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¹ Edge detection
⁵ Infinite symmetric exponential filter

² Canny
⁶ Signal to Noise Ratio

³ Shen-Castan

$$S_{\sigma, \lambda, \theta_k, \varphi}(x, y) = h_{\sigma, \lambda, \theta_k, \varphi}(x, y) * i(x, y)$$

$$h_{\sigma, \lambda, \theta_k, \varphi}(x, y) = \cos\left(\frac{2\pi}{\lambda} \tilde{x} + \varphi\right) e^{-\frac{\tilde{x}^2 + \gamma^2 \tilde{y}^2}{2\sigma^2}}$$

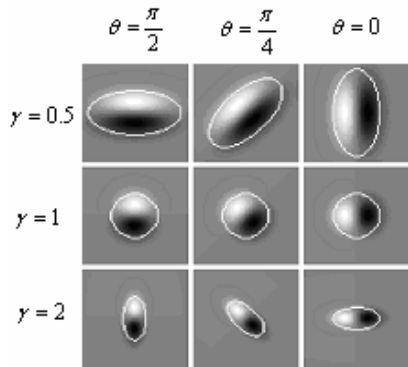
$$\begin{bmatrix} \tilde{x} \\ \tilde{y} \end{bmatrix} = \begin{bmatrix} \cos \theta_k & \sin \theta_k \\ -\sin \theta_k & \cos \theta_k \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \quad ()$$

$$\theta_k = \frac{(k-1)\pi}{N_\theta} \quad \text{for } k=1, 2, \dots, N_\theta$$

$$N_\theta \quad \varphi \in (-\pi, \pi]$$

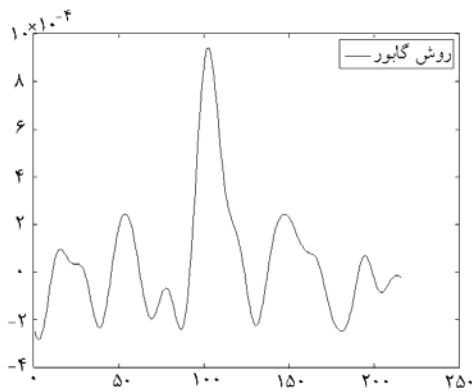
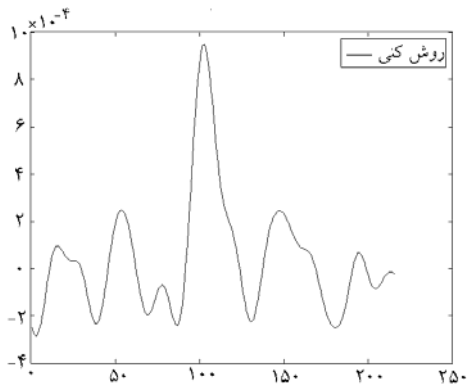
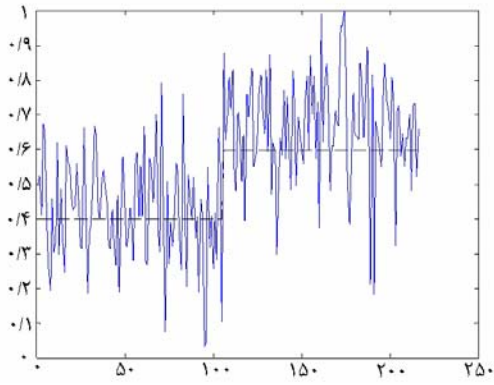
$$\varphi \quad () \quad \gamma$$

$$\varphi = 0 \quad \varphi = -\pi/2 \quad \varphi = \pi/2 \quad () \quad \varphi = \pi \quad ()$$



$$\lambda = 2\pi\sigma^2 \quad \varphi = \pi/2 \quad \sigma = 7$$

$$x^2 + \gamma^2 y^2 = 4\sigma^2$$



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x

$$G'_\sigma(x, y) = \frac{-x}{\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} \quad ()$$

) x

$\gamma = 1$

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$$h_{\sigma, \lambda, \theta_1, \varphi}(x, y) = \cos\left(\frac{2\pi}{\lambda}x + \varphi\right) e^{-\frac{x^2+y^2}{2\sigma^2}} \quad ()$$

