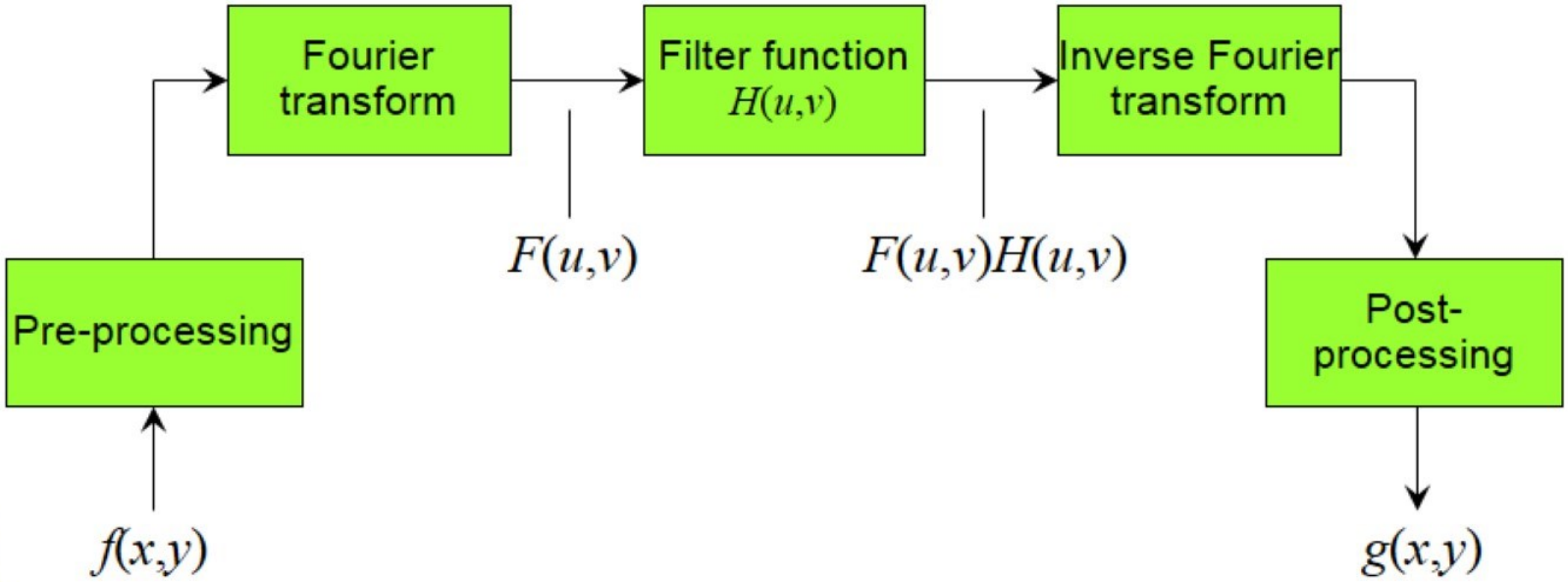
Image Processing

Frequency Domain Processing (Part II)

Pattern Recognition and Image Processing Laboratory (Since 2012)

Filtering in the Frequency Domain

Basic Steps in DFT Filtering



Filtering in the Frequency Domain

```
>> ex4_03  % See demonstration
```

Filtering in the Frequency Domain

Obtaining Frequency Domain Filters
from Spatial Filters

>> ex4_04 % See demonstration

Filtering in the Frequency Domain

Generating Filters Directly in the Frequency Domain

>> ex4_05 % See demonstration

Filtering in the Frequency Domain

Sharpening Frequency Domain Filters:
Basic Highpass Filter

>> ex4_06 % See demonstration

Filtering in the Frequency Domain

High-frequency emphasis filtering

$$H_{hfe}(u,v) = a + bH_{hp}(u,v)$$

>> ex4_07 % See demonstration

Note: Parameters a and b are equivalent to brightness and contrast adjustments in the spatial domain.


