ECE 468: Digital Image Processing

Lecture 10

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Outline

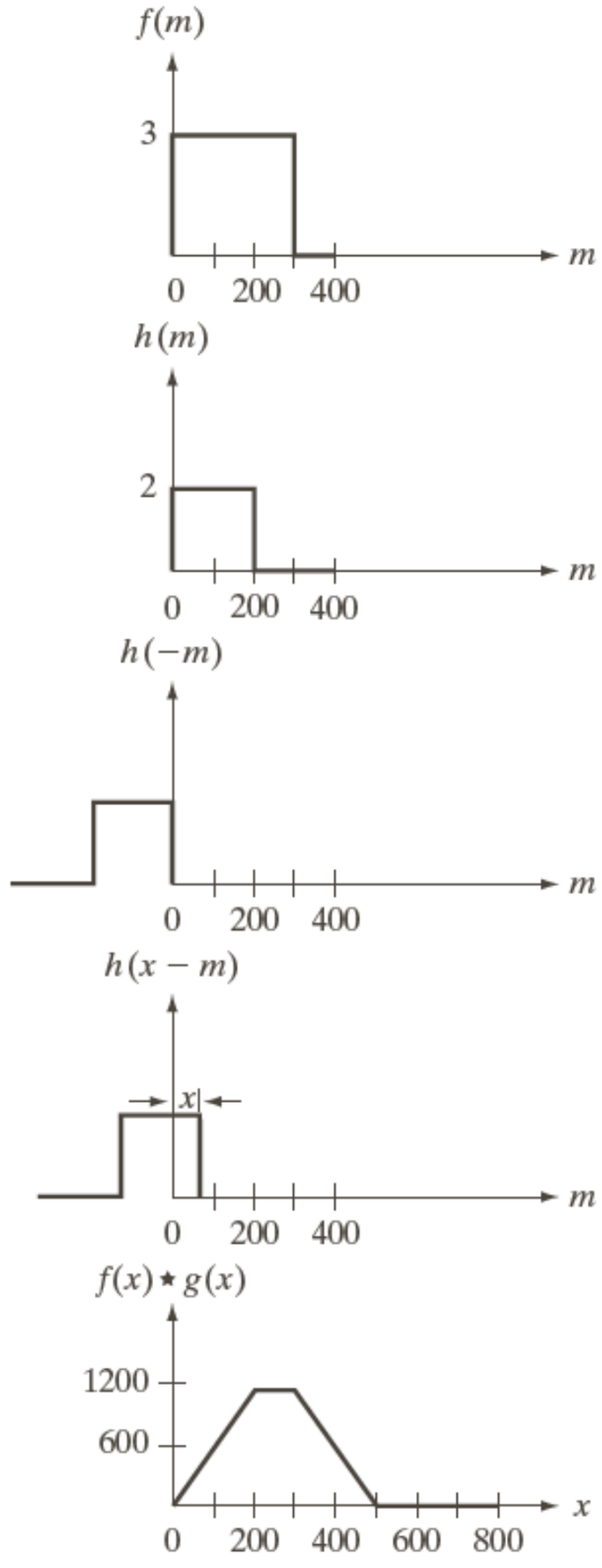
- 2D Continuous Fourier Transform (Textbook: 4.5, 4.6)

