

Sample 7-6

幾何学処理

幾何学的変換

画像処理特論

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動作確認: MATLAB R2023a

Geometric image processing

Geometric transformations

Advanced Topics in Image Processing

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Verified: MATLAB R2023a

準備

(Preparation)

```
close all
```

画像入力

(Image input)

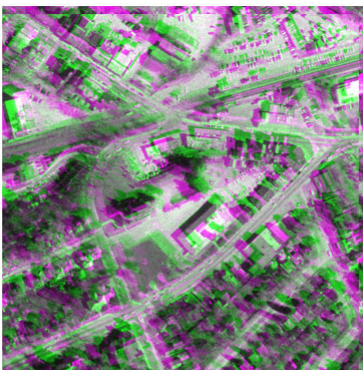
```
% Reading an image  
fixed = imread('westconcordorthophoto.png');
```

シフト画像の生成 (Generation of shifted image)

```
% Setting the amount of movement  
mx = -8;  
my = 8;  
  
% (Circularly) shifting the image  
moving = circshift(fixed,[my mx]);  
  
% Show the images  
figure(1)  
subplot(1,2,1)  
imshow(fixed)  
title('Fixed')  
subplot(1,2,2)  
imshow(moving)  
title('Moving')
```



```
% Show difference of the images  
figure(2)  
imshowpair(moving, fixed)
```



位相限定相関

(Phase only correlation)

2 枚の画像の位置ずれ量を位相特性から検出. (Detects the amount of displacement between two images from their phase characteristics.)

$$\text{POC}(\{x[n]\}_n, \{y[n]\}_n) = \text{IDSFT} \left(\frac{X(e^{j\omega}) \overline{Y(e^{j\omega})}}{|X(e^{j\omega}) \overline{Y(e^{j\omega})}|} \right) = \text{IDSFT} (e^{j(\angle X(e^{j\omega}) - \angle Y(e^{j\omega}))})$$

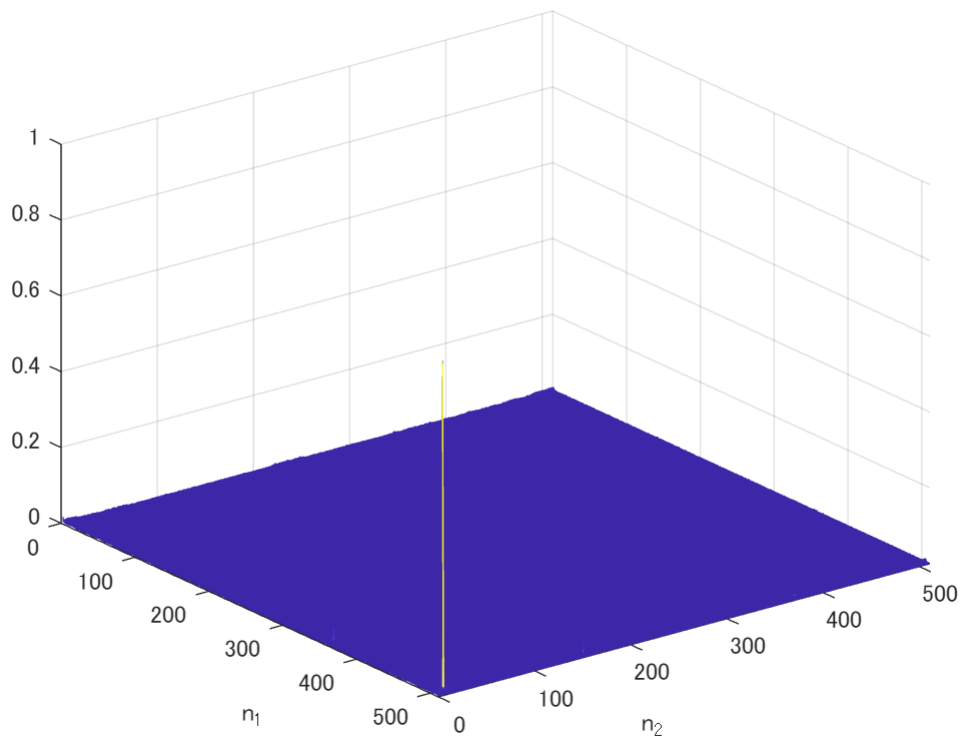
【参考資料】 (Reference)

- http://www.aoki.ecei.tohoku.ac.jp/~ito/vol1_030.pdf

```
% Definition of POC in frequency domain
nPoints = pow2(nextpow2(size(fixed)));
frqPoc = @(x,y) exp(1j*(angle(fftn(x,nPoints))-angle(fftn(y,nPoints))));

% POC Evaluation between two images
poc = abs(ifftn(frqPoc(moving,fixed)));

% POC result
[n1,n2] = ndgrid(1:nPoints(1),1:nPoints(2));
figure(3)
mesh(n1,n2,poc)
xlabel('n_2')
ylabel('n_1')
axis ij
ax = gca;
ax.XLim = [0 nPoints(2)-1];
ax.YLim = [0 nPoints(1)-1];
```



```
% POC result with band limitation for denoising
```

