Signal Processing – Assignment 1

Q1] conv, convn and filter are three different methods to apply convolution to signals in MATLAB.

Conv is used for 1D convolution. convn is used for general convolution of n dimensional signals. Filter is used to simulate filtering of 1D real time signals and can also , perform recursive operations.

Plots

A graph on a screen

AI-generated content may be incorrect.Conv:

A graph on a black background

AI-generated content may be incorrect.Convn:

A graph on a black background

AI-generated content may be incorrect.Filter:

Syntax:

Conv(x,h);

Convn(x,h);

Filter(b,a,x);

Here, x is the input, h the impulse response and b and a are respectively the numerator and denominator coefficients.

Differences:

Conv and convn gives same output for 1D signals. The only main difference is in there usage that conv can only be used with 1D signals while convn is a more general version of conv that can perform convolution with signal of any dimension. Filter ,on the other hand , gives different output as it does not perform inversion of impulse response for filtering. This makes it much more faster that the other two operations . Filter also introduces a delay in the output .

Usage:

Conv is optimized to being used with simple 1D signals like in audio processing and noise reduction . Convn is suitable for performing convolution to higher dimensional signals such as those in image processing. Filter is preferable to be used in real time signal filtering. They provide the feature to perform both Finite Impulse Response(FIR) and Infinite Impulse Response(IIR) functions .

Q3]

We will be applying gaussian filter to a grayscale image corrupted by gaussian noise. Image processing toolbox addon present in matlab provides the required functions(imnoise, imfilter, etc.) streamlines this process . Three different plots are made for the original grayscale image, noisy image, and the filtered image. The filtered image’s quality is compared with that of the original image using the peak signal to noise ratio(psnr). This metric is used to show the higher quality of the filtered image from the initial noisy image. Higher psnr value corresponds to a better quality image and less distortions from the original image.

From the below plots, it can be seen that the filtered image show less distortations from the original image ,the noise reduced and edges are smoother with better textures.

Plots:A close-up of a flower

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