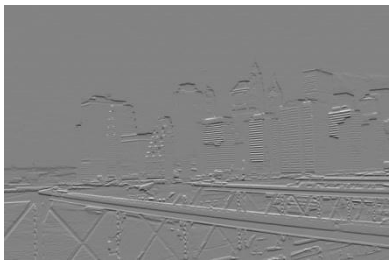
Sobel Edge Detector

The Sobel edge detector is a common operator for finding edges in a digital image. The Sobel kernels are shown below.

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \quad \text{and} \quad \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

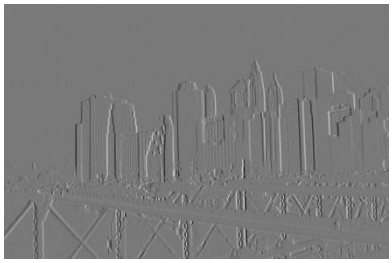
The larger kernel size acts as a low pass filter and removes some of the high frequency noise when computing the gradient. Additionally, having an odd kernel size allows the gradient result to remain centered with the original pixel (unlike even kernels that incur a ½ pixel bias). A Sobel operation is shown on a test image below.

Original Image



Vertical Kernel Result

Gradient Magnitude Image



Horizontal Kernel Result

Gradient Direction Image

The top-middle image shows the result of the vertical Sobel kernel and the bottom-middle shows the horizontal. The results of the two are then be RSS'd to create a gradient magnitude image (shown in the top-right). Additionally, the image gradient directions can be calculated by taking the arctangent of the two images (pixel-by-pixel)

$$M_{i,j} = \sqrt{V_{i,j}^2 + H_{i,j}^2}$$

$$D_{i,j} = \arctan\left(\frac{V_{i,j}}{H_{i,j}}\right)$$