

Homework Assignment X

Reading Assignment: Lecture Notes

1. Consider the down-sampler and up-sampler as illustrated in the figure below.

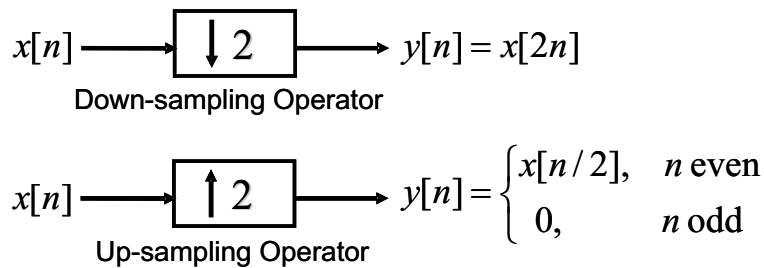


Figure 1: The down-sampler and the up-sampler.

- (a) Prove that the down-sampler and the upsampler are linear operators.
 (b) Give counter-examples to demonstrate that these are time-variant operators.

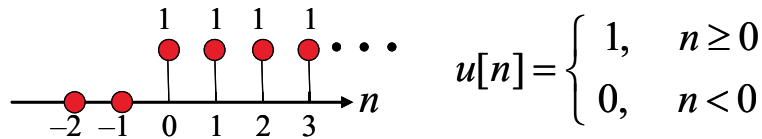


Figure 2: The unit-step signal.

2. The unit-step signal $u[n]$ is defined and sketched as shown in the figure above.

- (a) Sketch the result of the convolution between the unit-step signal and the filter

$$h[n] = \frac{1}{4}\delta[n] + \frac{1}{2}\delta[n - 1] + \frac{1}{4}\delta[n - 2].$$

- (b) Sketch the result of the convolution between the unit-step signal and the filter

$$h[n] = -\frac{1}{4}\delta[n] + \frac{1}{2}\delta[n - 1] - \frac{1}{4}\delta[n - 2].$$

- (c) Based on the result above, which filter is low-pass and which is high-pass?

3. Suppose that an interpolated signal $x_i[n]$ is constructed from the interpolation scheme below where the filter in use is

$$h[n] = \frac{1}{2}\delta[n+1] + \delta[n] + \frac{1}{2}\delta[n-1].$$

Find the relationship between the interpolated sample $x_i[n]$ and the original signal sample $x[n]$.

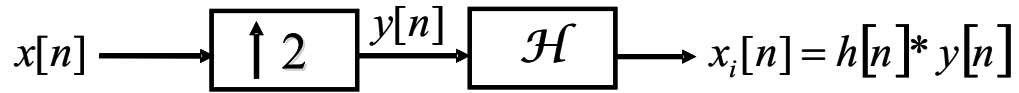


Figure 3: Interpolation.

Due date: Friday 12/09 in Lab.