

Fig. 7.6

Diagonal gradient components produced by the two Roberts filters.

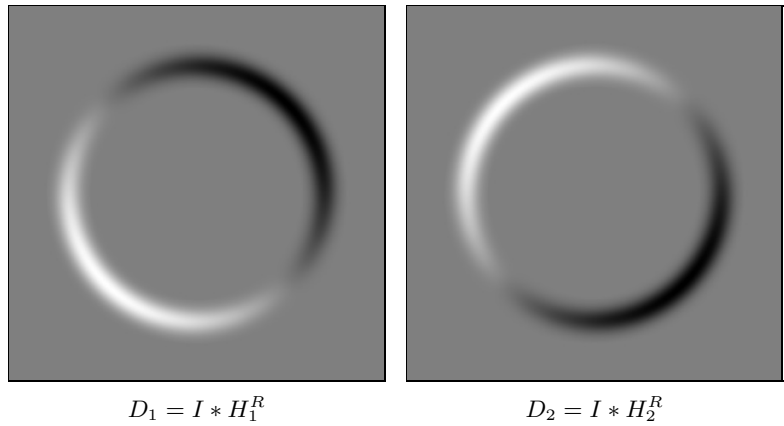
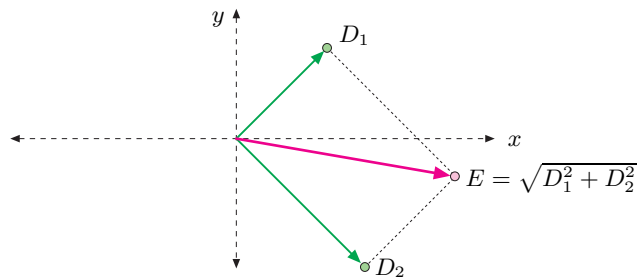


Fig. 7.7

Definition of edge strength for the Roberts operator. The edge strength $E(u, v)$ corresponds to the length of the vector obtained by adding the two orthogonal gradient components (filter results) $D_1(u, v)$ and $D_2(u, v)$.



operator by *Kirsch* [63] and the extended Sobel or *Robinson*⁴ operator, which uses the following eight filters with orientations spaced at 45°:

$$H_0^K = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad H_4^K = \begin{bmatrix} 1 & 0 & -1 \\ 2 & 0 & -2 \\ 1 & 0 & -1 \end{bmatrix}, \quad (7.17)$$

$$H_1^K = \begin{bmatrix} -2 & -1 & 0 \\ -1 & 0 & 1 \\ 0 & 1 & 2 \end{bmatrix} \quad H_5^K = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 0 & -1 \\ 0 & -1 & -2 \end{bmatrix}, \quad (7.18)$$

$$H_2^K = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \quad H_6^K = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}, \quad (7.19)$$

$$H_3^K = \begin{bmatrix} 0 & -1 & -2 \\ 1 & 0 & -1 \\ 2 & 1 & 0 \end{bmatrix} \quad H_7^K = \begin{bmatrix} 0 & 1 & 2 \\ -1 & 0 & 1 \\ -2 & -1 & 0 \end{bmatrix}. \quad (7.20)$$

Only the results of four of the eight filters H_0, H_1, \dots, H_7 above must actually be computed since the four others are identical except for the reversed sign. For example, from the fact that $H_4^K = -H_0^K$ and the convolution being linear (Eqn. (6.18)), it follows that

$$I * H_4^K = I * -H_0^K = -(I * H_0^K); \quad (7.21)$$

⁴ G. ROBINSON. Edge detection by compass gradient masks. *Computer Graphics and Image Processing* 6(5), 492–501 (1977).