From: "Digital Image Processing" by Gonzalez and Woods

z_1	z_2	z_3
z_4	z_5	z_6
z_7	z_8	z_9

(a)

1	0
0	−1

0	1
−1	0

(b) Roberts

−1	−1	−1
0	0	0
1	1	1

−1	0	1
−1	0	1
−1	0	1

(c) Prewitt

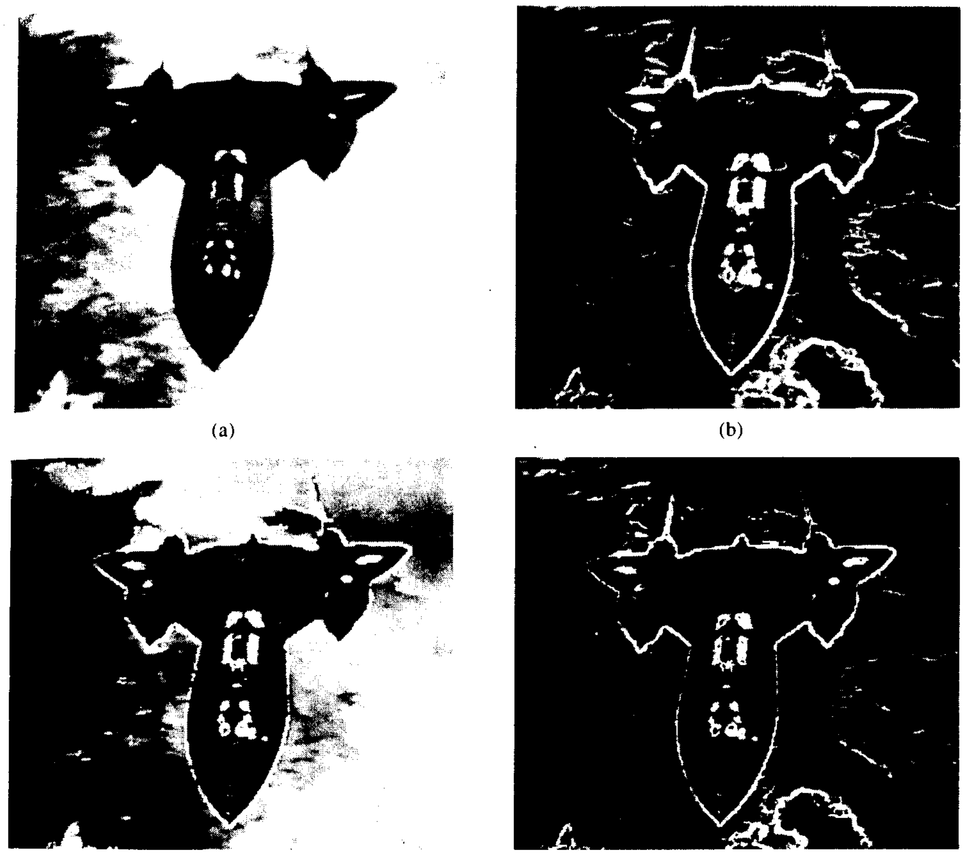
−1	−2	−1
0	0	0
1	2	1

−1	0	1
−2	0	2
−1	0	1

(d) Sobel

Figure 4.28 *A 3 × 3 region of an image (the z's are gray-level values) and various masks used to compute the derivative at point labeled z_5. Note that all mask coefficients sum to 0, indicating a response of 0 in constant areas, as expected of a derivative operator.*

Example: Figure 4.29(a) shows an original image, and Fig. 4.29(b) shows the result of computing the magnitude of the gradient by using the Prewitt masks (Eq. 4.3-9). Figure 4.29(c) was obtained by setting to maximum white (255) any gradient value greater than 25 (that is, approximately 10 percent or higher of the highest possible gray-level value in the image). Any point for which the gradient value did not meet this criterion was set equal to its original value in the image, thus restoring the background while, at the same time, enhancing



(a) (b) (c) (d)

Figure 4.29 *Edge enhancement by gradient techniques (see text).*

prominent edges. Finally, Fig. 4.29(d) was obtained in the same way as Fig. 4.29(c), except that points for which the gradient did not exceed 25 were set to zero (black). Clearly, this last result produced a binary image. In all cases, the principal edges are enhanced considerably. ❑

4.4 ENHANCEMENT IN THE FREQUENCY DOMAIN

In terms of the discussion in Section 4.1.2, enhancement in the frequency domain in principle is straightforward. We simply compute the Fourier transform of the image to be enhanced, multiply the result by a filter transfer function, and take the inverse transform to produce the enhanced image.