Lecturer :-
Dato' Prof. Dr. Ir Zainul Abidin
Md Sharrif.

- Course Code:- EEEB233
- Course Title :- Signals & Systems
- Prerequisites:- Circuit Analysis 1 (EEEB113), MATB 143 Differential Equation
- Corequisite:- Circuit Analysis 2 (EEEB123)
- Aims/Objectives

  To introduce the concepts and techniques associated with the understanding of signals and systems.

  To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems.

  To provide with an appreciation of applications for the techniques and mathematics used in this course.

TEXTBOOKS

- Adopted or Recommended:-
  Signals & Systems.
  by Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab.
  Prentice-Hall, Inc.
  Second Edition. 1997.

- Reference:-
  Signal and Linear System Analysis.
  by Gordon E. Carlson.
  John Wiley & Sons, Inc. 1996

EEEB233, Signals & Systems .

Course Outcomes

- Determine the mathematical representation of signals and systems, signal energy and power, transformation of signal independent variable, properties of periodic signals, even and odd signal, exponential and sinusoidal signal, unit impulse and unit step. Derive the equation describing the relationship between input and output of continuous-time and discrete-time systems. Determining basic system properties

- Derive, calculate and compute the convolution sum and integral of Linear Time-Invariant System. Determine the convolution properties of LTI systems. Detremine the difference and differential equation of LTI systems.

- Determine the Response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-Time Periodic Signals, Convergence of the Fourier Series, Properties of Continuous-Time Fourier Series, and Fourier Series Representation of Discrete-Time Periodic Signals.

- Determine Continuous-Time Fourier Transform, Discrete-Time Fourier Transform for Aperiodic signals, convergence of Fourier transforms, Fourier Transform of periodic signal, properties of Fourier Transform,

- Determine Time and Frequency Characteristics of signals & Systems. Determine the magnitude-Phase representation of the Fourier Transforms

EEEB233, Signals & Systems

Course Outcomes

- Explain the Sampling Theorem, Interpolation and aliasing.

- Design Communication Systems. Explain Amplitude Modulation/ Demodulation, Frequency Division Multiplex, Single-Sideband Sinusoidal Amplitude Modulation, Amplitude Modulation with a Pulse-Train Carrier, Pulse-Amplitude Modulation, Sinusoidal Frequency Modulation and Discrete_Time Modulation.

- Derive and determine Laplace Transform & z-Transform, region of convergence, their properties. Determine the inverse Laplace transform & z-transform. Solve the differential and difference equation using Laplace and z-transform. Obtain system/transfer function through Laplace transform & z-transform. Derive block diagram representation from system functions. Sketch Poles & Zeros plot. Evaluate Fourier Transform from Pole-Zero Plot

- Design continuous analog filters. Design discrete filters through mapping(bilinear transformation) from continuous filters Design and determine the stability of Linear Feedback Systems.

ASSESSMENT

- Final Exam
- Tests
- Quizzes
- Assignments

- No of assessment :-
  Final Exam=1.
  Test = 1.
  Quizzes or Assignments = 6.

Outline of Syllabus ,

42 hours of Lectures will involved the 11 Chapters, with 14 hours of tutorial.

- 1. Signal & System Representation
- 2. Linear Time-Invariant Systems
- 3. Fourier Series Representation of Periodic Signals
- 4. The Continuous-Time and Discrete-Time Fourier Transform
- 5. Time and Frequency Characterization of Signals and Systems.
- 6. Sampling and Communication Systems
- 7. Laplace Transform, z-transform, and Linear Feedback System.

College of Engineering

Signal And System

Introduction:-

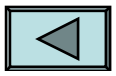
Concepts arise and use in various fields

1) Communication
2) Aeronautics & astronautics
3) Circuit Design
4) Acoustics
5) Seismology
6) Biomedical engineering
7) Energy generation & distribution
8) Chemical process control
9) Speech processing
10) Image processing
11) Economic & Financial Forecasting
12) Weather forcasting & etc.....

College of Engineering

Signals & Systems

- Two basic features in common.
- Signals are function of independent variables.
- System response to input signals by producing other signals.
- Example:- voltage & current are signals. Circuits are systems.



2nd Example:-

- Automobile driver depresses the accelerator pedal.
- The automobile responses by increasing the speed of the vehicle.
- System is the automobile, pressure on pedal is the input signal, the automobile speed is the response or output signal.

3nd Example:-

- Digitized electrocardiogram as input to a computer program for an automated diagnosis of electrocardiogram.
- The program responses by estimating parameter (the heart rate of the patient).
- System is the computer program, digitized electrocardiogram is the input signal, the heart rate is the response or output signal.

4nd Example:-

- Light from different sources and reflected from objects as input signal to a camera.
- The camera responses by producing photo chemical changes on the photographic films.
- System is the camera, light is the input signal, the photograph/film is the response or output signal.

