

Digital Image Processing

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Problem 8 Requirement new

8. Morphological Processing

Implement the "*Opening by reconstruction*", "*Filling holes*" and "*Border clearing*" operations on pages 681-683, and reproduce the results in Figure 9.29, Figures 9.31, and Figure 9.32. (The images fig9.29(a) and fig9.31(a) are provided in ftp address)

Problem 8 Requirement old

8. Morphological Processing

a). Implement the morphological operations: erosion, dilation, opening and closing, and use the noisy_fingerprint.tif to check your implementation.

b). Implement boundary extraction, hole filling, connected component extraction. Using licoln_from_penny.tif, region_filling_reflection.tif and chickenfilet_with_bones.tif to verify the results, respectively.

Problem 8 solution new

opening by reconstruction

```

1  img = imread('Fig0929(a)(text_image).tif');
2  se = strel('rectangle',[51 1]);
3  eroded = imerode(img,se);
4  opened = imopen(img,se);
5  rec_open = imreconstruct(eroded,img);
6
7  subplot(2,2,1),imshow(img);title('original');
8  subplot(2,2,2),imshow(eroded);title('eroded');
9  subplot(2,2,3),imshow(opened);title('opened');
10 subplot(2,2,4),imshow(rec_open);title('rec_open');

```

original

ponents or broken connection paths. There is no position past the level of detail required to identify those

Segmentation of nontrivial images is one of the most difficult tasks in image processing. Segmentation accuracy determines the effectiveness of computerized analysis procedures. For this reason, considerable effort can be taken to improve the probability of rugged segmentation. In applications such as industrial inspection applications, at least some improvement in the environment is possible at times. The experienced image processing designer invariably pays considerable attention to such

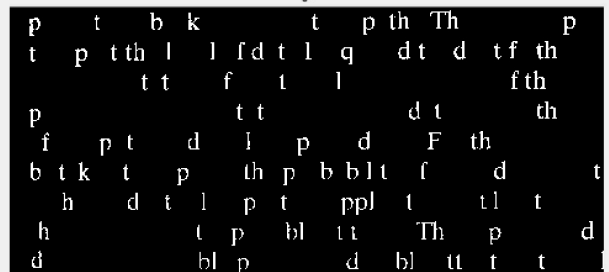
eroded



opened



rec_open



filling holes

```

1  img = imread('Fig0929(a)(text_image).tif');
2  f_img = zeros(size(img));
3  [M,N] = size(img);
4
5  f_img(1,:) = 1-img(1,:);
6  f_img(M,:) = 1-img(M,:);
7  f_img(:,1) = 1-img(:,1);
8  f_img(:,N) = 1-img(:,N);
9
10 se = strel('square',3);
11 fill_img = imadd(logical((~(logical(imdilate(logical(f_img),se)).*(~img))).*(~img))),ir
12
13 subplot(2,2,1),imshow(img);title('original');
14 subplot(2,2,2),imshow(~img);title('reverse');
15 subplot(2,2,3),imshow(f_img);title('f_img');
16 subplot(2,2,4),imshow(fill_img);title('fill_img');

```

original

ponents or broken connection paths. There is no point past the level of detail required to identify those

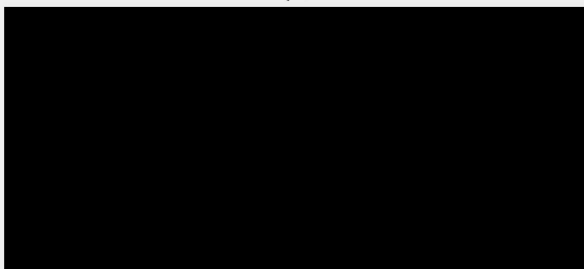
Segmentation of nontrivial images is one of the most difficult tasks in image processing. Segmentation accuracy determines the effectiveness of computerized analysis procedures. For this reason, care must be taken to improve the probability of rugged segmentation. This is especially true in such as industrial inspection applications, at least some of the time. The experienced designer invariably pays considerable attention to such

reverse

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f_img



fill_img

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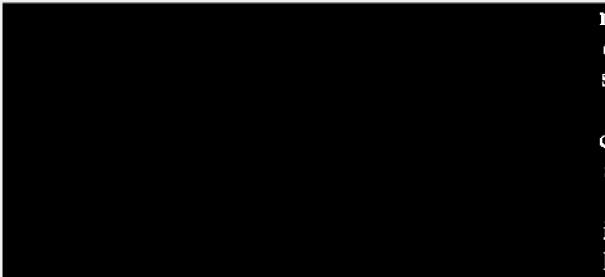
Border clearing

```

1  img = imread('Fig0931(a)(text_image).tif');
2  f_img = zeros(size(img));
3  [M,N] = size(img);
4
5  f_img(1,:) = 1-img(1,:);
6  f_img(M,:) = 1-img(M,:);
7  f_img(:,1) = 1-img(:,1);
8  f_img(:,N) = 1-img(:,N);
9
10 se = strel('square',3);
11 eroded = imdilate(f_img,se);
12 border = imreconstruct(logical(eroded),img);
13
14 subplot(1,2,1),imshow(border);title('border');
15 subplot(1,2,2),imshow(imsubtract(img,border));title('no border');