Disclaimer

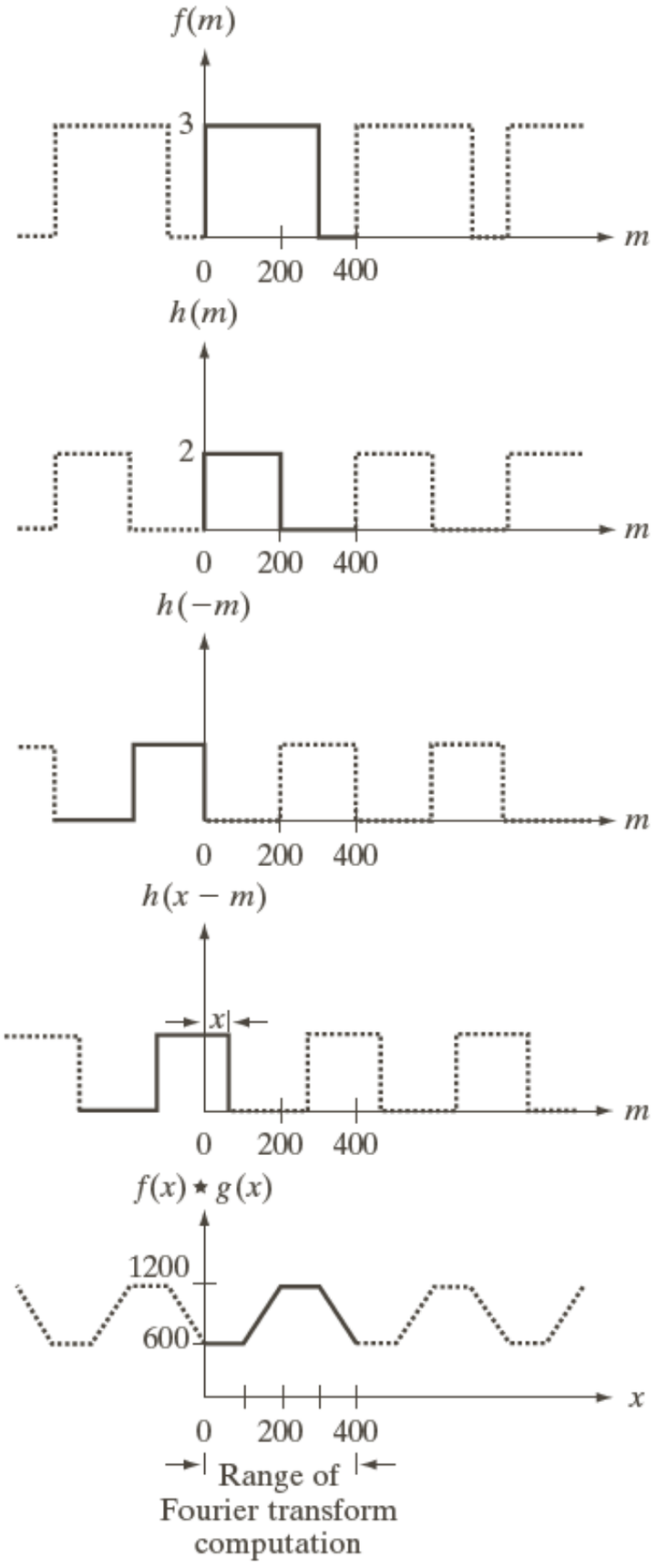
The following slides are just excerpts from the textbook.

You should learn all material presented in chapter 4 in the textbook!

