

EE5801: CSP Lab/ EE5301: DSP Lab

Assignment 1

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

Technical details :

Convolution :

[10 marks]

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

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

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 :

[10 marks]

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

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

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

0.7254, -0.0631, 0.7147, -0.2050, -0.1241, 1.4897, 1.4090, 1.4172}

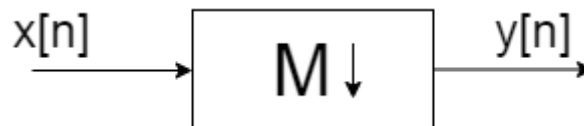
$y[n] = \{0.6715, -1.2075, 0.7172, 1.6302, 0.4889, 1.0347, 0.7269, -0.3034, 0.2939, -0.7873, 0.8884, -1.1471, -1.0689, -0.8095, -2.9443\}$

Downsampling :

[10 marks]

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

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



Take $M = 2$ and 3

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 :

[10 marks]

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

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



Take $L = 2$ and 3

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.
- **Coding format:** 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.
- Write your understanding about all four operations in MS word or latex.
- Upload the below files in a single zip file with your id, Example: EE20MTECH11010_ **A1**.zip.
 1. main.c
 2. common_functions.c
 3. common_functions.h
 4. A text file containing your outputs
 5. Pdf of your MS word or latex document.

Grading:

- Output - 50%
- coding format - 30%
- writing submission(pdf file) - 20%
- late submission - (-5)%