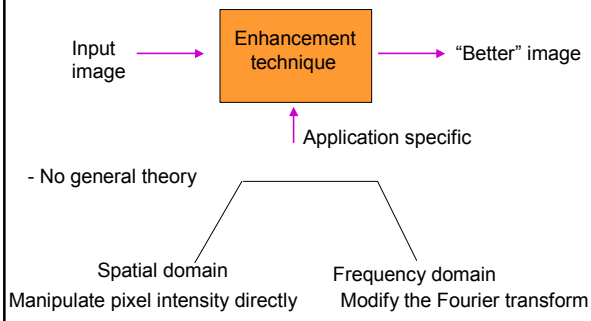
Image Enhancement

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

Image Enhancement

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

Image Enhancement



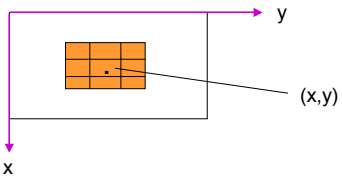
- No general theory

Spatial domain
Manipulate pixel intensity directly

Frequency domain
Modify the Fourier transform

Spatial domain techniques

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



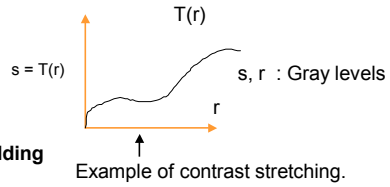
Simplest case: Neighbourhood is (x,y)

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

Contrast Stretching

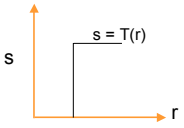
Example:

s = T (r)



Example of contrast stretching.

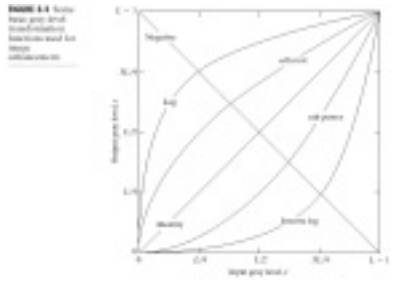
Thresholding



There are all point operations

hence referred to as point processing.

Figure 3.3



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) ⟶ Spatial convolution mask

Convolution Masks **Vs** **Spatial masks**

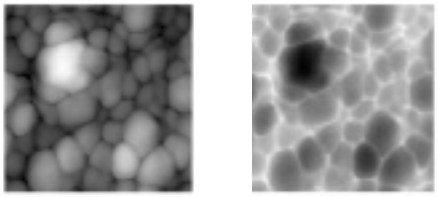
↓ ↓

Involves flipping about origin

No flipping

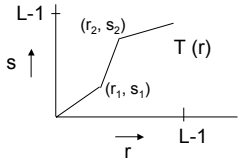
Gray level transformations

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



Contrast Stretching

(b) Contrast stretching



$r_1 = s_1$, $r_2 = s_2$ — no change

$r_1 = r_2$, $s_1 = 0$, $s_2 = L-1$ — Thresholding at r_1

Log Transformation

(c) Compressing dynamic range

$s = c \log (1 + |r|)$ c ⟶ Scaling factor

Example: Displaying the Fourier Spectrum

Power-Law Transformations

$$s = cr^{\gamma}$$

C and \gamma are positive constants.

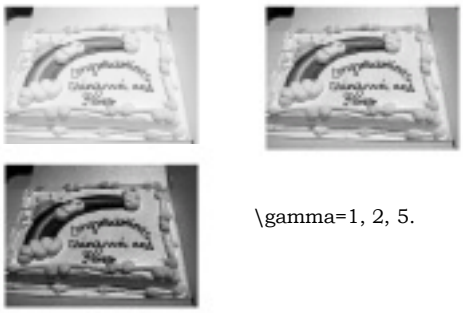
Often referred to as “gamma correction”.

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

Gamma correction

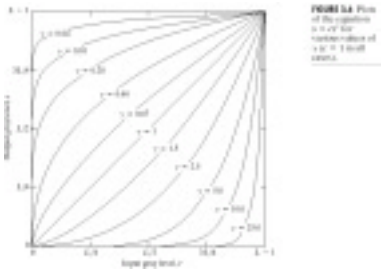
\gamma=1, 0.7, 04. 0.1

Gamma correction (cont.)



\gamma=1, 2, 5.

Figure 3.6



In Matlab

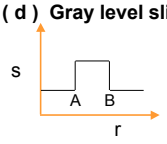
- Checkout the imadjust function.
  - Adjust image intensity values or colormap

Syntax

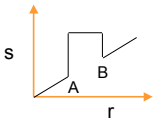
```
J = imadjust(I,[low_in high_in],[low_out high_out],gamma)
newmap = imadjust(map,[low_in high_in],[low_out high_out],gamma)
RGB2 = imadjust(RGB1,...)
```


Point Processing (contd.)

(d) Gray level slicing (Intensity level slicing)



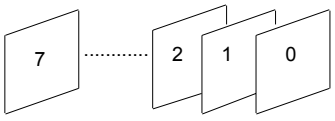
Highlights only the range [A - B]



Preserves other intensities

Bit plane slicing

(e) Bit plane slicing



Highlights contributions made by specific bits

MSB plane: an example

Threshold at 128

Figure 3.13: bit plane slicing

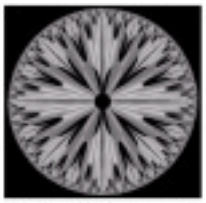


Figure 3.14: bit planes