CSE300 ASSIGNMENT
INTRODUCTION TO LaTeX
Introduction to Signal with Fourier Series

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Chapter 1

Signal

1.1 Introduction

1.1.1 Definition

A signal is the term implies, is a set of **information** or **data**.It is a function of independent variables (such as time,space *etc*) that carry some information.
A signal is a physical quantity that **varies** with time, space or any other **independent variable** by which information can be conveyed.

1.1.2 Example

There is some example of signals:

- Voice signal
- Telephone or television signal

1.1.3 Signal Representation

In the following figure signal is represented in time domain:

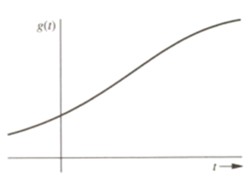

Figure 1.1: Signal in time domain

1.2 Classification of Signals

Signal can be classified based on two axes.

1. Based on continuity in time axis

   Continuous time: Speaking

   Discrete time: Temperature Scale

2. Based on continuity in amplitude axis

   Continuous Amplitude: Speaking

   Discrete Amplitude: Road signal Light

Following figure describes signal based on time axis and amplitude axis

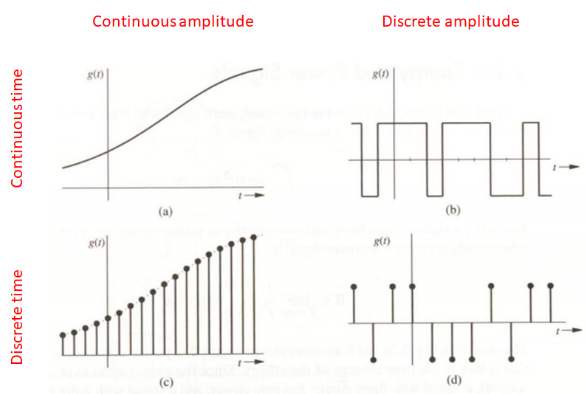

Figure 1.2: Classification of Signal

Signal also can be classified in following two types:

1. Analog Signal
2. Digital Signal

Next section, we will discuss about this to type of signal.

1.3 Analog and Digital Signal

1.3.1 Analog Signal

An analog signal is any continuous signal for which the time varying feature (variable) of the signal is a representation of some other time varying quantity,**i.e.** , analogous to another time varying signal.It has continuous amplitude but time can be continuous or discrete.

In figure 1.1(a) and 1.1(c) is the examples of analog signal.

1.3.2 Digital Signal

A digital signal is a signal that is being used to represent data as a sequence of discrete values; at any given time it can only take on one of a finite number of values.This contrasts with an analog signal, which represents continuous values; at any given time it represents a real number within a continuous range of values.

In figure 1.1(b) and 1.1(d) is the examples of digital signal.

1.3.3 Advantage of Digital Signal

There are some advantages of digital signal over analog signal:

- Better noise immunity
- Viability of regenerative repeaters
- Hardware implementation is flexible with the use of integrated circuit, microprocessor etc.
- Digital signal can be encoded for low error rate and privacy
- Easier and efficient to multiplex digital signals
- Digital signal storage is relatively easy and inexpensive
- Decreasing cost of hardware with increasing capacity

Chapter 2

Fourier Series

2.1 Fourier Series

In this chapter,we will discuss about **Fourier Series**.

2.1.1 Fundamental Formulas

Let g_{T_0} denote a periodic signal with period T_0 By using a Fourier series expansion of this signal, we are able to resolve it into an infinite sum of sine and cosine terms. The expansion may be expressed in the *trigonometric* form:

$$g_{T_0}(t) = a_0 + 2\sum_{n=1}^{\infty}[a_n cos(2\pi n f_0 t) + b_n sin(2\pi n f_0 t)] \tag{2.1}$$

where f_0 is the *fundamental frequency*:

$$f_0 = \frac{1}{T_0} \tag{2.2}$$

The value of the co-efficient of the equation 2.1 can be determined by the following formulas:

$$a_0 = \frac{1}{T_0}\int_{T_0/2}^{-T_0/2} g_{T_0}(t)dt \tag{2.3}$$

$$a_n = \frac{1}{T_0}\int_{T_0/2}^{-T_0/2} g_{T_0}(t)cos(2\pi n f_0 t)dt \tag{2.4}$$

$$b_n = \frac{1}{T_0}\int_{T_0/2}^{-T_0/2} g_{T_0}(t)sin(2\pi n f_0 t)dt \tag{2.5}$$

2.1.2 Complex Form of Fourier Series

The equation 2.1 can be expressed in the following exponential form:

$$g_{T_0}(t) = \sum_{-\infty}^{\infty} c_n e^{j2\pi n f_0 t} \tag{2.6}$$

where,

$$c_n = \frac{1}{T_0} \int_{T_0/2}^{-T_0/2} g_{T_0}(t) e^{-j2\pi n f_0 t} dt \tag{2.7}$$