

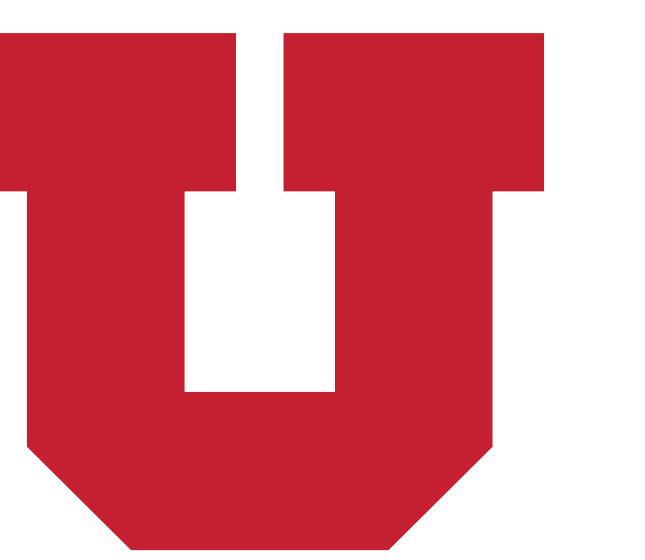


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# Sampling and Aliasing

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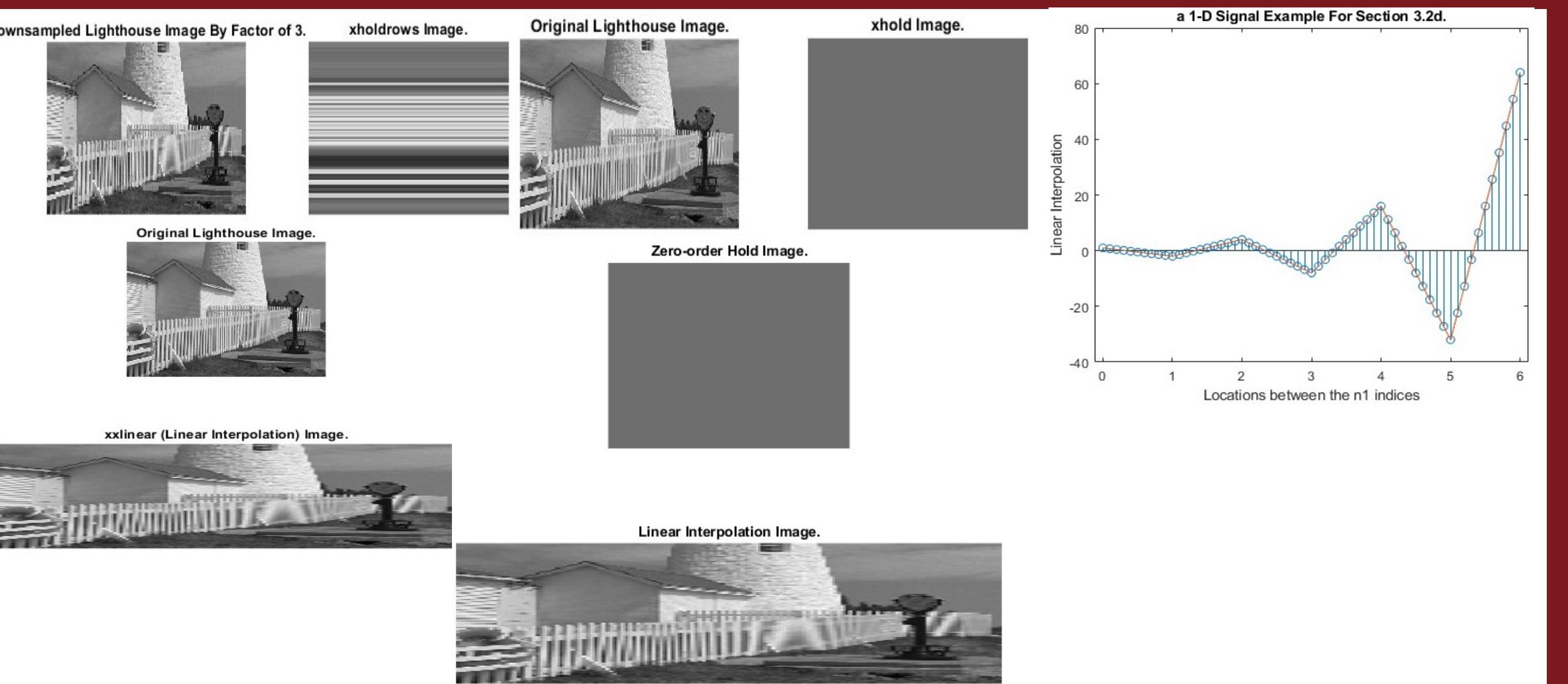
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## Background

When sampling to convert a continuous-time (or analog) signal to a digital form for computer processing and storage, the primary issue is aliasing and the sampling strategy necessary to avoid aliasing of frequency components.