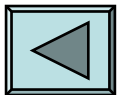
5nd Example:-

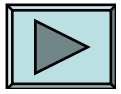
- Control input signal to a robot arm.
- The robot responses by producing movement of the arm.
- System is the robot arm, control electrical signal is the input signal, the movement of the arm is the response or output signal.

Signals & Systems

Objectives

- When presented with a specific system , we are interested in characterizing it in detail to understand how it will response to input signals.
- Examples :- Understanding of human auditory system. Vocal Tract System. Economic system. Analysis of circuits. Determination of aircraft response characteristic due to pilot commands & wind gusts.

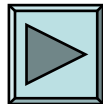




Signals & Systems

Objectives & Applications

- Designing of systems to process signals in particular ways.Example Economic forecasting.. Stock market predicting.
- Restoration of degraded or corrupted signals. E.g. Speech communication with background noise as in aircraft cockpit or car. Aim to retain the pilot voice and get rid of the engine noise. Restoration /enhancement of old recording/image.



Signals & Systems

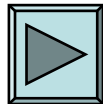
Objectives & Applications

- Images from deep space probes or earth-observing satellites represent degraded versions of the scenes being imaged.
- Why.. Because of equipment limitations, atmospheric effect, errors in signal transmission in returning the image to earth.
- Process by system to restore/enhance the images.

Signals & Systems

Objectives & Applications

- Designing of signals with particular properties.
- In Communication - design signal to meet the constraints and requirement for successful transmission.
- Distortion due to atmospheric effect and interference from other signals from other stations.



Continuous or Discrete

- Two types of signals are present naturally.
- Signals varying continuously with time or some other variable e.g. space or distance.
- Signals that exist only at discrete point of time e.g. daily closing stock market average or index.

Roots of Continuous/Discrete

- Continuous -time signals & systems have very strong roots in problems associated with physics, electrical circuits and communications.
- Techniques of discrete-time signals & systems have strong roots in numerical analysis, statistics, time-series, econometrics.

Recent development

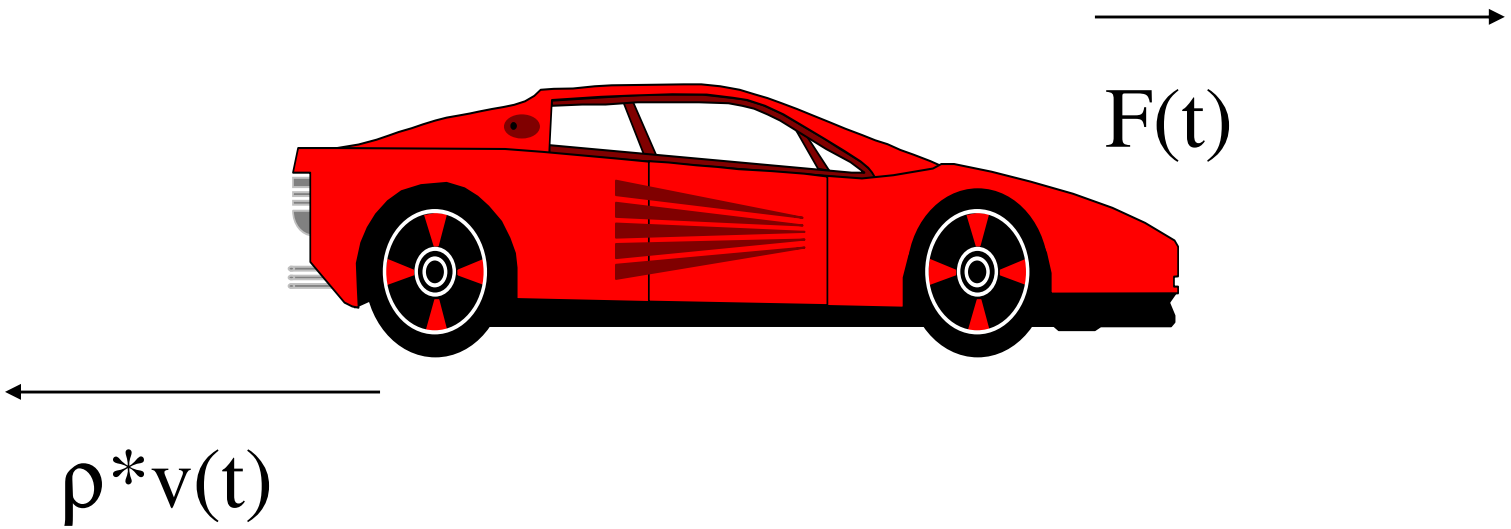
- Historically the two types of signals & systems are being developed separately.
- Recently they are intertwined and related via the advent of digital computers, microprocessors and micro controllers through new emerging VLSI technology for densely packing devices and circuits on chips.

