

Image Processing

(1) Introduction

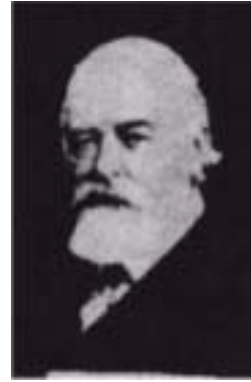
- Digital image processing: using computers to
 - improve the quality of images
 - enhance or extract important information from images for better human understanding or machine perception
 - produce special image effects

(a) Origin of image processing

- Media industry (1921)
 - Digital images were transmitted through undersea cables, and then printed by telegram printers



Produced in 1921 from a coded tape
by a telegraph printer



Made in 1922 from a
punched tape



Transmitted through a cable from
London to New York in 1929

(b) Applications of image processing

- Classified by image sources:
 - Gamma-ray imaging



Bone scan



Positron emission tomography (PET)

- X-ray imaging

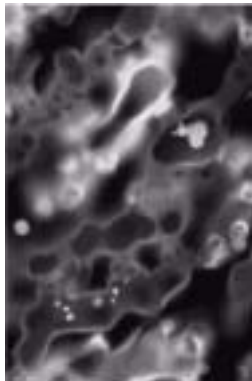


Angiogram



Computer aided tomography (CAT)

- Ultraviolet imaging



Normal corn

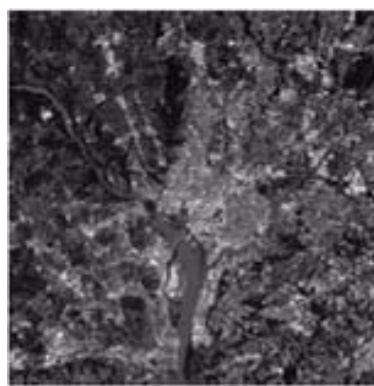


Smut corn

- Visible light/infrared imaging



Microscopy image: Taxol



Satellite image of D.C, USA



Multispectral image of Hurricane



Infrared satellite image of the Americas

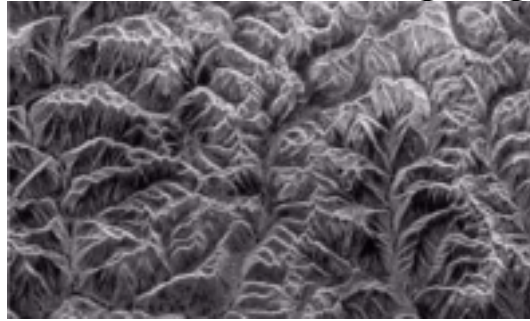


Fingerprint image



License plate recognition

- Microwave imaging



Radar image of Tibet

- Radio imaging

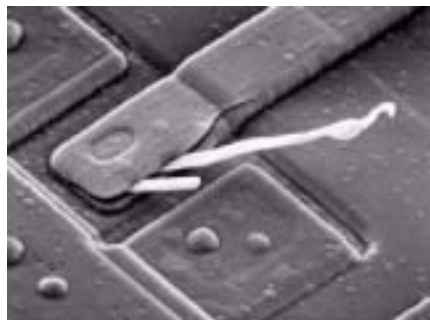


Magnetic resonance image (MRI) of human spine



Ultrasound imaging

- Electronic microscope imaging



Damaged IC image



Computer graphic image of the human skull

(c) Computer vision, image processing, and computer graphics

- Computer vision: using computers to realize biological vision functions
 - Recognition, analysis, understanding, segmentation, classification
 - Include low-level and high-level processing
 - * Low level: general image processing functions
 - * High level: applications of artificial intelligence to understand the image contents and meanings (recognition, reasoning...)
 - Applications: robotics, automated inspection, autonomous navigation, document image analysis (optical character recognition, OCR), biometrics (face, voice, fingerprint, retina...)
- Image processing: low-level processing, without considering image contents and its meanings
 - Enhancement: improve image quality according to the characteristics of human vision
 - * Noising reduction

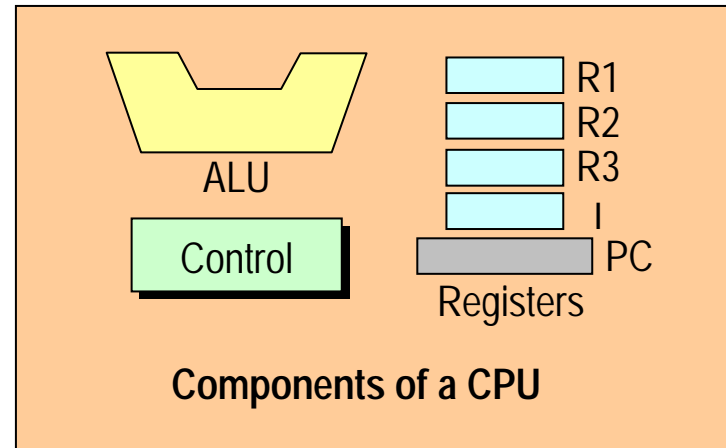
- * Contrast enhancement
- * Pseudo-color processing: medical imaging
- * Edge enhancement: contour description
- Image restoration: restore the damaged image to its original state
 - * Over-/Under-exposal restoration
 - * Defocus restoration: object motion, geometric transform...
 - * Calibration
- Encoding and compression: reduce the amount of storage or transmission
- Transformation: transform the image from spatial domain to another for more efficient processing, representation, or storage
 - * Fourier, K-L, discrete cosine, wavelet, Hough...
- Image editing: cropping, translation, rotation, flipping, resizing, warping, special effect...
- Computer graphics
 - Using computers to generate images
 - Visual effects: shadows, light projection, view angle change,

occlusion of objects...

- Modeling: cloud, trees, water, fire, object surfaces...
- Applications: commercial or art images, animation, virtual reality, computer games, computer aided design...



Bitmap-based image



Vector-based image