```

border



no border

ponents or broken connection paths. There is no position past the level of detail required to identify those

Segmentation of nontrivial images is one of the most difficult tasks in image processing. Segmentation accuracy determines the effectiveness of computerized analysis procedures. For this reason, great care must be taken to improve the probability of rugged segmentation. Such as industrial inspection applications, at least some level of automation in the environment is possible at times. The experienced designer invariably pays considerable attention to such

Problem 8 solution old

close&open.m

```

1  img = imread('noisy_fingerprint.tif');
2  se = strel('square',3);
3  eroded1 = imerode(img,se);
4  dilated1 = imdilate(eroded1,se);
5  close_img = imclose(dilated1,se);
6  imshow(close_img);title('close-dilate+enode');

```

boundary_extraction.m

```
1 img = imread('licoln_from_penny.tif');
2 se = strel('square',3);
3 eroded = imerode(img,se);
4 boundary = imsubtract(img,eroded);
5 subplot(1,2,1),imshow(img);title('original');
6 subplot(1,2,2),imshow(boundary);title('boundary');
```

hole_fill.m

```
1 img = imread('region_filling_reflections.tif');
2 fill_img = imfill(img,'holes');
3 subplot(1,2,1),imshow(img);title('original');
4 subplot(1,2,2),imshow(fill_img);title('fill image');
```

connected_extraction.m

```
1 img = im2bw(imread('chickenfilet_with_bones.tif'),0.8);
2 se = strel('square',5);
3 enroded = imerode(img,se);
4 connected_info = bwconncomp(enroded,8)
```

Result

original fingerprint



open-enrode

open-erode



open-dilate

open-dilate



close-dilate+enrode

close-dilate+enrode



boundary extraction

original

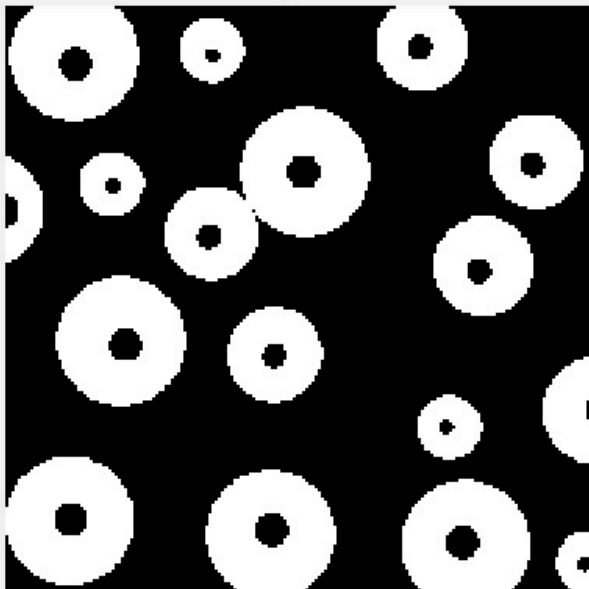


boundary

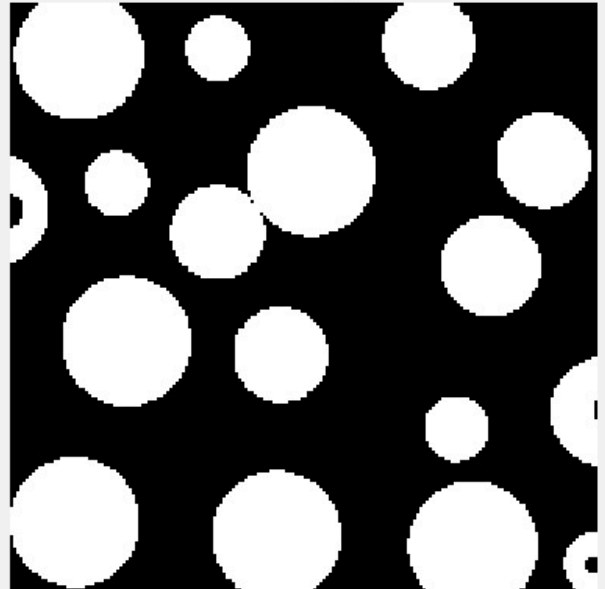


hole filling

original



fill image



connected component extraction

original





threshold



eroded



statistics result

MATLAB

```
1 connected_info =
2
3     Connectivity: 8
4     ImageSize: [321 712]
5     NumObjects: 17
6     PixelIdxList: {1x17 cell}
7
8 >> connected_info.PixelIdxList
9
10 ans =
11
12     Columns 1 through 6
13
14     [6x1 double]    [7x1 double]    [39x1 double]    [128x1 double]    [91608]    [935
15
16     Columns 7 through 12
17
18     [21x1 double]    [599x1 double]    [7x1 double]    [11x1 double]    [7x1 double]
19
20     Columns 13 through 17
21
22     [112839]    [4x1 double]    [19x1 double]    [664x1 double]    [80x1 double]
```