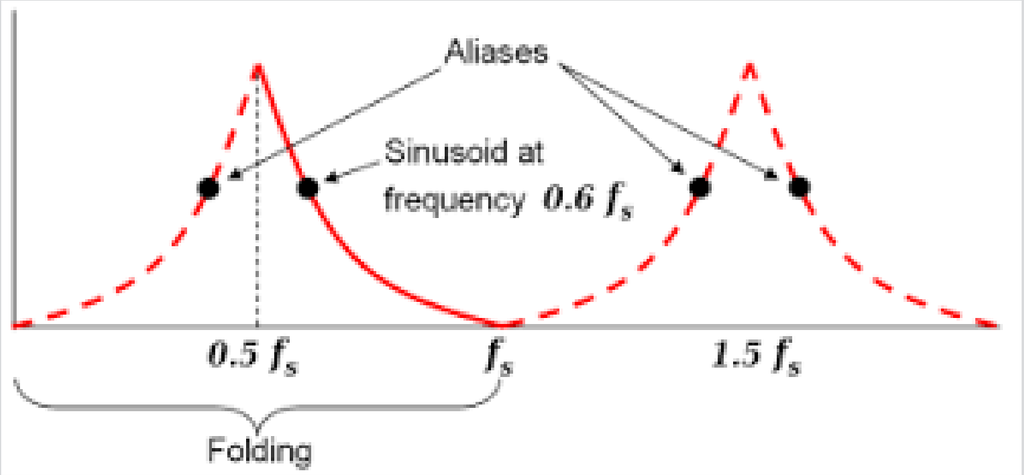
Nyquist rate of sampling $\triangle t$ = 1/2w (secs)

Audio files are encoded at a minimum of 44 kHz for this very reason. Humans can hear up to a maximum of about 22 kHz and so when we take that frequency and double it to obtain our sampling rate, fidelity of music is ensured

WHY DO WE NEED NYQUIST SAMPLING?



The effects of undersampling can be detrimental to our exercise of reconstructing signals especially in ADCs

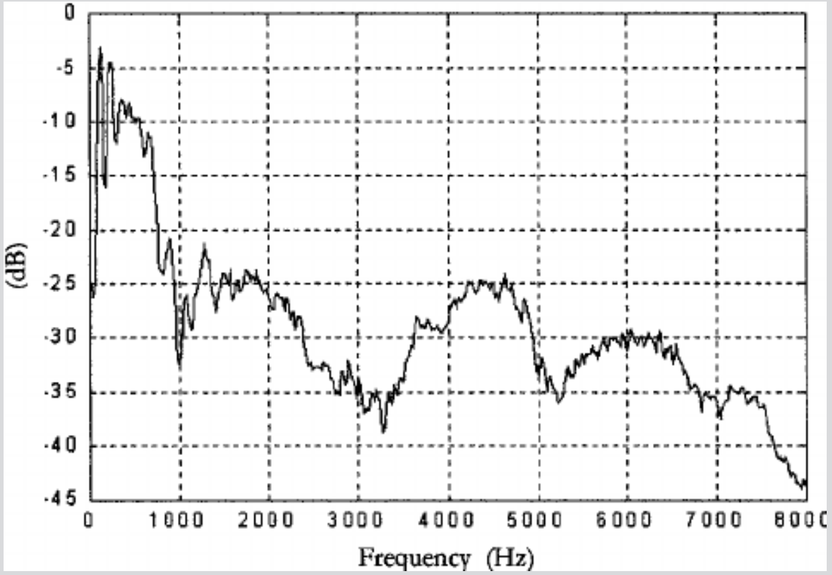


Frequency folding effect

If a signal of max freq component of 1500 Hz is sampled at say 1000 Hz then the reconstructed signal will appear to be of only 500 Hz

SPECTRUM OF A SIGNAL

The frequency domain representation of a time domain signal is known as its spectrum. This domain of representation is called the spectral domain and it mainly **contains spectral or frequency contents of the signal we are interested in.**



A spectrogram is **a visual representation of the frequency content** of a signal as it changes over time. It is a **two-dimensional plot** where the x-axis represents time, the y-axis represents frequency, and the color intensity (or brightness) represents the magnitude (or power) of the signal's frequency components at each time point.

THANK YOU