Image Processing

Intensity Transformation and Spatial Filtering (Part I)

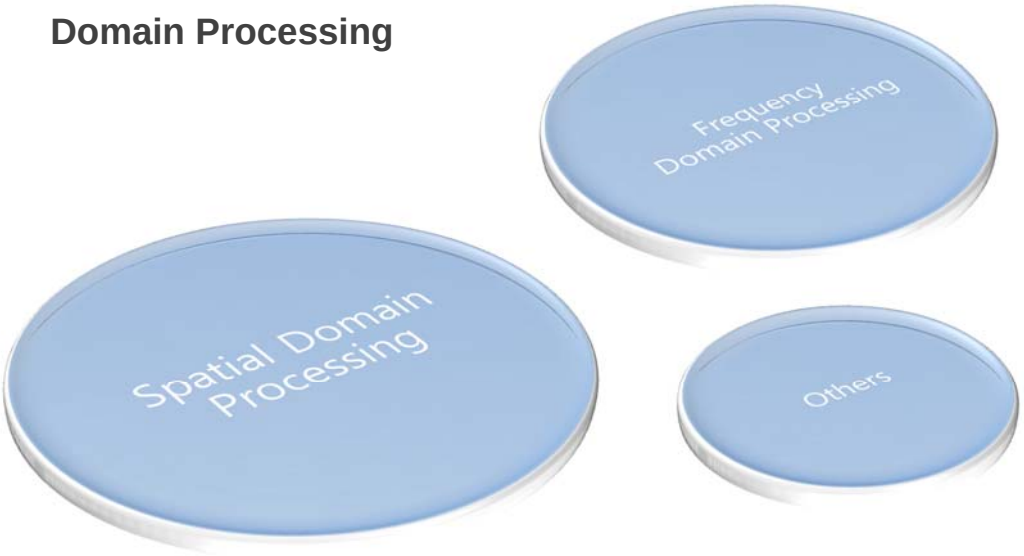
Pattern Recognition and Image Processing Laboratory (Since 2012)

Introduction

Transformation

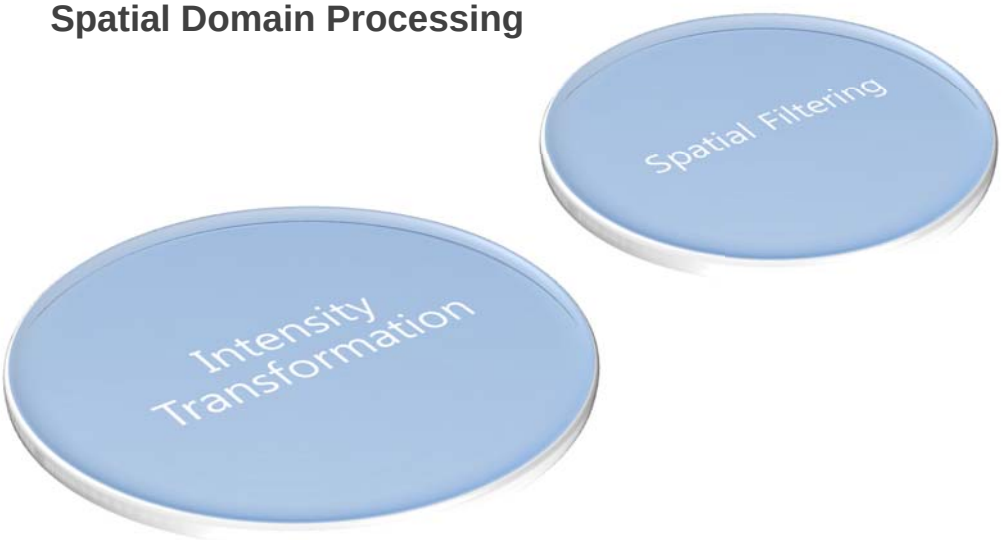
Introduction

Domain Processing



Introduction

Spatial Domain Processing



Intensity Transformation Function

A spatial domain processing is denoted by the expression.