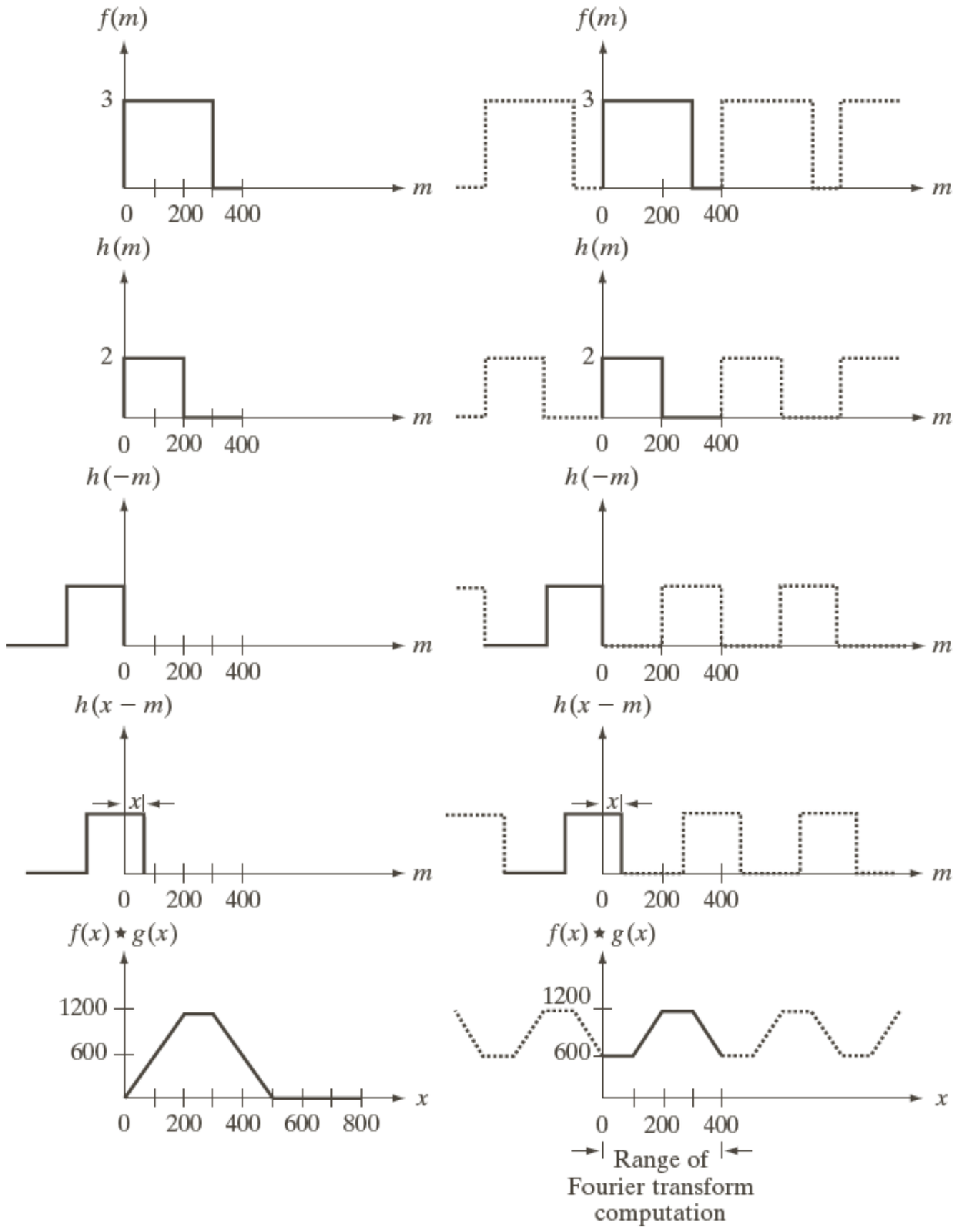
Convolution



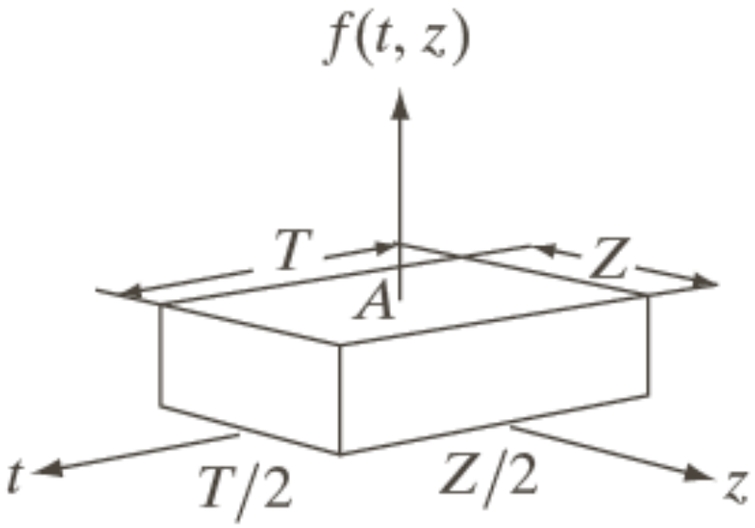
Circular Convolution

