(Assigned on 2/24, due on 3/10)

5.11 Refer to the contraharmonic filter given in Eq. (5.3-6).
(a) Explain why the filter is effective in eliminating pepper noise when Q is positive.
(b) Explain why the filter is effective in eliminating salt noise when Q is negative.
© Explain why the filter gives poor results (such as results shown in Fig. 5.9) when the wrong polarity is chosen for Q.
(d) Discuss the behavior of the filter when Q=-1.
(e) Discuss (for positive and negative Q) the behavior of the filter in areas of constant intensity levels.

5.16 Consider a linear, position-invariant image degradation system with impulse response

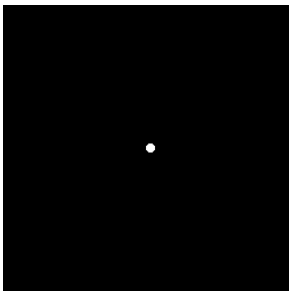
$$h(x-\alpha, y-\beta) = e^{[(x-\alpha)^2+(y-\beta)^2]}$$

Suppose that the input to the system is an image consisting of a line of infinitesimal width located at x=a, and modeled by f(x,y)=δ(x-a) , where δ is an impulse. Assuming no noise, what is the output image g(x,y)?

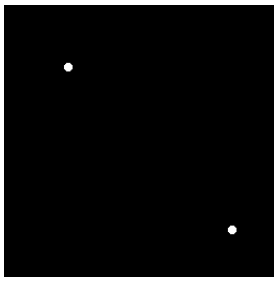
5.19 A space probe is designated to transmit images from a planet as it approaches it for landing. During the last stages of landing, one of the control thrusters fails, resulting in rapid rotation about it vertical axis. The images sent during the last two seconds prior to landing are blurred as a consequence of this circular motion. The camera is located in the bottom of the probe, along its vertical axis, and pointing down. Fortunately, the rotation of the craft is also about its vertical axis, so the images are blurred by uniform rotational motion. During the acquisition time of each image the craft rotation was limited to π/8 radians. The image acquisition process can be modeled as an ideal shutter that is open only during the time the craft rotated the π/8 radians. You may assume that vertical motion was negligible during image acquisition. Formulate a solution for restoring the images.

5.26 An astronomer working with a large-scale telescope observes that her images are a little blurry. The manufacturer tells the astronomer that the unit is operating within specifications. The telescope lenses focus images onto a high-resolution, CCD imaging array, and the images are then converted by the telescope electronics into digital images. Trying to improve the situation by conducting controlled lab experiments with the lenses and imaging sensors is not possible due to the size and weight of the telescope components. The astronomer, having heard about the success as an image processing expert, calls you to help her formulate a digital image processing solution for sharpening the images a little more. How would you go about solving this problem, given that the only images you can obtain are images of stellar bodies?

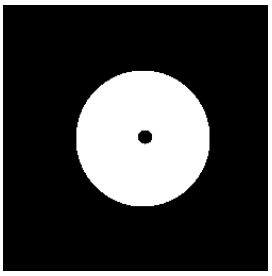
5.28 Sketch the Radon transform of the following square images. Label quantitatively all the important features of your sketches. Figure (a) consists of one dot in the center, and (b) has two dots along the diagonal. Describe your solution to (c) by an intensity profile. Assume a parallel-beam geometry.



(a)



(b)



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