

EE5301: DSP Lab/EE5801: CSP Lab

Assignment 1

Problem : Implement basic signal processing algorithms convolution, correlation, downsampling and upsampling.

Technical details :

Convolution : convolution of two sequences $x[n]$ and $h[n]$ is

$$y[n] = \sum_{k=0}^{\infty} x(k) h(n - k)$$

Inputs : $x[n] = \{0.5377, 1.8339, -2.2588, 0.8622, 0.3188, -1.3077, -0.4336, 0.3426, 3.5784, 2.7694, -1.3499, 3.0349, 0.7254, -0.0631, 0.7147, -0.2050, -0.1241, 1.4897, 1.4090, 1.4172\}$

$h[n] = \{0.6715, -1.2075, 0.7172, 1.6302, 0.4889, 1.0347, 0.7269, -0.3034, 0.2939, -0.7873, 0.8884, -1.1471, -1.0689, -0.8095, -2.9443\}$

Correlation : correlation of two sequences $x[n]$ and $h[n]$ is

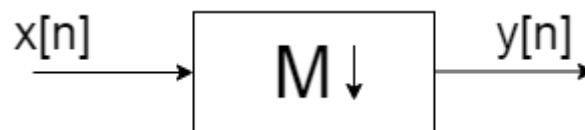
$$R_{xy}[k] = \sum_{n=0}^{\infty} x(n) y(n - k)$$

Inputs : $x[n] = \{0.5377, 1.8339, -2.2588, 0.8622, 0.3188, -1.3077, -0.4336, 0.3426, 3.5784, 2.7694, -1.3499, 3.0349, 0.7254, -0.0631, 0.7147, -0.2050, -0.1241, 1.4897, 1.4090, 1.4172\}$

$y[n] = \{0.6715, -1.2075, 0.7172, 1.6302, 0.4889, 1.0347, 0.7269, -0.3034, 0.2939, -0.7873, 0.8884, -1.1471, -1.0689, -0.8095, -2.9443\}$

Downsampling : $y[n] = x[Mn]$

Given the sequence $x[n]$, downsample it with factor M to get $y[n]$.



Take $M = 2$, input $x[n] = \{0.3252, -0.7549, 1.3703, -1.7115, -0.1022, -0.2414, 0.3192, 0.3129, -0.8649, -0.0301, -0.1649, 0.6277, 1.0933, 1.1093, -0.8637, 0.0774, -1.2141, -1.1135, -0.0068, 1.5326, -0.7697, 0.3714, -0.2256, 1.1174, -1.0891, 0.0326, 0.5525, 1.1006, 1.5442, 0.0859, -1.4916, -0.7423, -1.0616, 2.3505, -0.6156, 0.7481\}$

Upsampling : $y[n] = \begin{cases} x[n/L], & \text{if } n \text{ is a multiple of } L \\ 0, & \text{otherwise} \end{cases}$

Given the sequence $x[n]$, upsample it with factor L to get $y[n]$.



Take $L = 2$, input $x[n] = \{0.3252, 1.3703, -0.1022, 0.3192, -0.8649, -0.1649, 1.0933, -0.8637, -1.2141, -0.0068, -0.7697, -0.2256, -1.0891, 0.5525, 1.5442, -1.4916, -1.0616, -0.6156\}$

Submission Details :

- Write C code to implement above algorithms.

- Write main.c and two separate files named common_functions.c which contains four separate functions for above operations and header file named common_functions.h which contains function declarations.
- Upload main.c, common_functions.c, common_functions.h files and a text file containing your outputs.
- Also write your understanding about all four operations in words and upload a pdf file.
- Submit all files in a single zip file with your id, Example: EE20MTECH11010_ **A1**.zip.

Note:

1. Take input and output type as float arrays.
2. we would encourage you to write optimised and efficient codes