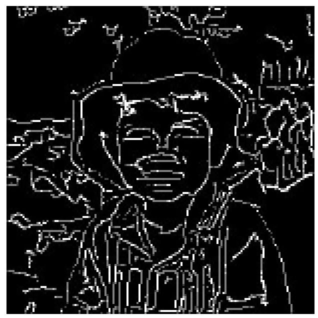
EDGE DETECTION



Examples of edge detection using the Canny algorithm

. The image above is first smoothed and then subject to filtering. The filtering parameters have been set differently resulting in edge detection in different scales.

Common gradient operators

	H1	H2
Roberts	$\begin{bmatrix} \boxed{0} & 1 \\ -1 & 0 \end{bmatrix}$	$\begin{bmatrix} \boxed{1} & 0 \\ 0 & -1 \end{bmatrix}$
Prewitt	$\begin{bmatrix} -1 & 0 & 1 \\ -1 & \boxed{0} & 1 \\ -1 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} -1 & -1 & -1 \\ 0 & \boxed{0} & 0 \\ 1 & 1 & 1 \end{bmatrix}$
Sobel	$\begin{bmatrix} -1 & 0 & 1 \\ -2 & \boxed{0} & 2 \\ -1 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} -1 & -2 & -1 \\ 0 & \boxed{0} & 0 \\ 1 & 2 & 1 \end{bmatrix}$
Isotropic	$\begin{bmatrix} -1 & 0 & 1 \\ -\sqrt{2} & \boxed{0} & \sqrt{2} \\ -1 & 0 & 1 \end{bmatrix}$	$\begin{bmatrix} -1 & -\sqrt{2} & -1 \\ 0 & \boxed{0} & 0 \\ 1 & \sqrt{2} & 1 \end{bmatrix}$

Gradient operators

Image f(x,y)
Magnitude of Grad(f):

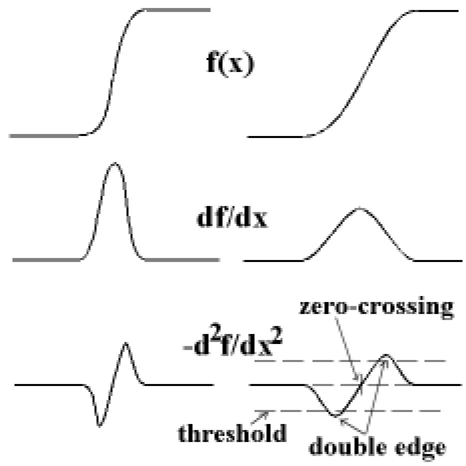
a) $\left[(\partial f/\partial x)^2 + (\partial f/\partial y)^2\right]^{1/2}$

b) $|\partial f/\partial x| + |\partial f/\partial y|$

c) $\mathrm{Max}\left(|\partial f/\partial x|, |\partial f/\partial y|\right)$

• Direction of Grad(f): $\arctan\left(\dfrac{\partial f/\partial y}{\partial f/\partial x}\right)$

1st and 2nd derivatives



The left column shows the original signal (top) with a sharp slope, its first derivative (middle), and its second derivative with minus sign (lower). The right column shows the same but for a signal with a less sharp slope. It can be seen that the maximum of the first derivative (the edge) is less well defined spatially in the case of a less sharp slope. In order to locate such edges more accuratley, it may be advantageous to compute the second derivate and look for zero-crossings.