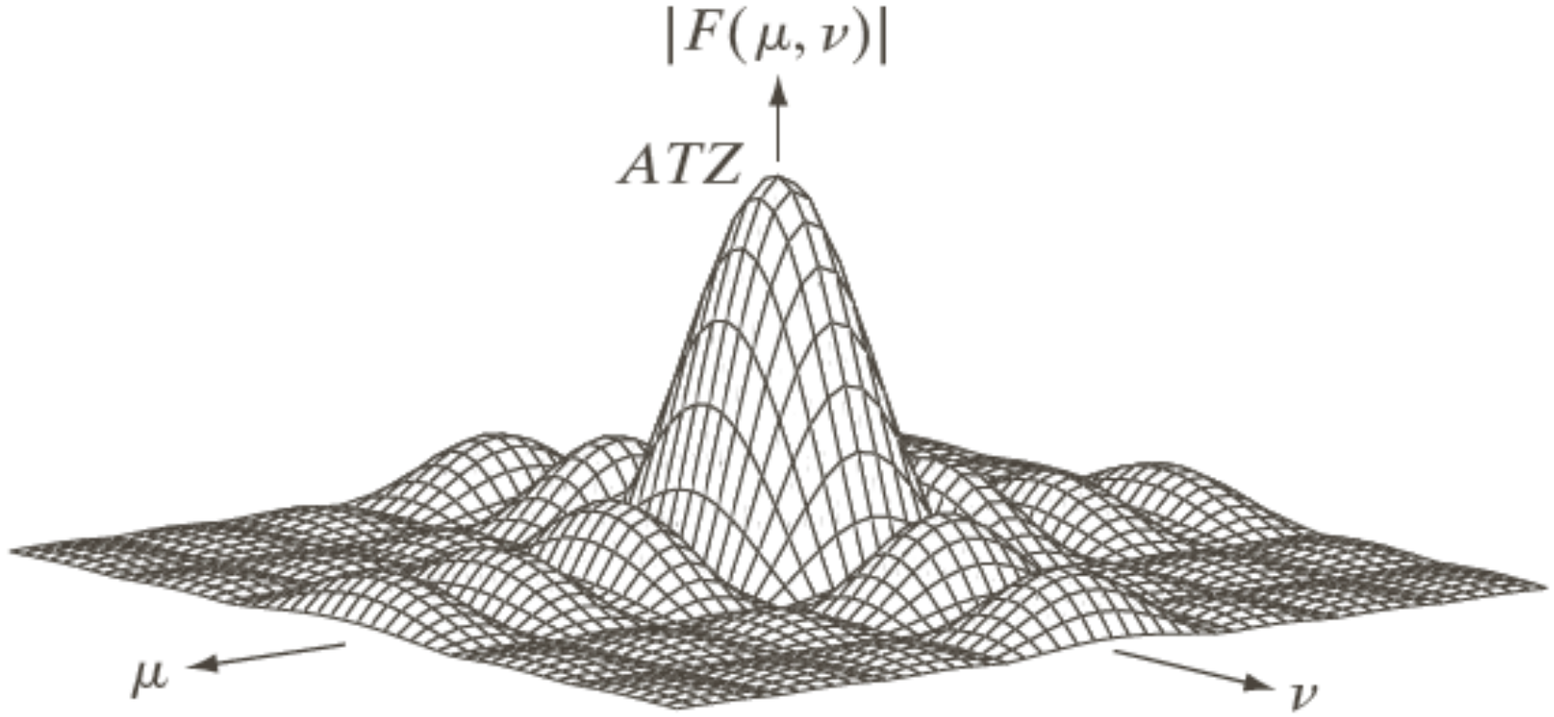


Convolution vs. Circular Convolution



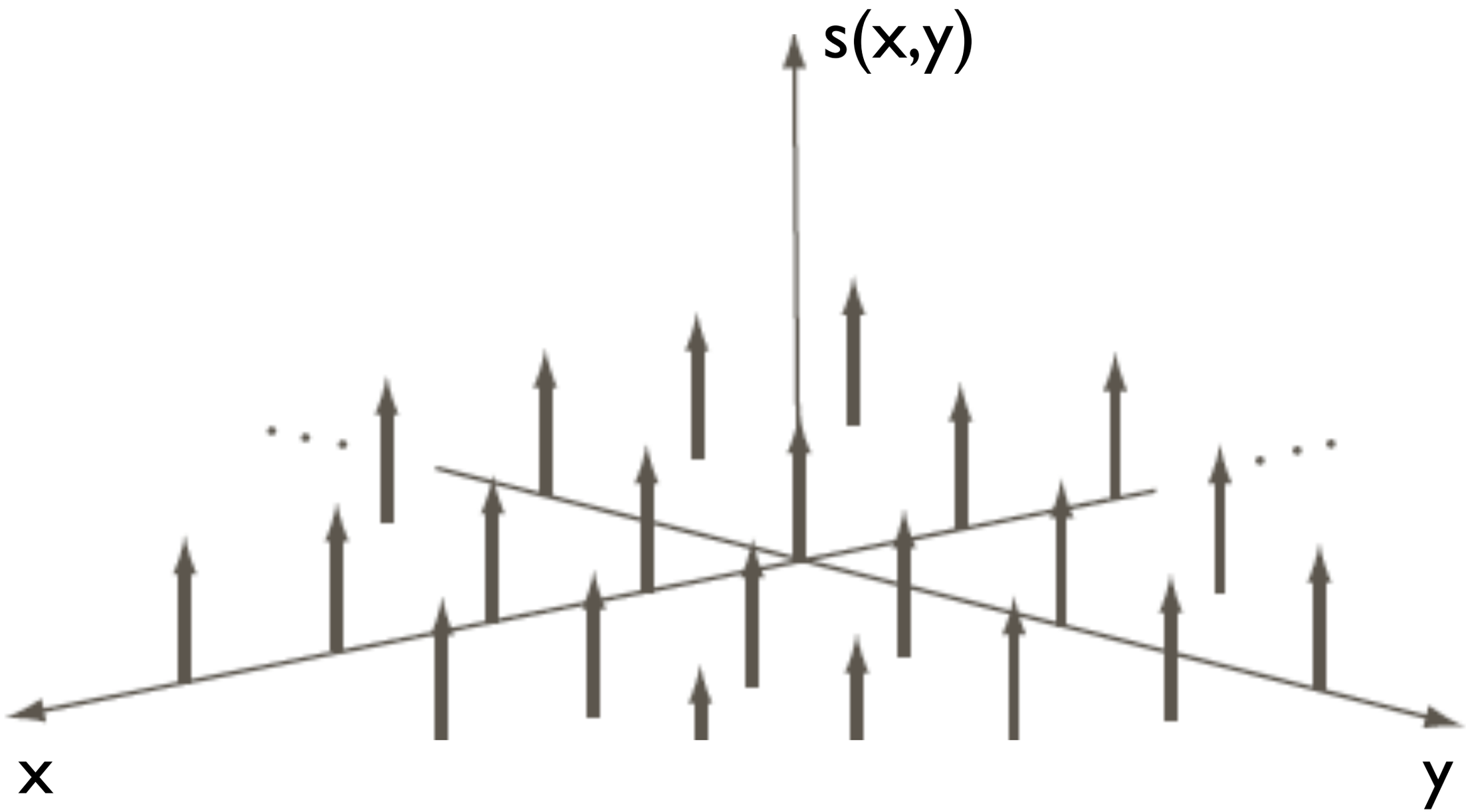
CFT of Rectangular Pulse





$$F(\mu,\nu) = ATZ\,\frac{\sin(\pi\mu T)}{\pi\mu T}\,\frac{\sin(\pi\nu Z)}{\pi\nu Z}$$

