

```
I = im2double(imread('.\Data\23_2.bmp'));
```

```
subplot(2,3,1);imshow(I);
```

```
title("原图");
```



计算特征频率图、最大幅度图和方向图（分成 Cos 图和 Sin 图）

```
[W, H] = size(I);
```

```
% 由于 8*8 实在太小，造成特征不够突出
```

```
% 因此取其邻域 32*32 来当作特征
```

```
% 虽然变成 32*32，但主要还是以左上上的 8*8 为特征图
```

```
% 因此新高宽如下的 M 和 N
```

```
M = floor(W/8) - 3;
```

```
N = floor(H/8) - 3;
```

```
% 矩阵初始化
```

```
freq = zeros(M,N); %频率图
```

```
mag = zeros(M,N); % 最大幅度图
```

```
angs = zeros(M, N); % 角度图
```

```
Sin = zeros(M, N); % Sin 图
```

```
Cos = zeros(M, N); % Cos 图
```

```
for i = 1:M
```

```
    for j = 1:N
```

```
        I1 = I(i*8-7:min(i*8 + 24, end),j*8-7:min(j*8 + 24,end));
```

```
        dft = fftshift(fft2(I1,32,32));
```

```
        dft = abs(dft);
```

```
        dft(17,17) = 0;%去除直流分量
```

```
        [maxi, maxj] = MaxPoint(dft);
```

```
        freq(i, j) = sqrt((maxi - 17)^2 + (maxj - 17)^2);
```

```
        mag(i, j) = dft(maxi, maxj);
```

```
        % 将角度图分成 Cos 图和 Sin 图
```

```
        angs(i, j) = atan((maxj-17)/(maxi-17));
```

```
        Sin(i, j) = sin(angs(i, j) * 2);
```

```
        Cos(i, j) = cos(angs(i, j) * 2);
```

```
    end
```

```
end
```

```
mask = zeros(size(freq));
```

```
% 经过调参取得的参数
```

```
mask(mag > 7 & freq < 8 & freq > 1) = 1;
```

```
% 形态学处理
```

```
se=strel('disk', 5);
```

```
mask=imopen(mask, se);
```

```
se=strel('disk', 15);  
  
mask=imclose(mask, se);
```

## 抠出指纹区

```
newmask = zeros(size(I));  
  
[w, H] = size(I);  
  
for i = 1:w  
  
    for j = 1:H  
  
        x = ceil(i / 8);  
  
        y = ceil(j / 8);  
  
        if mask(min(x,M),min(y,N)) == 1  
  
            newmask(i, j) = 1;  
  
        end  
  
    end  
  
end  
  
NewI = I .* newmask;  
  
subplot(2,3,2);imshow(NewI);  
  
title("仅有指纹区");  
  
imwrite(NewI, ".\Data\23_2_with_mask.bmp");
```

原图



仅有指纹区



```
orientimage = zeros(8*M,8*N); % 方向图初始化
```

```
for i = 1:M
```

```
    for j = 1:N
```

```
        if mask(i,j) == 1
```

```
            % 绘制初始方向图
```

```
            line = zeros(8,8);
```

```
            line(4:5,:) = 1;
```

```
            line = imrotate(line, ang(i,j) * 180 / pi, 'bicubic', 'crop');
```

```
            orientimage(8*i-7:8*i, 8*j-7:8*j) = line;
```

```
        end
```

```
    end
```

```
end
```

```
subplot(2,3,3);imshow(orientimage);
```

```
title("没有平滑的方向图");
```

```
imwrite(orientimage, ".\Data\23_2_orientimage.bmp");
```



对 Sin 图、Cos 图和频率图做空域平滑

```
h = ones(3,3) ./ 9;
```

```
Sin = imfilter(Sin, h);
```

```
Cos = imfilter(Cos, h);
```

```
freq = imfilter(freq, h);
```

```
angs = atan2(Sin, Cos) / 2;
```

```
filterimage = zeros(size(I)); % 新图像初始化
```

```
H = ones(32,32);
```

```
for i = 1:M
```

```
    for j = 1:N
```

```
        if mask(i,j) == 1
```

```
% 绘制平滑后方向图
```

```
line = zeros(8,8);
```

```
line(4:5,:) = 1;
```

```
line = imrotate(line, angs(i,j) * 180 / pi, 'bicubic', 'crop');
```

```
orientimage(8*i-7:8*i, 8*j-7:8*j) = line;
```

```
% 利用 Gabor 滤波器进行特征提取
```

```
I1 = I(i*8-7:min(i*8 + 24, end),j*8-7:min(j*8 + 24,end));
```

```
[mag, phase] = imgaborfilt(I1,10, angs(i,j) * 180 / pi - 90);
```

```
% 取中间的滤波结果当作特征
```

```
filterimage(i*8-7:i*8,j*8-7:j*8) = mag(13:20, 13:20) .* cos(phase(13:20, 13:20));
```

```
end
```

```
end
```

```
end
```

```
subplot(2,3,4);imshow(orientimage);
```

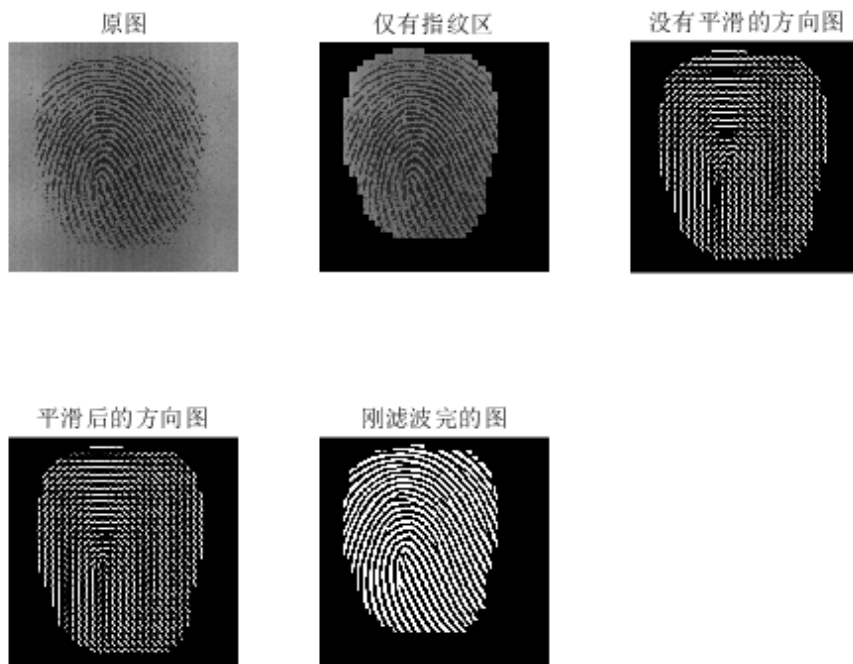
```
title("平滑后的方向图");
```

```
imwrite(orientimage, ".\Data\23_2_orientimage_smoothing.bmp");
```

```
subplot(2,3,5);imshow(filterimage);
```

```
title("刚滤波完的图");
```

```
imwrite(filterimage, ".\Data\23_2_filterimage.bmp");
```



进行亮度调整

```
newfilterimage = filterimage;  
  
newfilterimage(filterimage > 0.01) = 1;  
  
subplot(2,3,6);imshow(newfilterimage);  
  
title("亮度增强图");  
  
imwrite(newfilterimage, ".\Data\23_2_filterimage_final.bmp");
```

原图



仅有指纹区



没有平滑的方向图



平滑后的方向图



刚滤波完的图



亮度增强图

