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Power Point Presentation on

"Discrete Time Signals & Systems"

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Introduction :

Discrete time signals are signals that are defined at discrete intervals of time, as opposed to continuous-time signals that are defined over an continuous range of time. Discrete time signals can be represented mathematically using sequences, which are ordered sets of numbers.

Types of Discrete Time Signals:

- **Periodic Discrete Time Signals** : These signals have a repeating pattern over a certain period, and can be represented using a finite number of discrete time samples.

- **Aperiodic Discrete Time Signals :** These signals do not have a repeating pattern and can be represented using an infinite number of discrete time samples.

Discrete Time Systems

A discrete-time system is a device or algorithm that produces an output signal based on a given input signal. They can be represented mathematically using difference equations, which are equations that describe the relationship between the input and output of the system.

Types of Discrete Time Systems :

- **Linear** : A system is linear if the output is a linear combination of the input and the system's impulse response.
- **Time-invariant** : A system is time-invariant if the output does not depend on when the input is applied.
- **Causal** : A system is causal if the output at any time only depends on the input up to that time and not on future inputs.
- **Stable** : A system is stable if the output remains bounded for any input that is bounded.

Time Domain Analysis of Discrete Time Signals and Systems

The time domain analysis of discrete time signals and systems refers to the study of the behavior of signals and systems in terms of their values at discrete time instants. There are several key concepts used in the time-domain analysis of discrete-time signals and systems, including impulse response, convolution, and correlation.

- **Impulse Response** : The impulse response of a discrete-time system is the output produced by the system when the input is an impulse, or a delta function. The impulse response provides information about how the system responds to different inputs.

- **Convolution** : Convolution is a mathematical operation that is used to describe the output of a linear, time-invariant system when the input is a discrete-time signal. The convolution of the input signal and the impulse response of the system gives the output signal..

Correlation : Correlation is a measure of similarity between two signals. The cross-correlation of two signals is a measure of how similar the two signals are at different time lags

Frequency Domain Analysis of Discrete Time Signals and Systems

The frequency domain analysis of discrete-time signals and systems refers to the study of the behavior of signals and systems in terms of their frequency content. There are several key concepts used in the frequency-domain analysis of discrete-time signals and systems, including the Fourier series, the Fourier Transform, and the Laplace Transform.

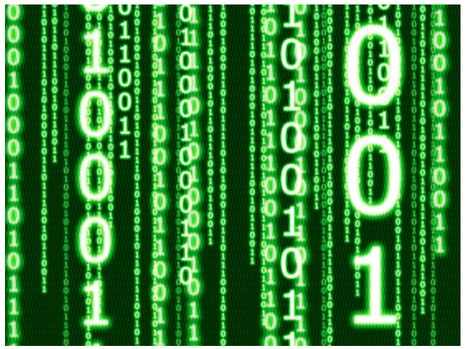
- **Fourier Series** : The Fourier series is a representation of a periodic signal as a sum of sinusoidal functions with different frequencies, amplitudes, and phases. It is used to decompose a periodic signal into its frequency components.

- **Fourier Transform** : The Fourier Transform is a generalization of the Fourier series to non-periodic signals. It provides a representation of a signal in the frequency domain, which can be used to analyze the frequency content of the signal.

- **Laplace Transform** : The Laplace Transform is a powerful tool for the analysis of discrete-time systems. It provides a representation of a signal or system in the complex frequency domain, which can be used to analyze the stability and response of the system.

Sampling and Reconstruction of Analog Signals

In practice, it is often necessary to convert continuous-time signals to discrete-time signals in order to process them using digital systems. This process is called sampling. The reverse process, where a discrete-time signal is converted back to a continuous-time signal, is called reconstruction.

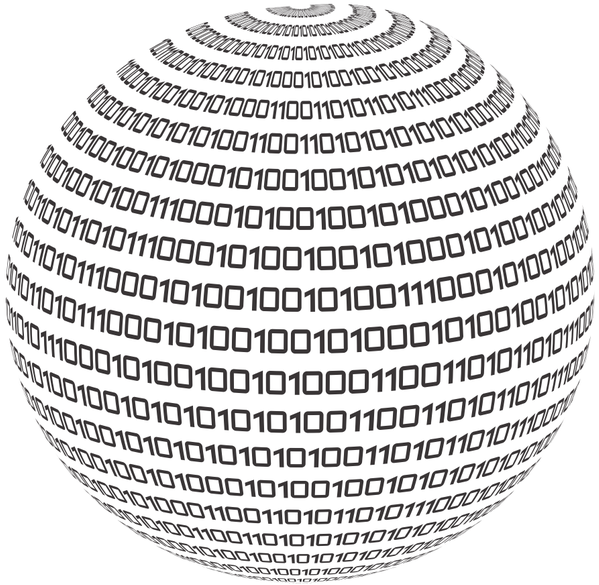


Sampling :

Sampling is the process of taking the value of a continuous-time signal at regular intervals of time. The resulting discrete-time signal is called a sampled signal. The rate at which the signal is sampled is called the sampling frequency. It's important to choose a sampling frequency that is higher than the highest frequency present in the signal to avoid distortion, this is called the Nyquist rate.

Reconstruction :

Reconstruction is the process of converting a discrete-time signal back to a continuous-time signal. The process of reconstruction can introduce errors, especially if the original signal was not bandlimited or the sampling frequency was not high enough. One of the common methods to reconstruct the signal is using interpolation techniques such as the sinc interpolation.



Conclusion :

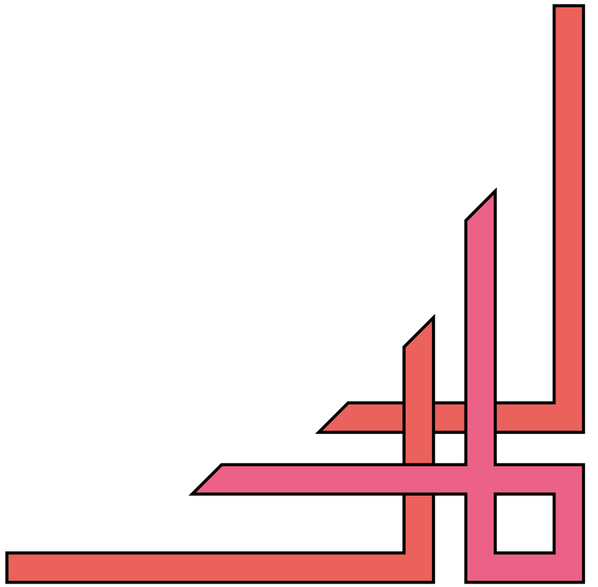
- Signals and Systems is an introduction to analog and digital signal processing, a topic that forms an integral part of engineering systems in many diverse areas, including seismic data processing, communications, speech processing, image processing, defense electronics, consumer electronics, and consumer products.

- The objective of any signal processing is to transmit information, be it audio, video or otherwise

Reference:

1) Digital Image Processing, 3rd Edition, R. C. Gonzalez, R. E. Woods

3. ChatGPT (https://chat.openai.com/chat)



Thank You