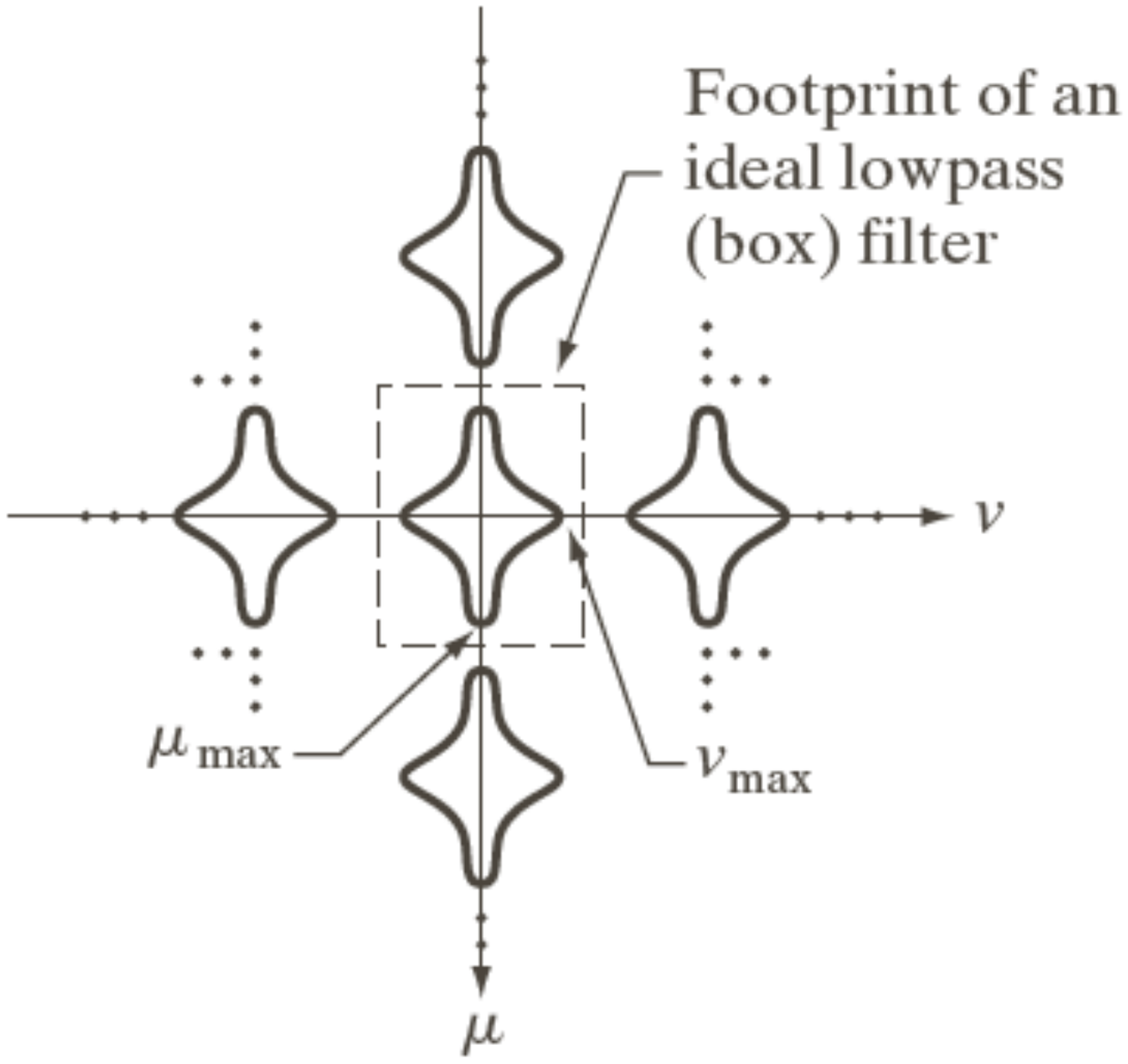
Train of Impulses in 2D

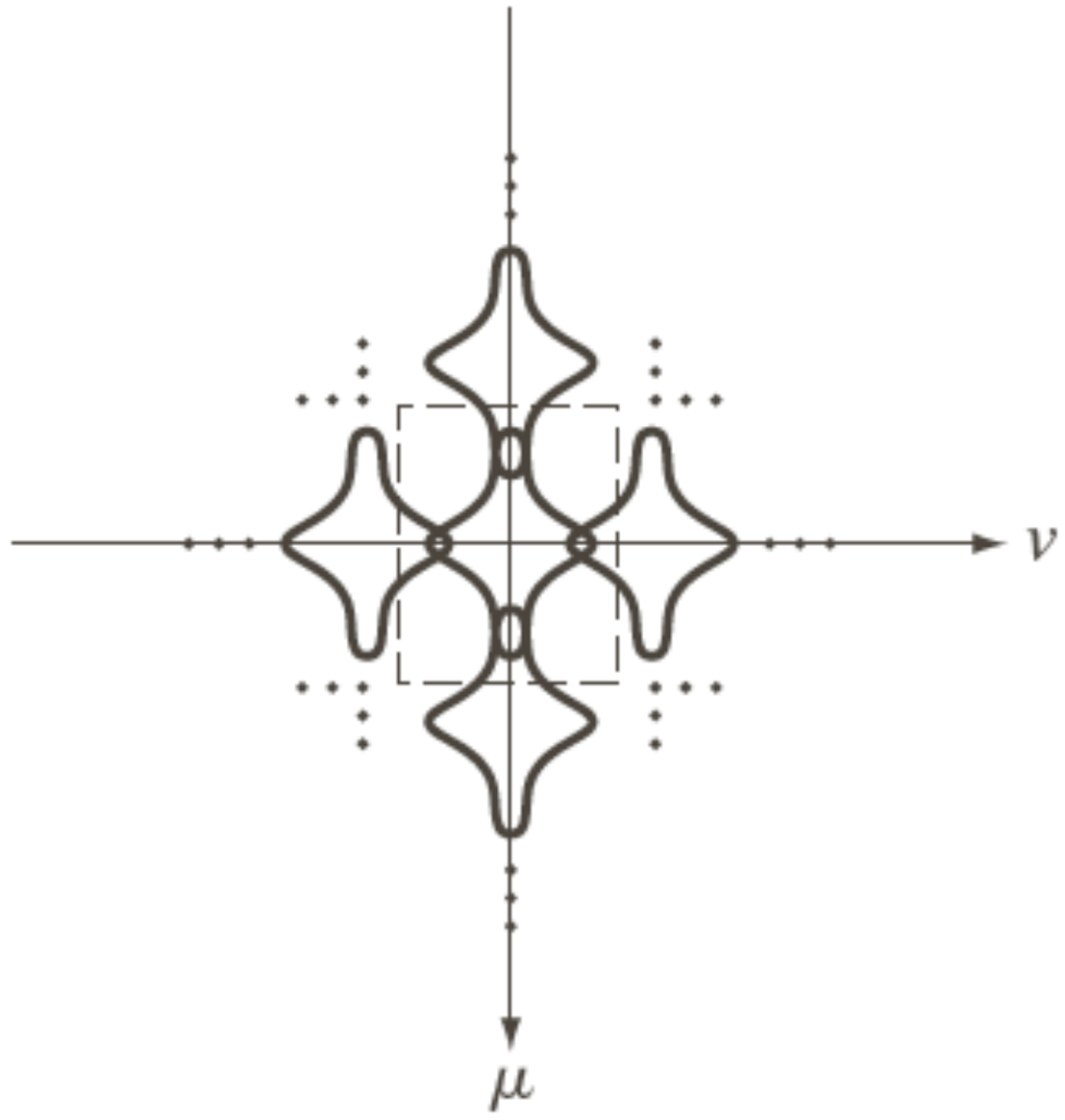


Outline

- Sampling theorem of functions in 2D (Textbook 4.5.3)

