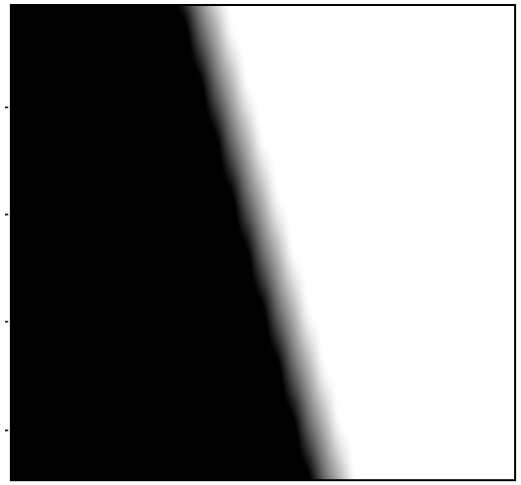
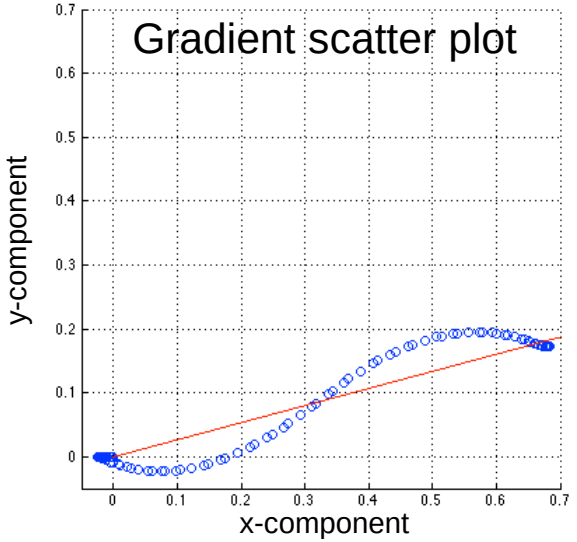
Edge orientation

Central Difference

$$\begin{pmatrix} 0 & 0 & 0 \\ -1 & [0] & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 & -1 & 0 \\ 0 & [0] & 0 \\ 0 & 1 & 0 \end{pmatrix}$$

