Ứng dụng
Xử lý ảnh số & video số

Tuần 4: Toán tử hình thái học trên ảnh độ xám

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KHOA CÔNG NGHỆ THÔNG TIN
TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN

2.3. Toán tử hình thái học trên ảnh độ xám

2.3.1. **Toán tử giãn nở độ xám** (Grayscale Dilation)

2.3.2. **Toán tử co độ xám** (Grayscale Erosion)

2.3.3. **Toán tử mở độ xám** (Grayscale Opening)

2.3.4. **Toán tử đóng độ xám** (Grayscale Closing)

2.3.5. Toán tử làm trơn (Grayscale smoothing)

2.3.6. Toán tử Gradient (Grayscale Morphology Gradient)

2.3.7. Toán tử đỉnh nón (Top-hat transformation)

2.3.8. Toán tử phân đoạn vân (Textural segmentation)

2.3.9. Toán tử đếm hạt (Granulometry)

2.3.10. Toán tử hồi phục (Reconstruction)

2.3.1. Toán tử giãn nở độ xám

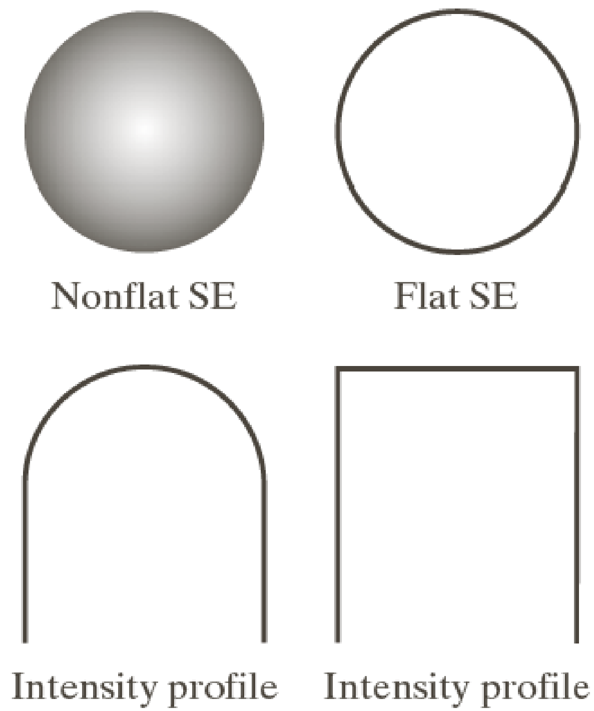
Định nghĩa

$$(f \oplus b)(s,t) = \max\{f(s-x,t-y)+b(x,y) \mid$$
$$(s-x),(t-y) \in D_f;(x,y) \in D_b\}$$

2.3.1. Toán tử giãn nở độ xám

$f(x, y)$: gray-scale image

$b(x, y)$: structuring element



2.3.2. Toán tử co độ xám

Định nghĩa

$$(f \Theta b)(s,t) = \min\{ f(s+x, t+y) - b(x,y) \mid (s+x),(t+y) \in D_f ; (x,y) \in D_b \}$$