$$g(x,y) = T[f(x,y)]$$

Output Image

Operator on f

Input Image

Intensity Transformation Function

$$g(x,y) = T[f(x,y)]$$

$$s = T(r)$$

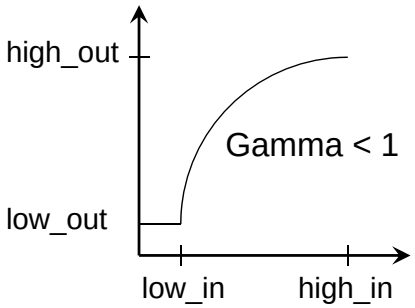
Intensity of g

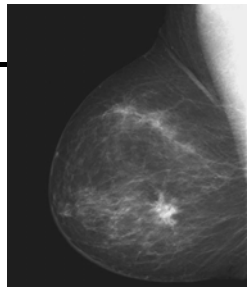
Intensity of f

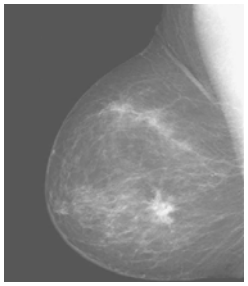
Intensity Transformation Function

Function imadjust

```
>> g = imadjust(f, [low_in high_in], …
       [low_out high_out], gamma)
```



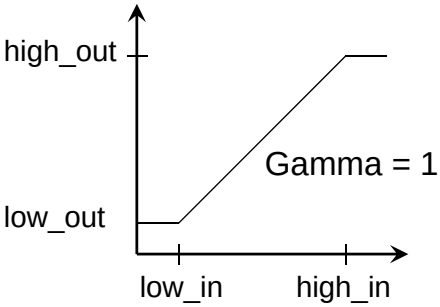


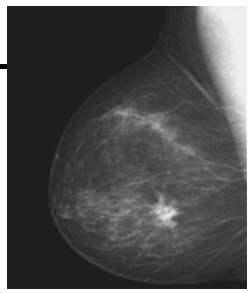


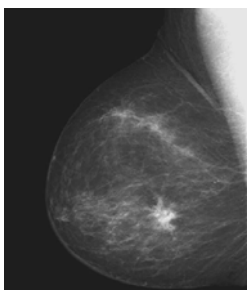
Intensity Transformation Function

Function imadjust

```
>> g = imadjust(f, [low_in high_in], …
       [low_out high_out], gamma)
```



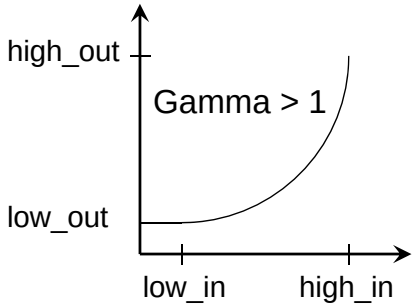


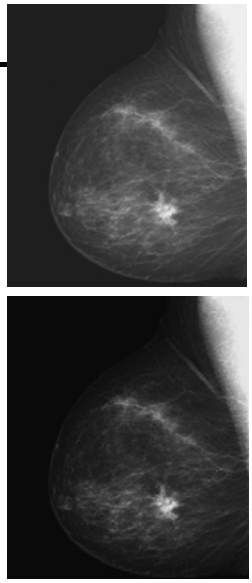


Intensity Transformation Function

Function imadjust

```
>> g = imadjust(f, [low_in high_in], …
       [low_out high_out], gamma)
```





Intensity Transformation Function

>> ex3_01 % See demonstration

Intensity Transformation Function

```
>> f = imread('breast.tif');
>> g1 = imadjust(f, [0 1], [1 0]); % Neg. Image
>> g11 = imcomplement(f);
>> imshow(g1), figure, imshow(g11)
```

Note: Compare the results between g1 and g11.

Intensity Transformation Function

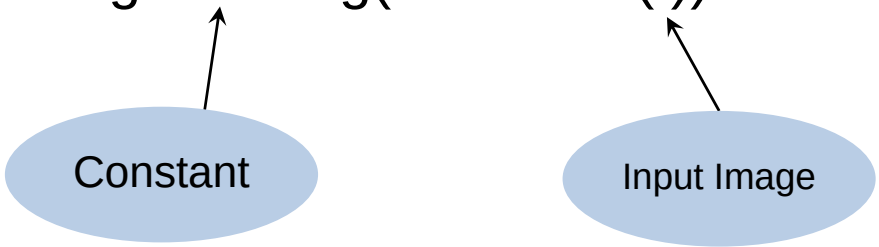
```
>> g2 = imadjust(f, [0.5 0.75], [1 0]);
>> g3 = imadjust(f, [ ], [ ], 2);
>> figure, imshow(g2)
>> figure, imshow(g3)
```

Note: Compare the results between g2 and g3.

