**Lecture 1**

1. **What is the signal? Or Define the Signal?**

**Answer**: Signal processing is a discipline in electrical engineering and in mathematics that deals with analysis and processing of analog and digital signals, and deals with storing, filtering, and other operations on signals. These signals include transmission signals, sound or voice signals, image signals, and other signals etc.

1. **What is the Image Processing? Or Define the Image Processing?**

**Answer:** The field that deals with the type of signals for which the input is an image and the output is also an image is done in image processing. As it name suggests, it deals with the processing on images.

It can be further divided into analog image processing and digital image processing.

**Analog image processing:** Analog image processing is done on analog signals. It includes processing on two dimensional analog signals. In this type of processing, the images are manipulated by electrical means by varying the electrical signal. The common example include is the television image.

**Digital image processing:** The digital image processing deals with developing a digital system that performs operations on a digital image.

1. **What is an Image? Or Define Image?**

**Answer:** An image is nothing more than a two dimensional signal. It is defined by the mathematical function f(x, y) where x and y are the two co-ordinates horizontally and vertically.

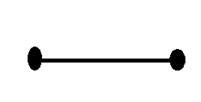
The value of f(x, y) at any point is gives the pixel value at that point of an image.

1. **Define Different dimensions of signals?**

**Answer:**

**1 dimension signal**

The common example of a 1 dimension signal is a waveform. It can be mathematically represented as F(x) = waveform Where x is an independent variable. Since it is a one dimension signal, so that's why there is only one variable x is used.

Pictorial representation of a one dimensional signal is given below:

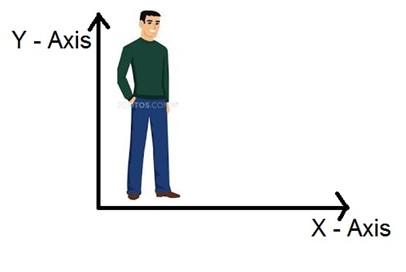
The above figure shows a one dimensional signal.

**2 dimensions signal**

The common example of a two dimensional signal is an image, which has already been discussed above.

As we have already seen that an image is two dimensional signals, i-e: it has two dimensions. It can be mathematically represented as:

F (x, y) = Image

Where x and y are two variables.

**3 dimension signal**

Three dimensional signals as it names refers to those signals which has three dimensions. We live in a three dimensional world. An example of a three dimensional signal is a cube or a volumetric data or the most common example would be animated or 3d cartoon character.

The mathematical representation of three dimensional signals is:

F(x, y, z) = animated character.

**4 dimension signal**

In a four dimensional signal, four dimensions are involved. The first three are the same as of three dimensional signals which are (X, Y, Z), and the fourth one which is added to them is T (time). Time is often referred to as temporal dimension which is a way to measure change. Mathematically a four d signal can be stated as:

F(x, y, z, t) = animated movie.

1. **What is the Pixel? Or Define Pixel?**

**Answer:**

**Pixel**

Pixel is the smallest element of an image. Each pixel corresponds to any one value. In an 8-bit gray scale image, the value of the pixel between 0 and 255. The value of a pixel at any point corresponds to the intensity of the light photons striking at that point. Each pixel stores a value proportional to the light intensity at that particular location.

**PEL**

A pixel is also known as PEL.

1. **What is a Digital Image? Or Define Digital Image with 3 Common Formats?**

**Answer:**

A **digital image** is a representation of a two-dimensional image as a finite set of digital values, called picture elements or pixel

Pixel values typically represent gray levels, colors, heights, opacities etc.

**Remember** digitization implies that a digital image is an approximation of a real scene.

Common image formats include:

* + 1 sample per point (B&W or Grayscale)
  + 3 samples per point (Red, Green, and Blue)
  + 4 samples per point (Red, Green, Blue, and “Alpha”, a.k.a. Opacity)

1. **What is Digital Image Processing?**

**Answer:**

**Digital Image Processing**

Digital image processing focuses on two major tasks

* 1. Improvement of pictorial information for human interpretation
  2. Processing of image data for storage, transmission and representation for autonomous machine perception

Some argument about where image processing ends and fields such as image analysis and computer vision start.

The continuum from image processing to computer vision can be broken up into Low Level, Mid-Level and High Level processes

|  |  |  |
| --- | --- | --- |
| Low Level Process | Mid-Level Process | High Level Process |
| **Input:** Image | **Input:** Image | **Input:** Attributes |
| **Output:** Image | **Output:** Attributes | **Output:** Understanding |
| **Examples:** Noise removal, image sharpening | **Examples:** Object recognition, segmentation | **Examples:** Scene understanding, autonomous navigation |

Lecture 2