



Special Module on Media Processing and Communication

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Recap

► Lecture 1

- Overview
- Digital Representation
 - [Audio](#)
 - [Image](#)
 - [Video](#)
 - [Geometry](#)
- Need of Compression



Image Compression

Compression Ratio

$$C_r = n_o/n_c$$

n_o = Number of carrying units (bits) in the **original** data (image)

n_c = Number of carrying units (bits) in the **compressed** data (image)

Also,

$$R_d = 1 - 1/ C_r$$

R_d = Relative data redundancy



Image Compression

Fidelity Criteria

Measure of loss or degradation

- Mean Square Error (MSE)

$$MSE = \frac{1}{MN} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} [f(i, j) - f'(i, j)]^2$$

- Signal to Noise Ratio (SNR)
- Subjective Voting



Image Compression

Compression Techniques

- Loss-less Compression

Information can be compressed and restored without any loss of information

- Lossy Compression

Large compression, perfect recovery is not possible



Image Compression

Compression Techniques

Symmetric

- Same time for compression (coding) and decompression (decoding)
- Used for dialog (interactive) mode applications

Asymmetric

- Compression is done once so can take longer
- Decompression is done frequently so should be fast
- Used for retrieval model applications



Image Compression

Data Redundancy

- Coding

Variable length coding with shorter codes for frequent symbols

- Interpixel

Neighboring pixels are similar

- Psychovisual

Human visual perception - limited



Image Compression

Coding Redundancy

Example: (from Digital Image Processing by Gonzalez and Woods)

r_k	$p_r(r_k)$	Code 1	$l_1(r_k)$	Code 2	$l_2(r_k)$
$r_0 = 0$	0.19	000	3	11	2
$r_1 = 1/7$	0.25	001	3	01	2
$r_2 = 2/7$	0.21	010	3	10	2
$r_3 = 3/7$	0.16	011	3	001	3
$r_4 = 4/7$	0.08	100	3	0001	4
$r_5 = 5/7$	0.06	101	3	00001	5
$r_6 = 6/7$	0.03	110	3	000001	6
$r_7 = 1$	0.02	111	3	000000	6

TABLE 8.1

Example of
variable-length
coding.

fixed length coding
Avg length=3 bits

variable length coding
Avg length=2.7 bits

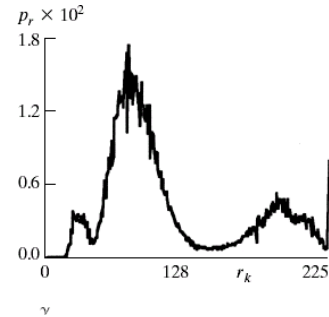
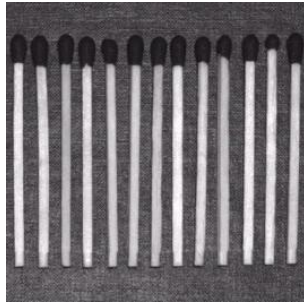


Image Compression

Interpixel Redundancy

Example: (from Digital Image Processing by Gonzalez and Woods)

Image



Histogram

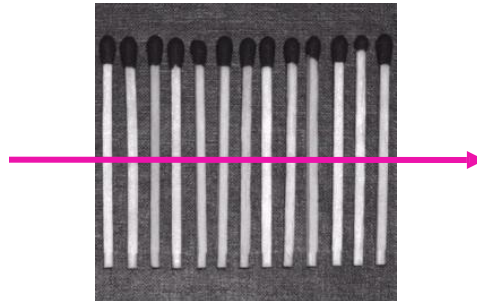


Image Compression

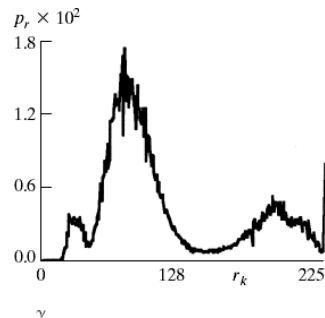
Interpixel Redundancy

Example: (from Digital Image Processing by Gonzalez and Woods)

Image



High interpixel correlation



Histogram



Image Compression

Psychovisual Redundancy

Example: (from Digital Image Processing by Gonzalez and Woods)



Original 256 levels

16 level quantization

IGS quantization



Image Compression

Loss-less Techniques

- Coding redundancy
 - Variable length coding
- Interpixel redundancy
 - Run length coding
 - Predictive coding