2.3.3. Toán tử mở độ xám

Định nghĩa

$$f \circ b = (f \Theta b) \oplus b$$

2.3.4. Toán tử đóng độ xám

Định nghĩa

$$f \bullet b = (f \oplus b)\Theta b$$

2.3.5. Toán tử làm trơn

Định nghĩa

$$h = (f \circ b) \bullet b$$

2.3.6. Toán tử Morphology Gradient

Định nghĩa

$$h = (f \oplus b) - (f \Theta b)$$

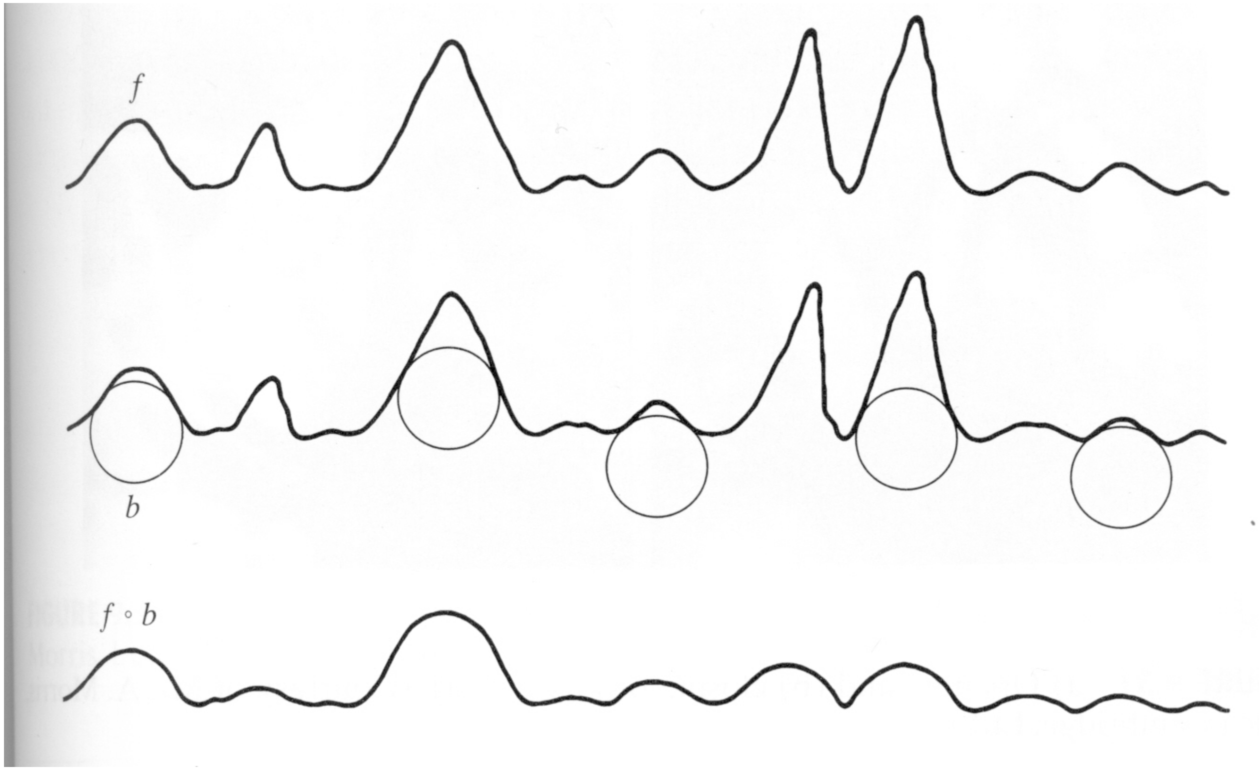
2.3.7. Toán tử đỉnh nón

Định nghĩa

$$h = f - (f \circ b)$$

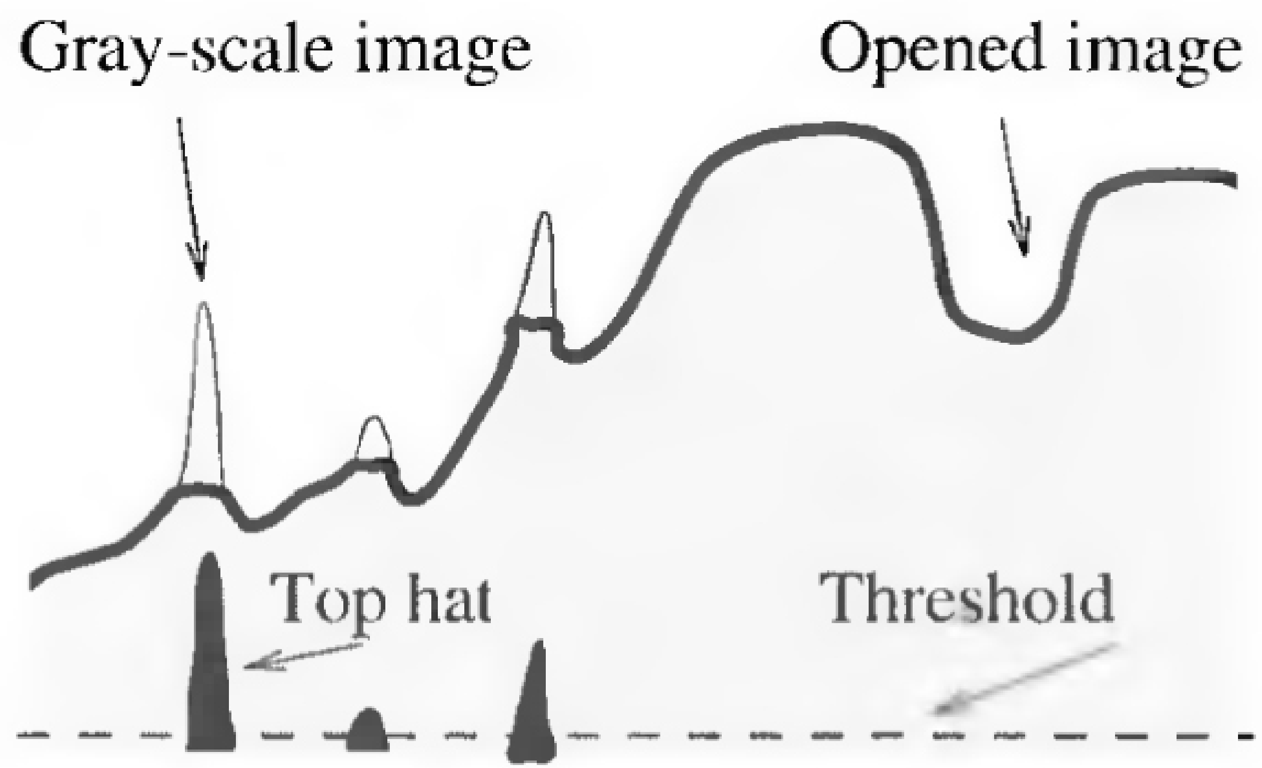
2.3.7. Toán tử đỉnh nón

Định nghĩa



2.3.7. Toán tử đỉnh nón

Định nghĩa



2.3.8. Toán tử Textual segmentation

Định nghĩa

$$h = (f \bullet b_1) \circ b_2$$

2.3.9. Toán tử Granulometry

Định nghĩa

2.3.9. Toán tử Granulometry

- Granulometry deals with determining the size of distribution of particles in an image
- Opening operations of a particular size should have the most effect on regions of the input image that contain particles of similar size
- For each opening, the sum (**surface area**) of the pixel values in the opening is computed

2.3.10. Toán tử hồi phục

- Let f and g denote the marker and mask image with the same size, respectively and f ≤ g.

The geodesic dilation of size 1 of f with respect to g is defined as

$$D_g^{(1)}(f) = (f \oplus b) \wedge g$$

$\wedge$ denotes the point – wise minimum operator

The geodesic dilation of size n of f with respect to g is defined as