$$\cos\left(\frac{2\pi}{\lambda}x + \varphi\right)$$

x = 0

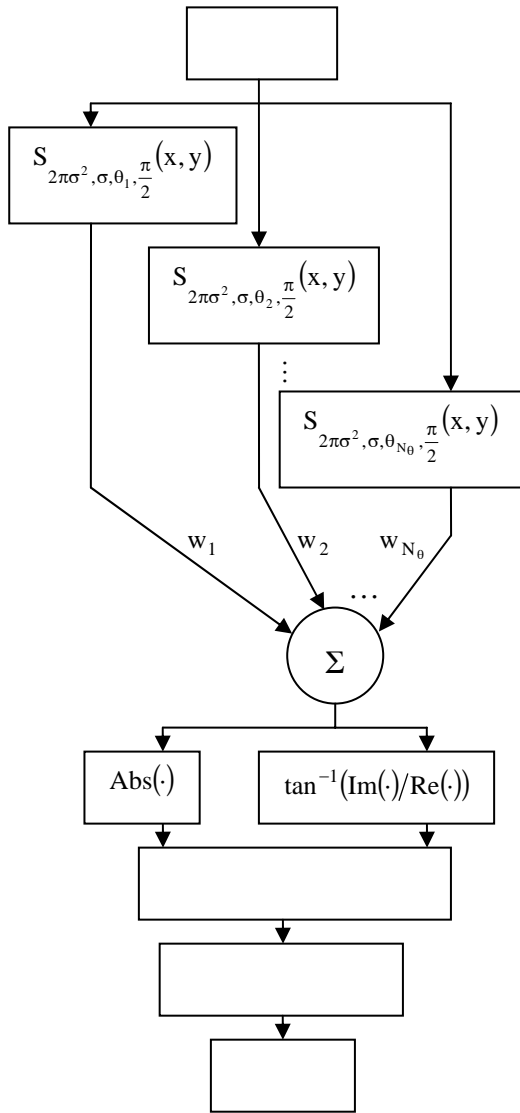
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$$\cos\left(\frac{2\pi}{\lambda}x + \varphi\right) = \cos\varphi + \frac{2\pi x}{\lambda} \sin\varphi \quad ()$$

$$\cos\left(\frac{2\pi}{\lambda}x + \varphi\right)$$

:

$$\lambda = 2\pi\sigma^2, \quad \varphi = \pi/2 \quad ()$$



$$IG_\sigma(x, y) = \sum_{k=1}^{N_\theta} e^{j\theta_k} S_{\sigma, 2\pi\sigma^2, \theta_k, \frac{\pi}{2}}(x, y) \quad ()$$

$$j = \sqrt{-1}$$

$$|IG_\sigma(x, y)| = \sqrt{\text{Re}^2(IG_\sigma(x, y)) + \text{Im}^2(IG_\sigma(x, y))} \quad ()$$

$$\theta(x, y) = \tan^{-1}\left(\frac{\text{Im}(IG_\sigma(x, y))}{\text{Re}(IG_\sigma(x, y))}\right)$$

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$$E_{TP} = E_D \cap E_{GT}$$

$$E_{TN} = B_D \cap B_{GT}$$

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2deoxyglucose

$$E_{FN} = B_D \cap E_{GT}$$

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$$E_{FP} = E_D \cap B_{GT}$$

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$$p = \frac{\text{card}(E_{TP})}{\text{card}(E_{TP}) + \text{card}(E_{FP}) + \text{card}(E_{FN})} \quad ()$$

$$x \quad \text{card}(x) \\ p$$

p

p ()

$B_D \quad E_D$

$(P(E_D | E_{GT}))$

ROC

$(P(E_D | B_{GT}))$

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$$\text{sensitivity} = \frac{\text{card}(E_{TP})}{\text{card}(E_{TP}) + \text{card}(E_{FN})} \quad ()$$

ROC

[

$B_{GT} \quad E_{GT}$

$$(1 - \text{specificity}) = \frac{\text{card}(E_{FP})}{\text{card}(E_{FP}) + \text{card}(E_{TN})} \quad ()$$

$B_D \quad E_D$

¹⁰ Receiver Operating Characteristic

¹¹ Sensitivity

¹² Specificity

ROC

ROC

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E_{TP}

opening

E_{FN}

E_{FP}

E_{TN}

opening

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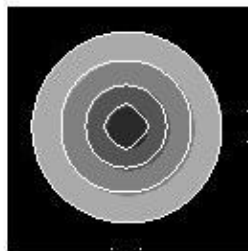
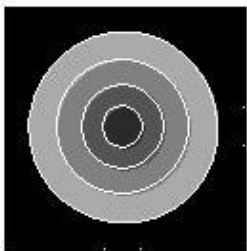
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($N_0=8$ $\gamma=1$

($N_0=2$ $\gamma=1$

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$\sigma=4$ (/ \times)

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(p)

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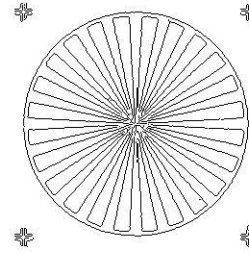
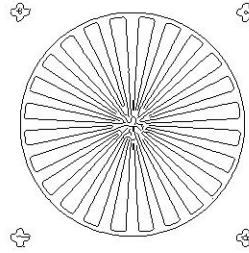
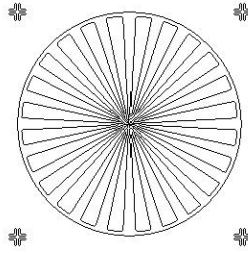
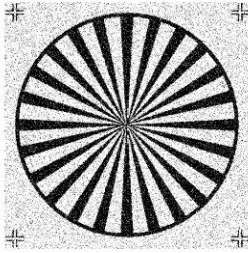
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The term watershed refers to a ridge that ...
 ... divides areas drained by different river systems.