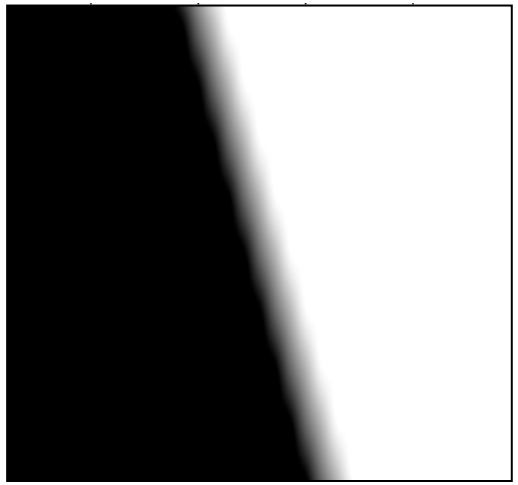


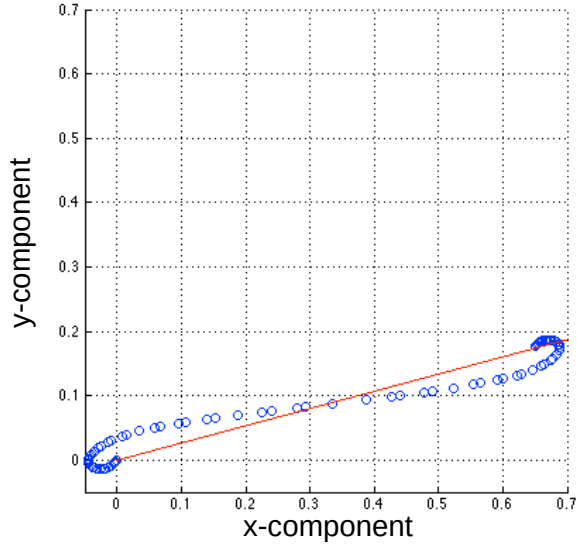


Roberts

$$\begin{pmatrix} [0] & 1 \\ -1 & 0 \end{pmatrix}$$

$$\begin{pmatrix} [1] & 0 \\ 0 & -1 \end{pmatrix}$$



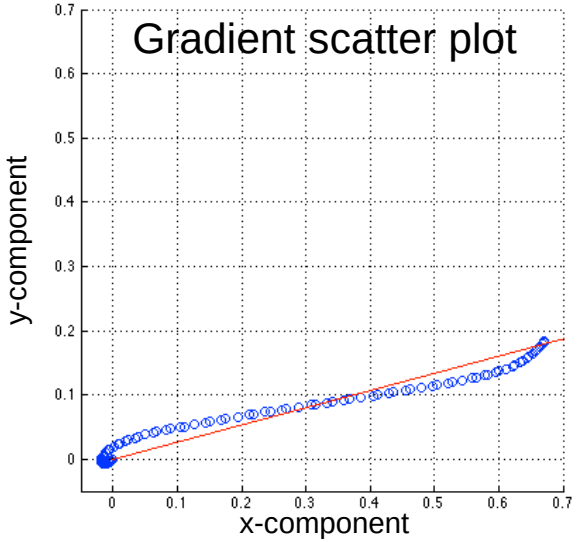


Edge orientation

Prewitt

$$\begin{pmatrix} -1 & 0 & 1 \\ -1 & [0] & 1 \\ -1 & 0 & 1 \end{pmatrix}$$

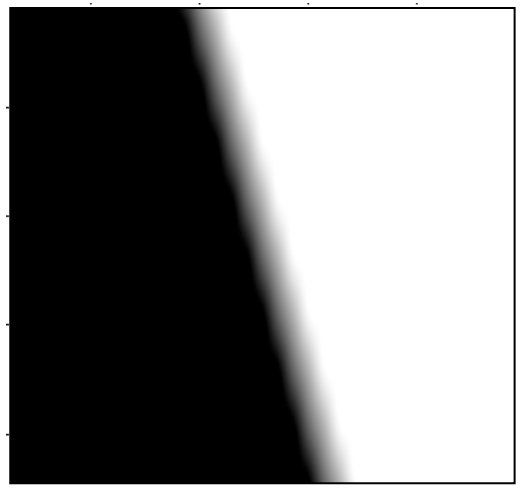
$$\begin{pmatrix} -1 & -1 & -1 \\ 0 & [0] & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

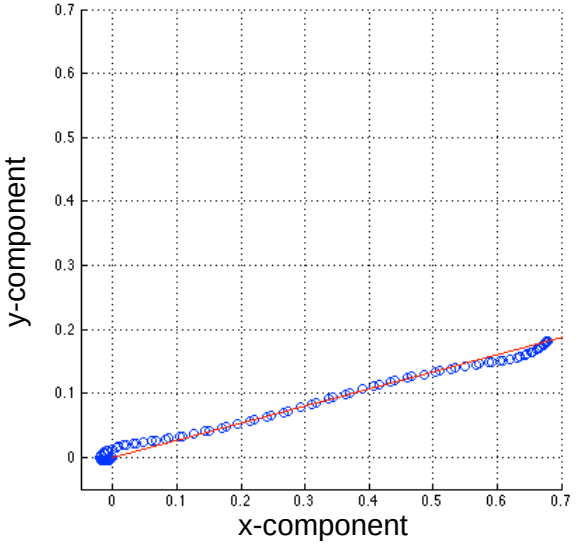


Sobel

$$\begin{pmatrix} -1 & 0 & 1 \\ -2 & [0] & 2 \\ -1 & 0 & 1 \end{pmatrix}$$

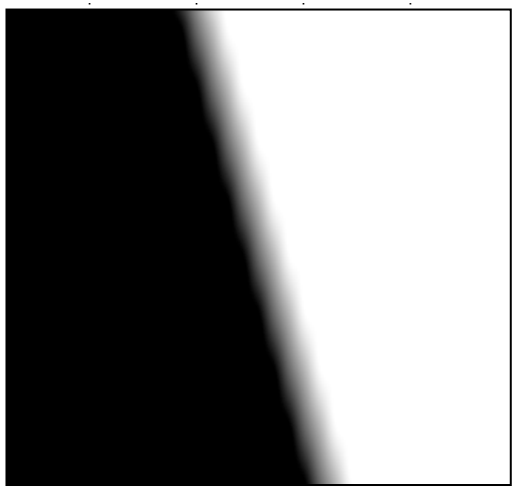
$$\begin{pmatrix} -1 & -2 & -1 \\ 0 & [0] & 0 \\ 1 & 2 & 1 \end{pmatrix}$$

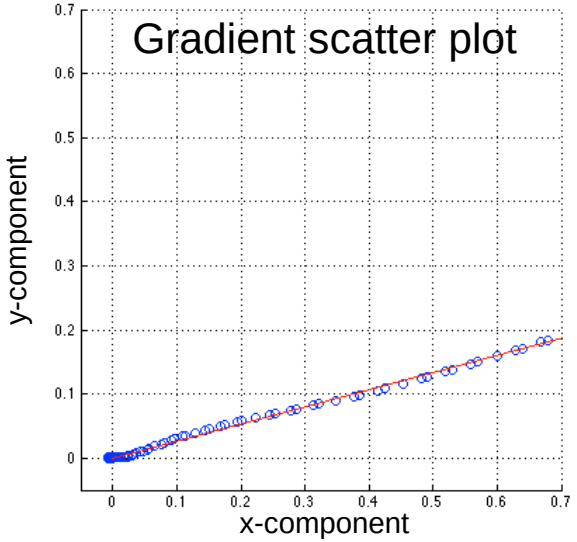




Edge orientation

5x5 “consistent” gradient operator [Ando, 2000]





$$\begin{pmatrix} -0.0604 & -0.1632 & 0 & 0.1632 & 0.0604 \\ -0.4286 & -1.1335 & 0 & 1.1335 & 0.4286 \\ -0.7448 & -1.9612 & \boxed{0} & 1.9612 & 0.7448 \\ -0.4286 & -1.1335 & 0 & 1.1335 & 0.4286 \\ -0.0604 & -0.1632 & 0 & 0.1632 & 0.0604 \end{pmatrix}$$

$$\begin{pmatrix} -0.0604 & -0.4286 & -0.7448 & -0.4286 & -0.0604 \\ -0.1632 & -1.1335 & -1.9612 & -1.1335 & -0.1632 \\ 0 & 0 & \boxed{0} & 0 & 0 \\ 0.1632 & 1.1335 & 1.9612 & 1.1335 & 0.1632 \\ 0.0604 & 0.4286 & 0.7448 & 0.4286 & 0.0604 \end{pmatrix}$$

Gradient consistency problem