The end of
part II

```
% ex4_03.m

% Obtaining Frequency Domain Filters from Spatial Filters

f = imread('lena.bmp');
%f = imread('building.tif');
figure(1); imshow(f);

F = fft2(f);
S = fftshift(log(1+abs(F)));
S = gscale(S);
figure(2);
imshow(S, []);

h = fspecial('sobel')';
figure(3);
freqz2(h);

PQ = paddedsize(size(f));
H = freqz2(h, PQ(1), PQ(2));
H1 = ifftshift(H);
figure(4);
imshow(abs(H), []);

gs = imfilter(double(f), h); % Performing on spacial domain
gf = dftfilt(f, H1);         % Performing on frequency domain

figure(5);
subplot(2,2,1); imshow(gs, []);
subplot(2,2,2); imshow(gf, []);
subplot(2,2,3); imshow(abs(gs), []);
subplot(2,2,4); imshow(abs(gf), []);

figure(6);
subplot(1,2,1); imshow(gs > 0.2*abs(max(gs(:))));
subplot(1,2,2); imshow(gf > 0.2*abs(max(gf(:))));

d = abs(gs-gf);
max(d(:))
min(d(:))
```

```
% ex4_04.m

% Generating Filters Directly in the Frequency Domain

f = imread('lena.bmp');

PQ = paddedsize(size(f));
[U, V] = dftuv(PQ(1), PQ(2));
D0 = 0.2*PQ(2);                          % 0.2 : Radian of a filter
F = fft2(f, PQ(1), PQ(2));               % Converting f to frequency
domain with zero padding
%H = exp(-(U.^2 + V.^2)/(2*(D0^2))); % A filter on frequency
domain
D = sqrt(U.^2 + V.^2);
H = double(D <= D0);
g = dftfilt(f, H);                       % Performing on frequency
domain

figure(1);
subplot(2,2,1); imshow(f);
subplot(2,2,2); imshow(fftshift(H));
subplot(2,2,3); imshow(log(1+abs(fftshift(F))), []);
subplot(2,2,4); imshow(g, []);

figure(2);
mesh(fftshift(H(1:10:512, 1:10:512)));
```

```
% ex4_05.m

% Generating the transfer functions of all lowpass filters

clear all;
close all;

[H1, D1] = lpfilter('ideal', 50, 50, 15);
[H2, D2] = lpfilter('btw', 50, 50, 15);
[H3, D3] = lpfilter('gaussian', 50, 50, 15);

figure(1);
subplot(2,2,1); mesh(fftshift(H1));
subplot(2,2,2); mesh(fftshift(H2));
subplot(2,2,3); mesh(fftshift(H3));
```

```
% ex4_06.m

% Plotting highpass filters
clear all;
close all;

f = imread('chestXray.tif');
PQ = paddedsize(size(f));
D0 = 0.1 * PQ(1);
H1 = hpfilter('btw', PQ(1), PQ(2), D0);
g = dftfilt(double(f), H1);
figure(1);
subplot(1,2,1); imshow(f, []);
subplot(1,2,2); imshow(g, []);

figure(2);
mesh(fftshift(H1));
axis([0 1000 0 1000 0 1]);
```

```
% ex4_07.m

% Plotting highpass filters

f = imread('chestXray.tif');
%f = imread('mri.tif');
%f = imread('pout.tif');
PQ = paddedsize(size(f));
D0 = 0.05 * PQ(1);
HBW = hpfilter('ideal', PQ(1), PQ(2), D0, 2);
H = 0.9 + 10*HBW;
gbw = dftfilt(double(f), HBW);
gbw1 = gscale(gbw);
ghf = dftfilt(double(f), H);
ghf1 = gscale(ghf);
ghe = histeq(ghf1, 256);

figure(1); imshow(f, []);
figure(2); imshow(gbw1, []);
figure(3); imshow(ghf1, []);
figure(4); imshow(ghe, []);
```

Image Processing

Workshop on Frequency Domain Processing (Part II)

Pattern Recognition and Image Processing Laboratory (Since 2012)

Workshop on Frequency Domain Processing (Part II)

1. ให้ทำความเข้าใจกับ MATLAB Script ต่อไปนี้ แล้วให้เฉลยว่าเป็นตัวกรอง (filter) ที่สร้างบน spatial domain เป็นแบบใด

```
h1 = [-1 -1 -1;
      -1  8 -1;
      -1 -1 -1]

figure(1);
freqz2(h1);
```

Workshop on Frequency Domain Processing (Part II)

1. (ต่อ)

```
h2 = [1   1   1;
      1  -8   1;
      1   1   1]

figure(2);
freqz2(h2);
```

Workshop on Frequency Domain Processing (Part II)

1. (ต่อ)

```
h3 = [1 1 0;
      1 0 1;
      0 1 1]

figure(3);
freqz2(h3);
```

Workshop on Frequency Domain Processing (Part I)

2. ให้นักศึกษาใช้ตัวอย่าง ex4_03 เป็นแนวทางในการนำตัวกรองทั้งหมดจากข้อ 1 มาประยุกต์ใช้กรองภาพ lena.bmp
3. ให้นักศึกษาสร้างตัวกรองแบบ lowpass filter และแบบ highpass filter อย่างอิสระ อย่างละ 2 filters บน spatial domain แต่ให้แสดงผลการสร้าง filters ดังกล่าวบน frequency domain โดยใช้ฟังก์ชัน `freqz2`
4. ให้นักศึกษาใช้ filters ที่สร้างจากข้อ 3 มาประยุกต์ใช้กรองภาพ lena.bmp โดยใช้ตัวอย่าง ex4_03 เป็นแนวทาง