Recent development

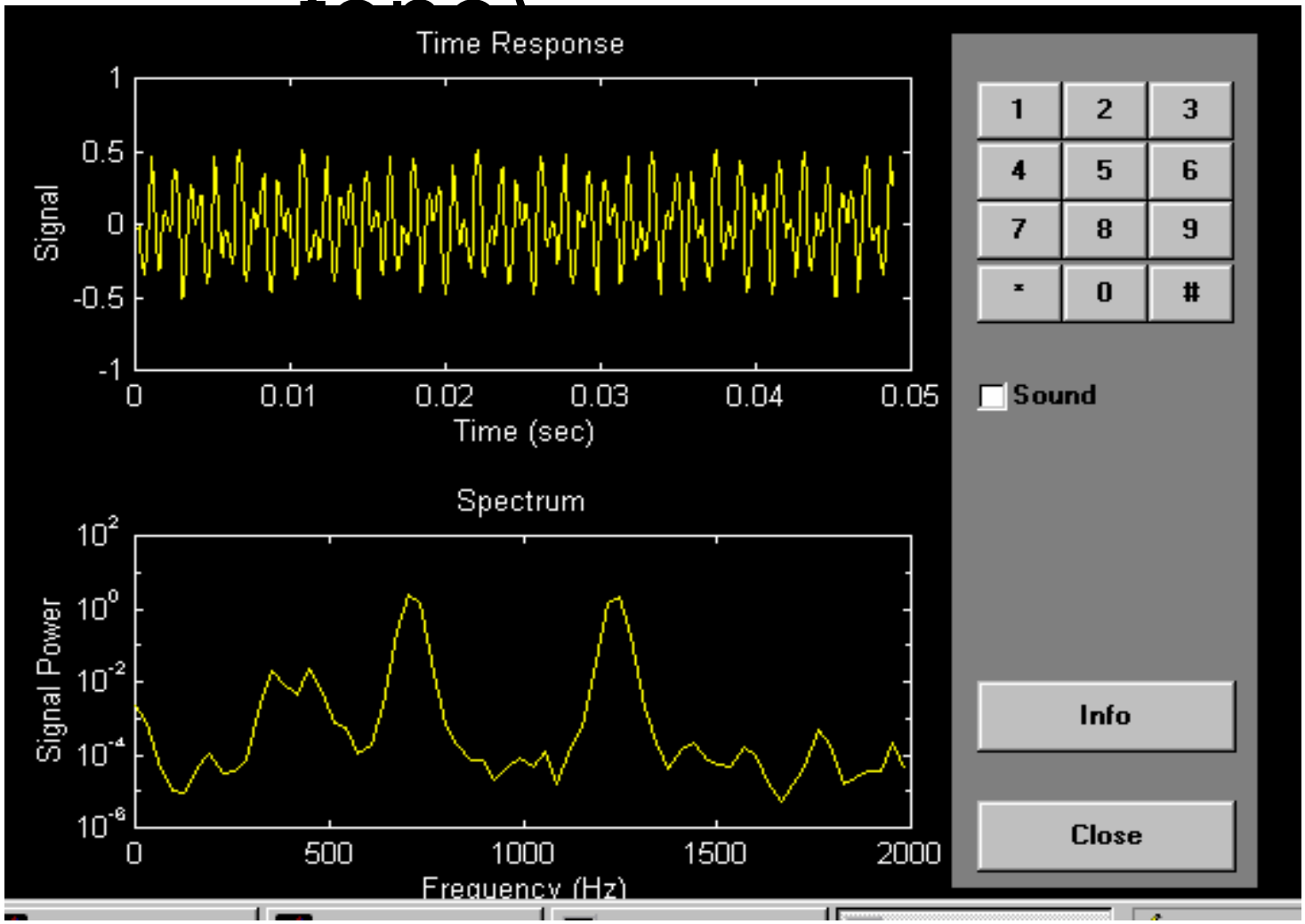
- More and more naturally occurring continuous signals have been digitized to produced digital signals or discrete signals.
- Digital/discrete systems have been used to processed these signals which later is converted back to analog/continuous signals for various application e.g. Highly Definitive Television (HDTV).

