Discrete Signal Processing for Image Analysis and related Algorithms

notes taken from *Discrete Time Signal Processing, Oppenheim, 1999*

# Images as Discrete Spatial Sequences

Digital images are represented mathematically as a two-dimensional array of 3D vectors in which each dimension correspond to a specific color channel (). Here each of the three-color channels is represented by bit number. Each row and column of this two-dimensional array can also be interpreted as a one-dimensional sequence of vectors , in which the nth vector in the sequence is denoted and is formally written as:

, (1)

Continuous (smooth) images are represented by continuous lines (here the superscript stands for  *continuous Greek*). So if we have a continuous (smooth) image given , at a position we have:

, (2)

The quantity is called *spatial pixel distance* or *dot pitch*.

## Sequences and Sequence Operations

The product and sum of two sequences and are defined as the sample-by-sample product and sum respectively.

Multiplication of a sequence by a number .

**Definition**: *shifted / delayed sequence*

A sequence is said to be a delayed or shifted version of a sequence if

, – integer (3)

**Definition**: the *unit sample sequence aka impulse* is defined as :

(4)

**Statement**: an arbitrary sequence can be represented as a sum of scaled delayed impulses as:

(5)

**Definition**: unit step sequence is given as

(6)

The relationship between unit step and impulse is given by