Basic Operation on Signals

An issue of major importance is the use of systems to process or manipulate signals. This issue involves a combination of some basic operations.

However, two classes of these operations can be identified that are:

① **Operation of dependent variables**

A. Amplitude scaling (Amplitude shifting, Amplification): The scaled signal $ax_{(t)}$ is $x_{(t)}$ multiplied by the factor a where a is a constant real number, such as, the physical device that performs amplitude scaling is an electronic amplifier.

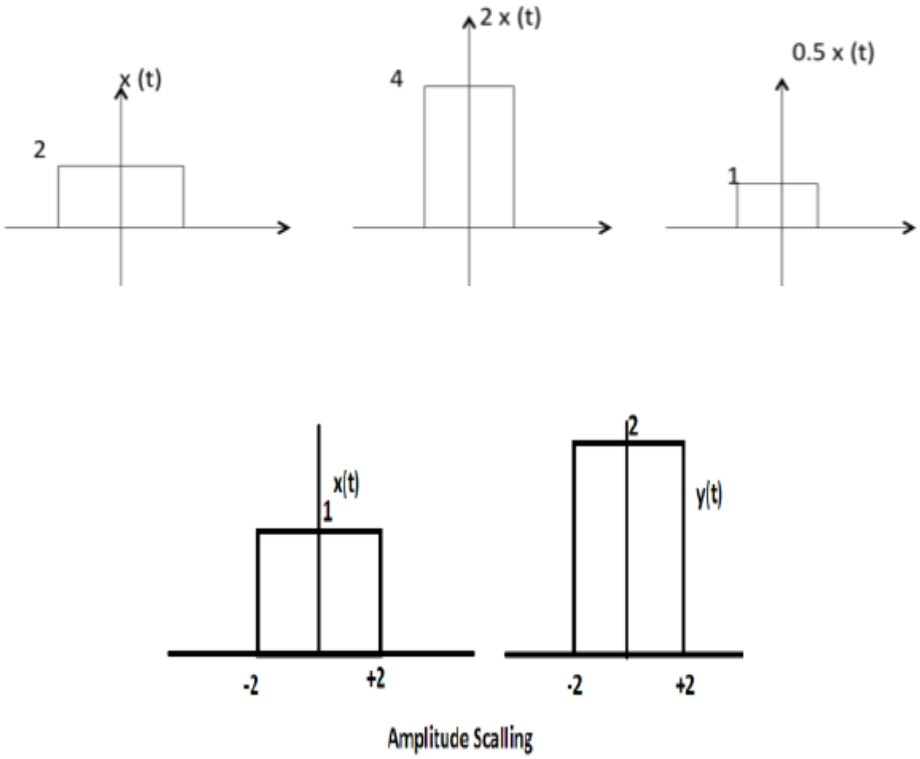

Figure 8: The amplitude scaling operation

In this case, only the values of y axis is changed since the amplitude is associated with this axis while, the values of x axis is constant.

B. Addition: If $x_1(t)$ and $x_2(t)$ denote a pair of CTSs. The signal z(t) obtained by the addition of $x_1(t)$ and $x_2(t)$ is defined by:

$z(t) = x_1(t) + x_2(t)$

In the case of DTS, it written as:

$z[n] = x_1[n] + {}_{x2}[n]$

It can be noted that the addition of two signals is nothing but addition of their corresponding amplitudes. This can be best explained by using the following example:

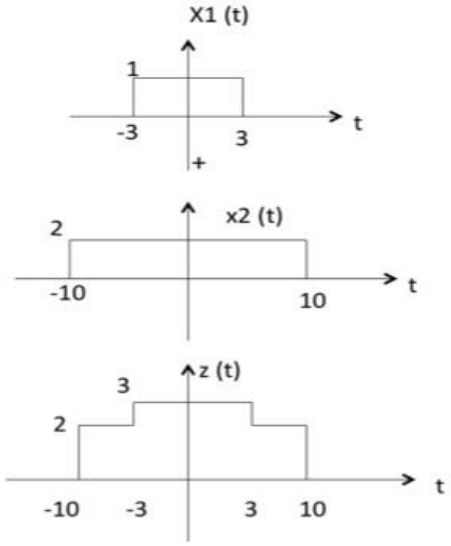

Figure 9: The addition operation

C. Subtraction: If $x_1(t)$ and $x_2(t)$ refer to a pair of CTSs. Then, the signal z(t) obtained by the subtracting of $x_1(t)$ from $x_2(t)$ is defined by:

$z(t) = x_1(t) - x_2(t)$

In the case of DTS, it written as:

$z[n] = x_1[n] - {}_{x2}[n]$

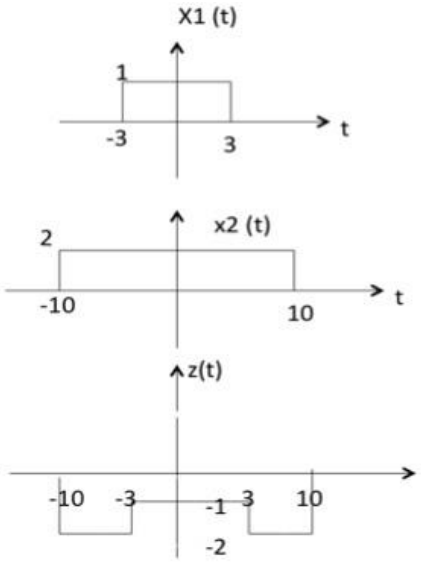

Figure 10: The subtraction operation

D. Multiplication: let $x_1(t)$ and $x_2(t)$ denote a pair of CTSs. The signal z(t) resulting from the multiplication of $x_1(t)$ and $x_2(t)$ is defined by the following equation:

$z(t) = x_1(t) * x_2(t)$

That is, for each prescribed time (t) the value of z(t) is given by the product of the corresponding values of $x_1(t)$ and $x_2(t)$.

For discrete-time signals we write:

$z[n] = x_1[n]\, x_2[n]$

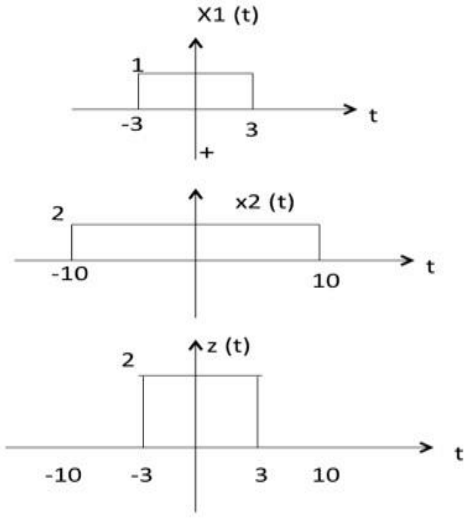

Figure 11: The Multiplication operation

Explains all the above operations with many examples and homeworks.