The objective of our presentation is to understand the Sampling Theorem which states that the sampling rate must be greater than twice the highest frequency contained in the analog signal. Frequency content is taken to mean the spectral content of a signal when represented as a sum of sinusoids.

We present the signal reconstruction of a D-to-A converter from a practical point of view as a generalization of interpolation.



## Lab P-8: Digital Images: A/D and D/A

An image can be represented as a function  $x(t_1, t_2)$ . ( $t_2$ : the horizontal length and ( $t_1$ ) is vertical length of two continuous variable coordinates of a point in space.

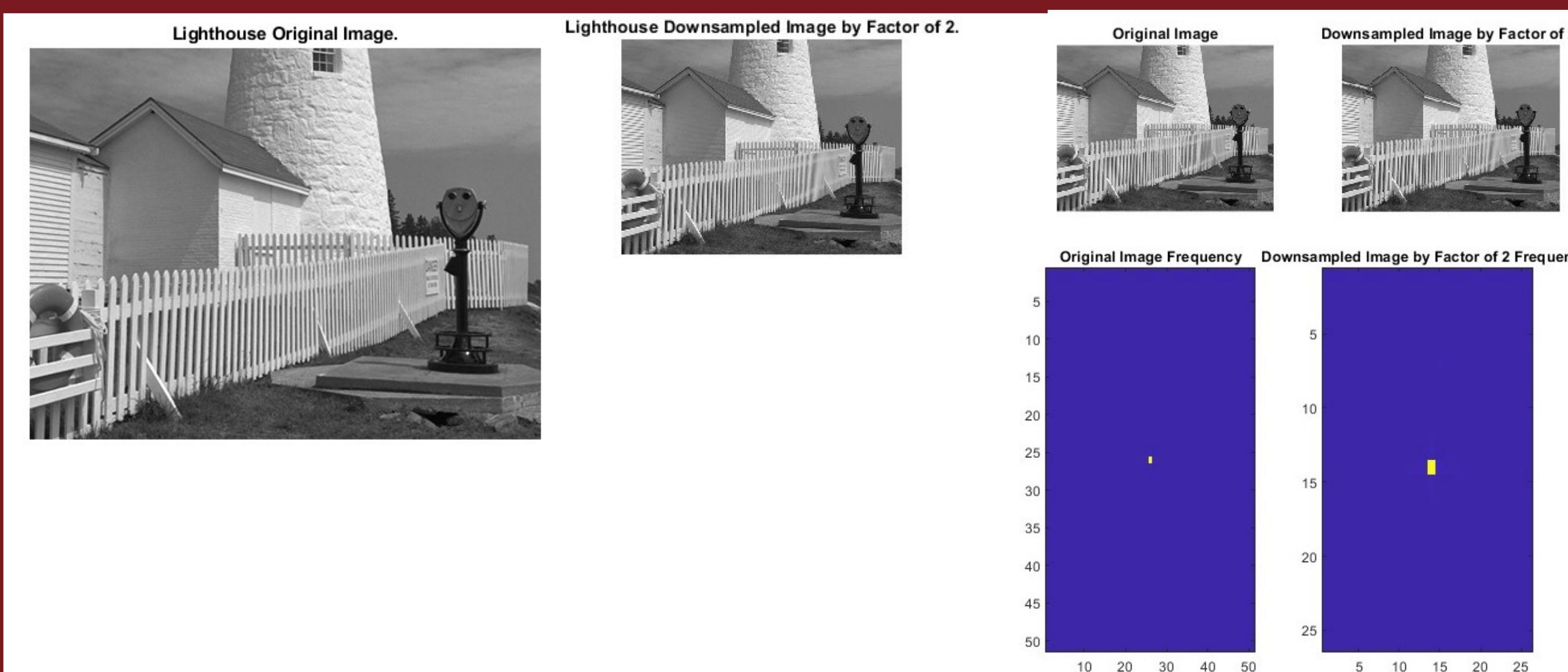
**I. For monochrome images (called grayscale):** The function will be a scalar function of the two spatial variables. **II. For color images :** The function will be a vector-valued function of the two variables. Ex: RGB needs three values at each spatial location.

