Homework Assignment #4
-- due: Nov 8, 15:30

3.1 Textbook p. 197, Problem 3.12.

3.2 Textbook p. 199, Problem 3.34.

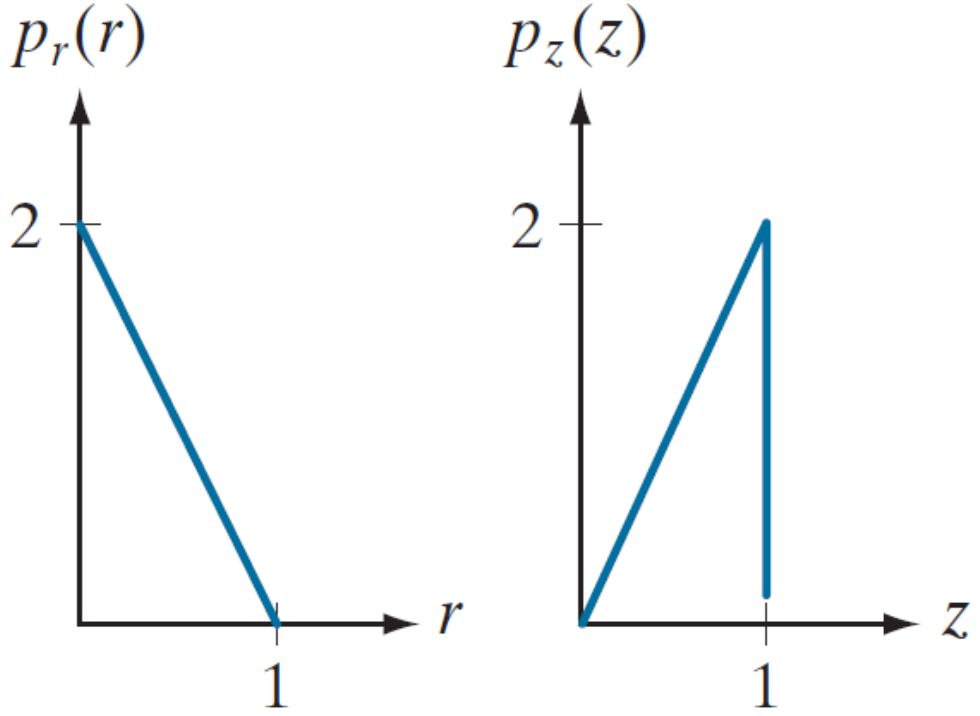
3.3 Textbook p. 200, Problem 3.42.

3.3 Textbook p. 308, Problem 4.2.

3.3 Textbook p. 309, Problem 4.6.

3.3 Textbook p. 309, Problem 4.9.

3.12 An image with intensities in the range [0,1] has the PDF, $p_r(r)$, shown in the following figure. It is desired to transform the intensity levels of this image so that they will have the specified $p_z(z)$ shown in the figure. Assume continuous quantities, and find the transformation (expressed in terms of r and z) that will accomplish this.



3.34 In the original image used to generate the three blurred images shown, the vertical bars are 5 pixels wide, 100 pixels high, and their separation is 20 pixels. The image was blurred using square box kernels of sizes 23, 25, and 45 elements on the side, respectively. The vertical bars on the left, lower part of (a) and (c) are blurred, but a clear separation exists between them.

However, the bars have merged in image (b), despite the fact that the kernel used to generate this image is much smaller than the kernel that produced image (c). Explain the reason for this.

(a) (b) (c)

3.42 Show that subtracting the Laplacian from an image gives a result that is proportional to the unsharp mask in Eq. (3-55). Use the definition for the Laplacian given in Eq. (3-53).

4.2 Repeat Example 4.1 in the textbook (page 211) but using the following function:

$f(t) = A$ for $0 \le t < T$ and $f(t) = 0$ for all other values of t. Explain the reason for any differences between your results and the results in the example.

4.6 With reference to Fig. 4.11:

(a)* Redraw the figure, showing what the dots would look like for a sampling rate that exceeds the Nyquist rate slightly.

(b) What is the *approximate* sampling rate represented by the large dots in Fig. 4.11?

(c) *Approximately*, what would be the lowest sampling rate that you would use so that (1) the Nyquist rate is satisfied, and (2) the samples look like a sine wave?

4.9 Show that the following expressions are true. (*Hint:* Make use of the solution to Problem 4.8):

(a)* $$\Im\{\cos(2\pi\mu_0 t)\} = \frac{1}{2}[\delta(\mu-\mu_0)+\delta(\mu+\mu_0)]$$

(b) $$\Im\{\sin(2\pi\mu_0 t)\} = \frac{1}{2j}[\delta(\mu-\mu_0)-\delta(\mu+\mu_0)]$$

Submission

- Please submit a .zip/.rar file to ceiba, containing
  - Project(source code and execution file)
  - Report(.pdf file)
- Late submission:
  - within 24 hours after its due will incur 20% penalty,
  - after 24 hours and within seven days of its due will incur 50% penalty, and
  - after seven days of its due will not be graded.

  Note: One minute late is the same as 23 hours late.

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