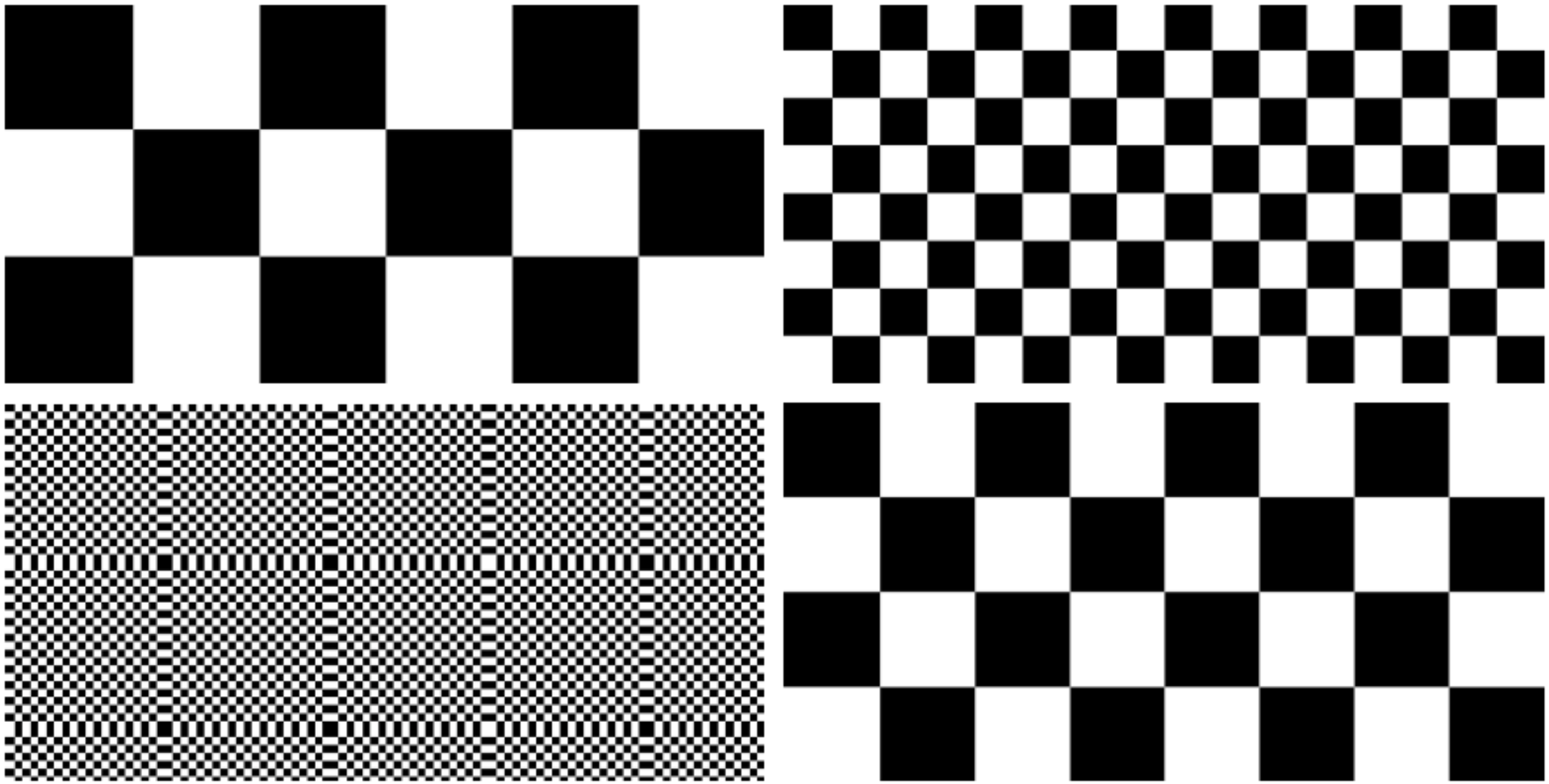
Sampling Theorem





$$\bar{F}(\mu,\nu) = \frac{1}{TZ} \sum_{m=-\infty}^{\infty} \sum_{n=-\infty}^{\infty} F(\mu - \frac{m}{T}, \nu - \frac{n}{T})$$

Aliasing



a b
c d

FIGURE 4.16 Aliasing in images. In (a) and (b), the lengths of the sides of the squares are 16 and 6 pixels, respectively, and aliasing is visually negligible. In (c) and (d), the sides of the squares are 0.9174 and 0.4798 pixels, respectively, and the results show significant aliasing. Note that (d) masquerades as a "normal" image.

Aliasing

original

subsampled

subsampled

smoothed + subsampled