Logarithm Transformation

Logarithm transformation is implemented using the expression

```
>> g = c * log(1+double(f))
```



Note: One of the principal uses of the log transformation is to suppress dynamic range.

Logarithm Transformation

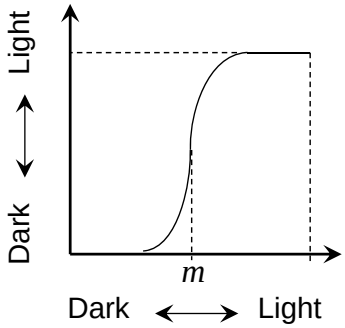
```
>> f = imread('pout.tif'); imshow(f);
>> c = 1;
>> gc = c*log(1+double(f));
>> gc1 = im2uint8(mat2gray(gc)); % decompress
                                 % to the full range of the display.
>> figure, imshow(uint8(gc)), figure, imshow(gc1);
```

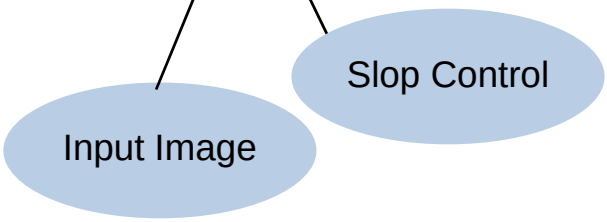
Note: Compare the results between gc and gc1.

Contrast-Stretching Transformation

A contrast-stretching transformation function is defined as

$$s = T(r) = \frac{1}{1+(m/r)^E}$$

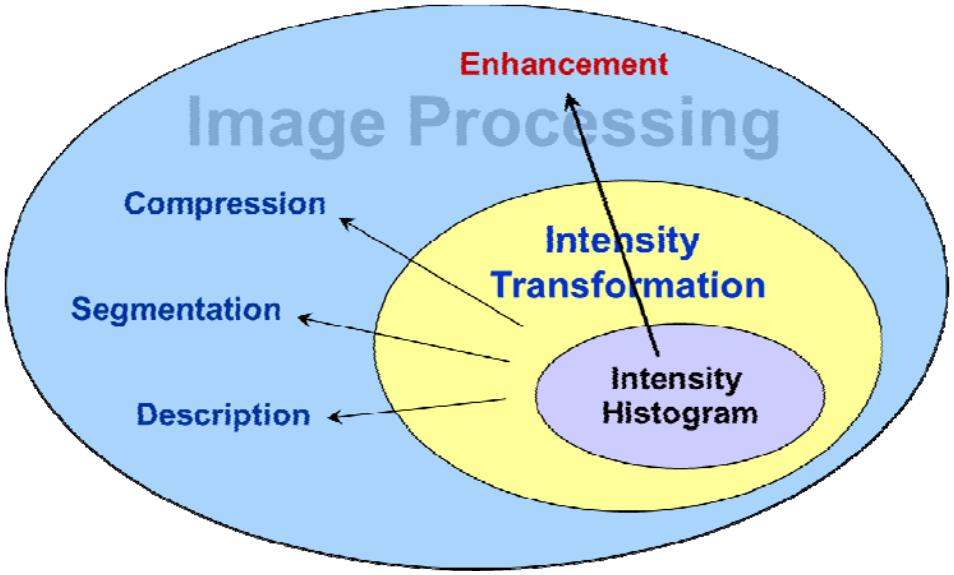




Contrast-Stretching Transformation

>> ex3_02 % See demonstration

Intensity Histogram



Intensity Histogram

The histogram of a digital image is defined as the discrete function

$$h(r_k) = n_k$$

where r_k is k^{th} intensity level in the interval [0, G] and n_k is the number of pixels in the image whose intensity level is r_k.

Intensity Histogram

```
>> b = 256
>> h = imhist(f, b)  % b is the number of bins,
>>                   % by default b = 256
>> p = imhist(f, b)/numel(f)  %  The normalized
>>                            %  histogram
```

Intensity Histogram

Histogram Equalization

```
>> h = imhist(f, b)      % b is the number of bins,
>>                       % by default b = 256.
>> p = imhist(f, b)/numel(f)  %  The normalized
>>                            %  histogram.
```

>> ex3_03 % See demonstration


The end of
part I