Mathematical Representation

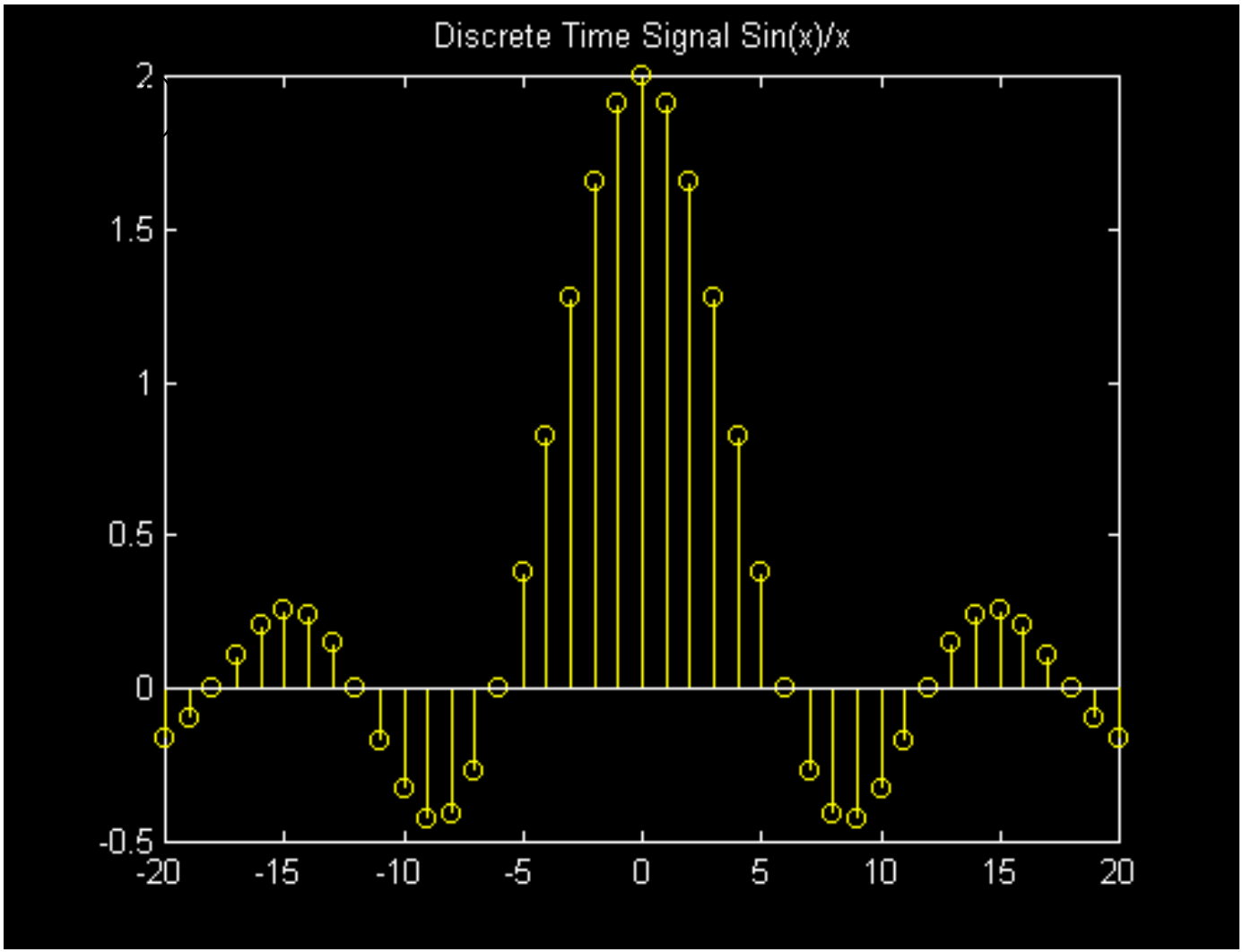
- An Automobile responding to an applied force F(t) from the engine and to the retarding frictional force ρ*v(t).



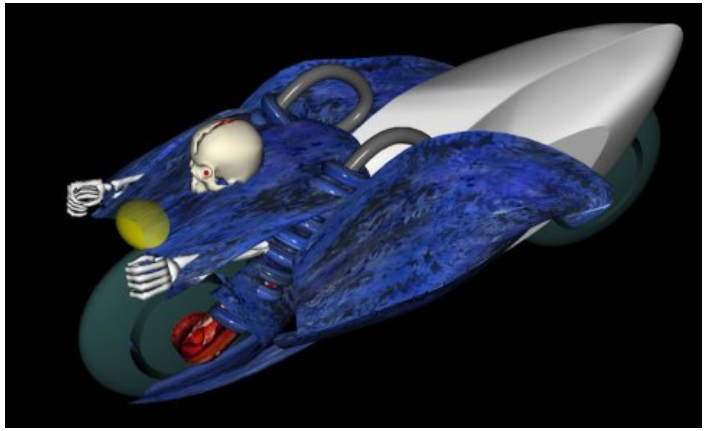
Signal function of time (eg. Speech & dual-tone)



Discrete Signal



Picture (2-D Signal)



Each pixel r(x,y), b(x,y) etc… Multi-function & multi-variable(dimension)