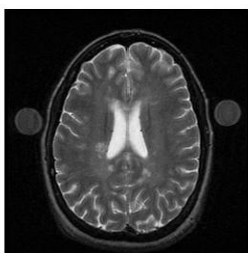
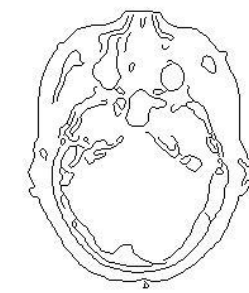
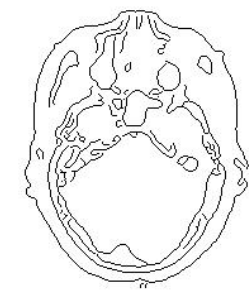
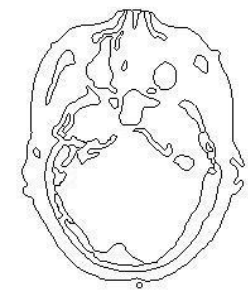
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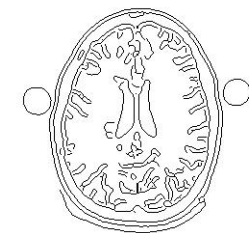
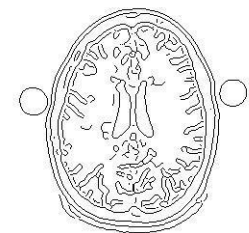
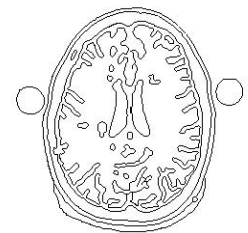
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 ... divides areas drained by different river systems.

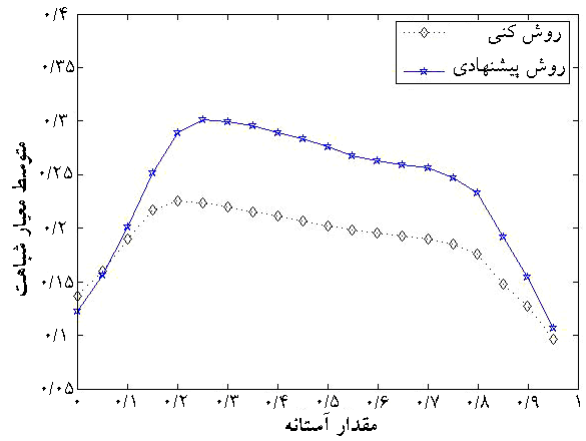
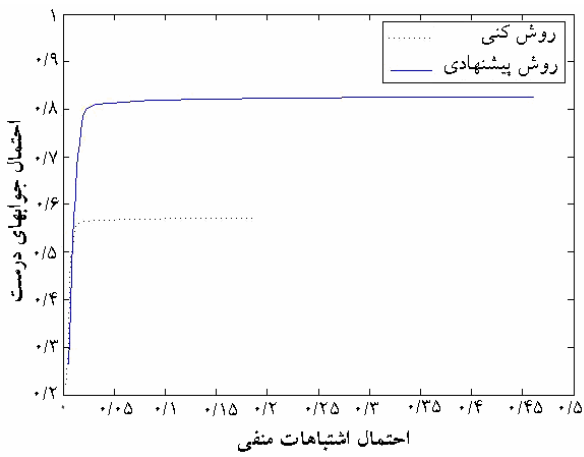


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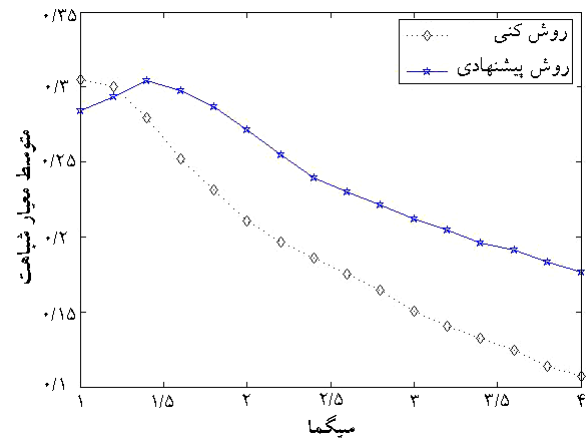


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