$$D_g^{(n)}(f) = D_g^{(1)}\left[D_g^{(n-1)}(f)\right] \text{ with } D_g^{(0)}(f) = f$$

2.3.10. Toán tử hồi phục

- **The geodesic erosion** of size 1 of f with respect to g is defined as

$$E_g^{(1)}(f) = (f \Theta b) \vee g$$

$\vee$ denotes the point – wise maximum operator

The geodesic erosion of size n of f with respect to g is defined as

$$E_g^{(n)}(f) = E_g^{(1)}\left[E_g^{(n-1)}(f)\right] \text{ with } E_g^{(0)}(f) = f$$

2.3.10. Toán tử hồi phục

- **The morphological reconstruction by dilation** of a gray-scale mask image g by a gray-scale marker image f, is defined as the geodesic dilation of f with respect to g, iterated until stability is reached, that is,

$$R_g^D(f) = D_g^{(k)}(f)$$

$$\text{with k such that } D_g^{(k)}(f) = D_g^{(k+1)}(f)$$

The morphological reconstruction by erosion of g by f is defined as

$$R_g^E(f) = E_g^{(k)}(f)$$

$$\text{with k such that } E_g^{(k)}(f) = E_g^{(k+1)}(f)$$

2.3.10. Toán tử hồi phục

- **The opening by reconstruction** of size n of an image f is defined as the reconstruction by dilation of f from the erosion of size n of f; that is,

$$O_R^{(n)}(f) = R_f^D\left[f \ominus nb\right]$$

The closing by reconstruction of size n of an image f is defined as the reconstruction by erosion of f from the dilation of size n of f; that is,

$$C_R^{(n)}(f) = R_f^E\left[f \oplus nb\right]$$