

Image Enhancement

Reading:
Chapter 3 (Spatial domain)
Chapter 4 (Frequency domain)

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Image Enhancement

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Image Enhancement

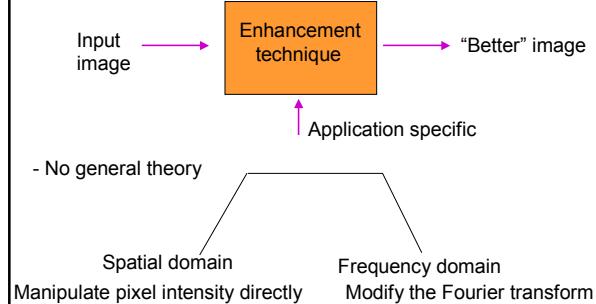
- Basic gray level transformations
- Histogram Modification
- Average and Median Filtering
- Frequency domain operations
- Homomorphic Filtering
- Edge enhancement

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Image Enhancement



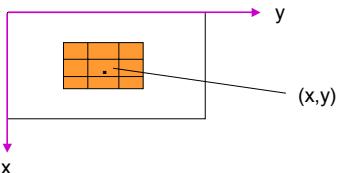
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Spatial domain techniques

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



Simplest case: Neighbourhood is (x,y)

[$g(\cdot)$ depends only on the value of f at (x,y)]

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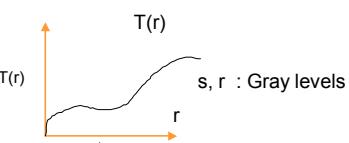
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Contrast Stretching

Example:

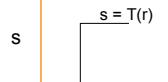
$$s = T(r)$$



Example of contrast stretching.

There are all point operations
hence referred to as point processing.

Thresholding



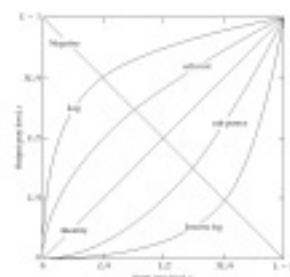
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Figure 3.3

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Basic gray level
transformation
histogram modification
thresholding and histogram
equalization



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Frequency domain techniques

$$g(x,y) = h(x,y) * f(x,y)$$

$$G(u,v) = H(u,v) F(u,v)$$

$$g(x,y) = F^{-1}\{ H(u,v) F(u,v) \}$$

$h(x,y) \longrightarrow$ Spatial convolution mask

Convolution Masks

Involves flipping about origin

Vs

Spatial masks

No flipping

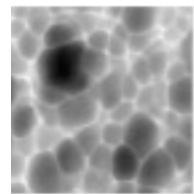
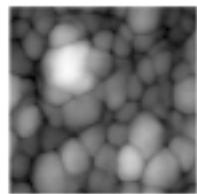
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Gray level transformations

(a) Negative image: Example: $g(x,y) = 255 - f(x,y)$



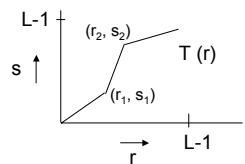
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Contrast Stretching

(b) Contrast stretching



$r_1 = s_1$	no change
$r_2 = s_2$	

$r_1 = r_2$
 $s_1 = 0$
 $s_2 = L-1$

Thresholding at r_1

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Log Transformation

(c) Compressing dynamic range

$$s = c \log(1 + |r|) \quad c \rightarrow \text{Scaling factor}$$

Example: Displaying the Fourier Spectrum

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Power-Law Transformations

$$s = cr^\gamma$$

C and γ are positive constants.

Often referred to as "gamma correction".

CRT –intensity-to-voltage response follows a power function (typical value of gamma in the range 1.5-2.5.)

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Gamma correction



$\gamma = 1, 0.7, 0.4, 0.1$

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Gamma correction (cont.)



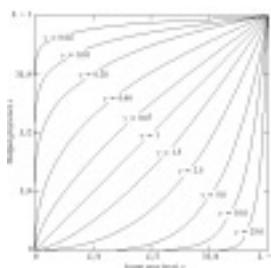
\gamma=1, 2, 5.

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Figure 3.6



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In Matlab

- Checkout the **imadjust** function.
 - Adjust image intensity values or colormap

Syntax

```
J = imadjust(I,[low_in high_in],[low_out high_out],gamma)
newmap = imadjust(map,[low_in high_in],[low_out high_out],gamma)
RGB2 = imadjust(RGB1,...)
```

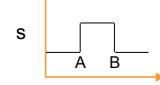
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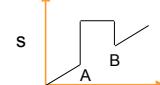
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Point Processing (contd.)

(d) Gray level slicing (Intensity level slicing)



Highlights only the range [A - B]



Preserves other intensities

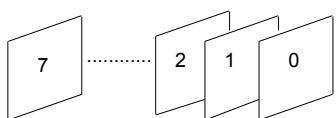
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Bit plane slicing

(e) Bit plane slicing



Highlights contributions made by specific bits

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MSB plane: an example



Threshold at 128

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Figure 3.13: bit plane slicing

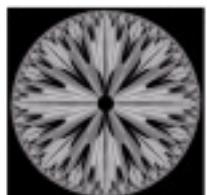


FIGURE 3.13 The 8-bit binary image (3.5) digitized using a grayscale-to-binary conversion algorithm.
(Courtesy of Mr. Michael J. Blaha, Susquehanna College, Pennsylvania, PA.)

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Figure 3.14: bit planes

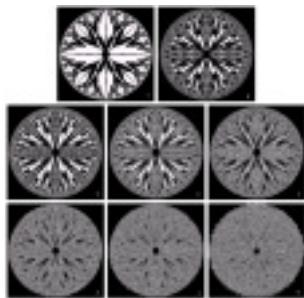


FIGURE 3.14 The eight bit planes of the image in Fig. 3.13. The number of the bottom-right of each image denotes its bit plane.

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