### I. Gray-scale Images : We will consider only sampled still images.

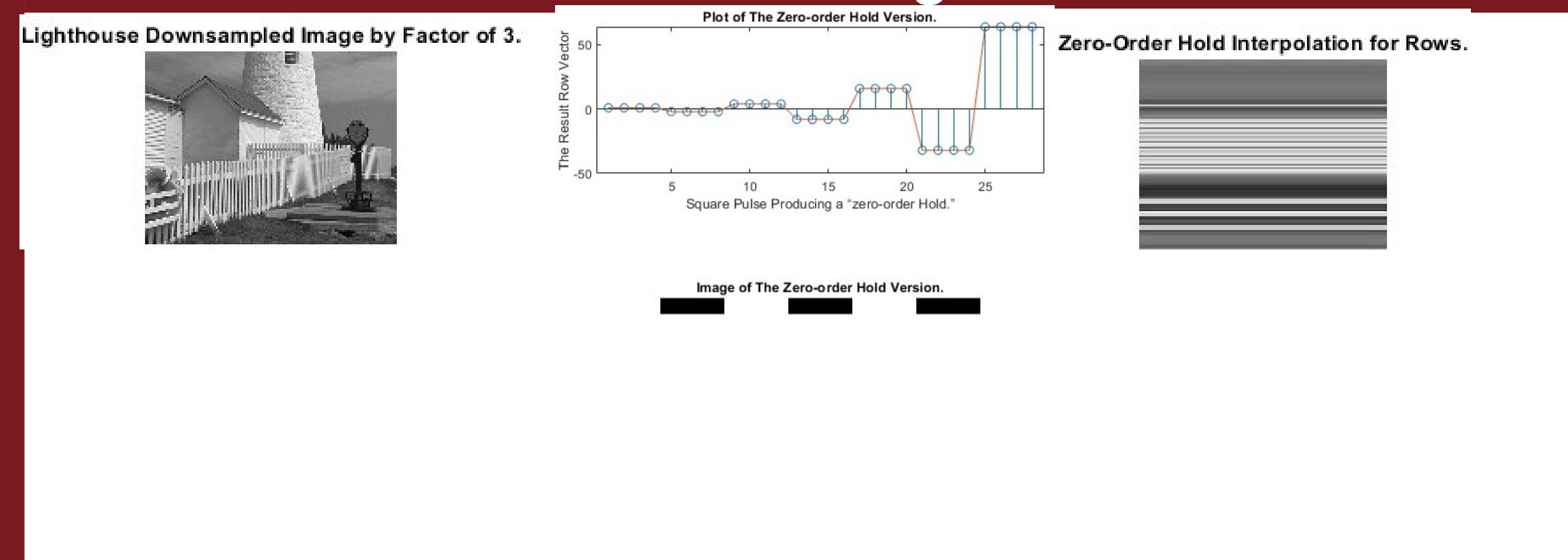
- These images will be represented as a two-dimensional array of numbers of the form :
 
$$x[m, n] = x(mT_1, nT_2) \quad 1 \leq m \leq M, \text{ and } 1 \leq n \leq N$$
  - T<sub>1</sub>: Sample spacing in the horizontal direction
  - T<sub>2</sub>: Sample spacing in the vertical direction
  - Typical M & N values: 256 or 512. Ex.: a 512x512 image
- ✓ In MATLAB we represent an image as a matrix, so it would consist of M rows and N columns.

## Lab S-8: Spectrograms: Harmonic Lines & Chirp Aliasing

### 1. Down-Sampling



### 2. Reconstruction of Images



## Summary

## References

1. James H. McClellan, Ronald W. Schafer. 4. Sampling and Aliasing, [dspfirst.gatech.edu/chapters/04sampling/overview.html](http://dspfirst.gatech.edu/chapters/04sampling/overview.html). Accessed 2 Dec. 2024.
2. Proakis, John G., and Dimitris G. Manolakis. Digital Signal Processing. Prentice Hall, 2006.