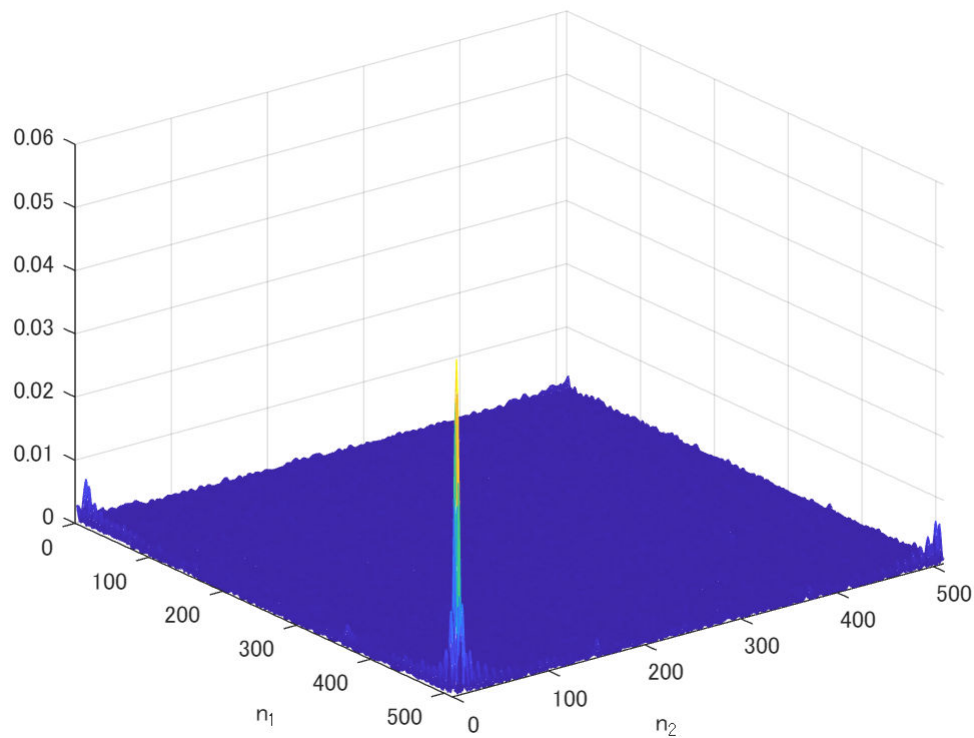
```

szRect = nPoints/4;
frqMask = zeros(nPoints);
frqMask(1:szRect,1:szRect) = ones(szRect);
frqMask = circshift(frqMask,-ceil(szRect/2));

% POC Evaluation between two images with band limitation
poc = abs(ifftn(frqMask.*frqPoc(moving,fixed)));

% POC result with band limitation
figure(4)
mesh(n1,n2,poc)
xlabel('n_2')
ylabel('n_1')
axis ij
ax = gca;
ax.XLim = [0 nPoints(2)-1];
ax.YLim = [0 nPoints(1)-1];

```



```

% Find the peak
[~,loc]= max(poc(:));
py = mod(loc,nPoints(1));
px = floor(loc/nPoints(1));

% Taking account of the negative shifot
py = mod(py+nPoints(1)/2,nPoints(1))-nPoints(1)/2;
px = mod(px+nPoints(2)/2,nPoints(2))-nPoints(2)/2;

```

```
disp(['The peak location is [px, py] = [ ' num2str(px) ' ' num2str(py) ' ]'])
```

The peak location is [px, py] = [-8 9]

画像レジストレーション

(Image registration)

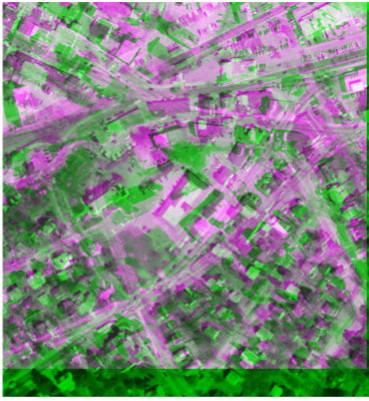
位置のずれた 2 枚の画像の位置合わせを実行する。 (Performs registration of two misaligned images.)

```
% Actual moving picture
moving = rgb2gray(imread('westconcordaerial.png'));

% Show the images
figure(5)
subplot(1,2,1)
imshow(fixed)
title('Fixed')
subplot(1,2,2)
imshow(moving)
title('Moving')
```



```
% Show difference of the images
figure(6)
imshowpair(moving, fixed)
```



幾何学的変換の推定(Estimation of geometric transformations)

```
tformEstimate = imregcorr(moving,fixed);
```

警告: 位相相関は強いピークになりませんでした。結果のレジストレーションの精度が低くなる可能性があります。

座標情報 (Information on the coordinate)

```
Rfixed = imref2d(size(fixed));
```

レジストレーション (Registration)

```
movingReg = imwarp(moving,tformEstimate,'OutputView',Rfixed);
```

結果の表示 (Display result)

```
imshowpair(fixed,movingReg);
```

