

Image Processing

(1) Introduction

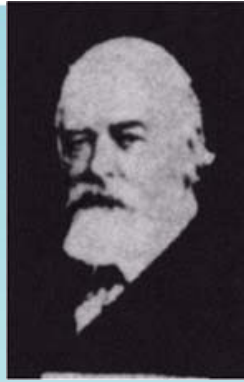
- Digital image processing: using computers to
 - * improve the quality of images
 - * enhance or extract important information from images for better human understanding or machine perception
 - * produce special image effects

(a) Origin of digital image

- 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

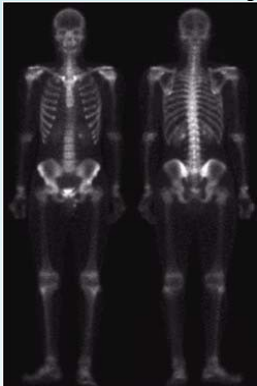


Transmitted through a cable from London to New York in 1929

(b) Applications of image processing

- Classified by image sources:

* Gamma-ray imaging



Bone scan

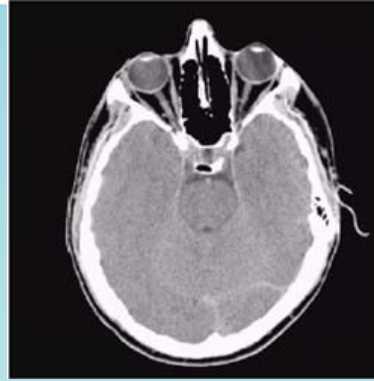


Positron emission tomography (PET)

* X-ray imaging

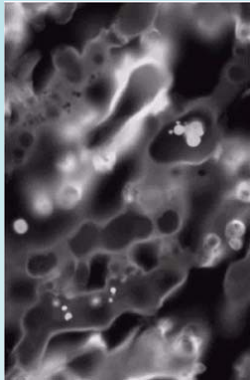


Angiogram

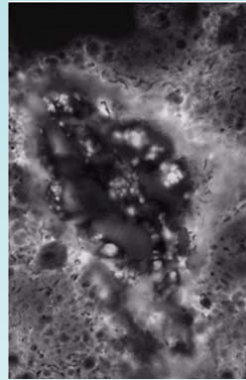


Computer aided tomography (CAT)

* Ultraviolet imaging



Normal corn



Smut corn

* Visible light/infrared imaging



Microscopy image: Taxol



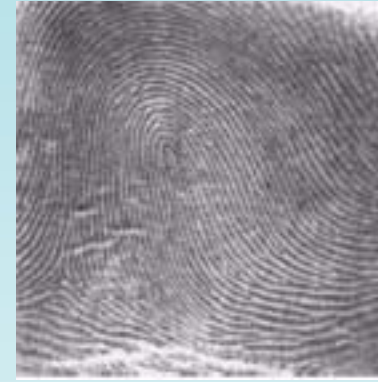
Satellite image of D.C, USA



Multispectral image of Hurricane



Infrared satellite image of the Americas

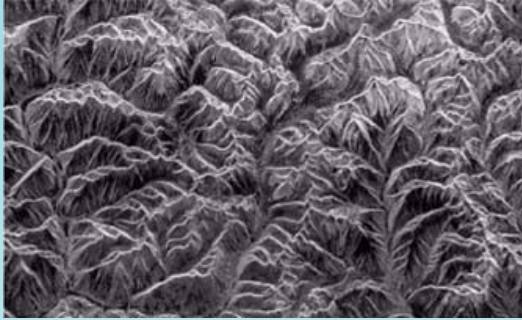


Fingerprint image



License plate of a car

* Microwave imaging



Radar image of Tibet

* Radio imaging

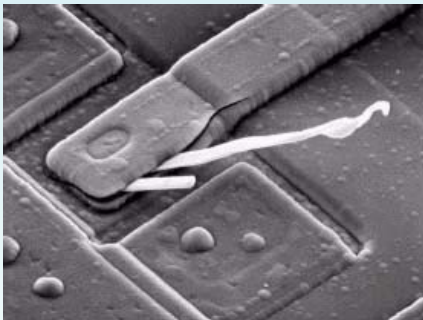


Magnetic resonance image (MRI) of human spine

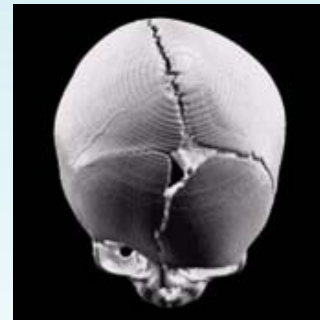


Ultrasound imaging

* Electronic microscope imaging



Damaged IC image



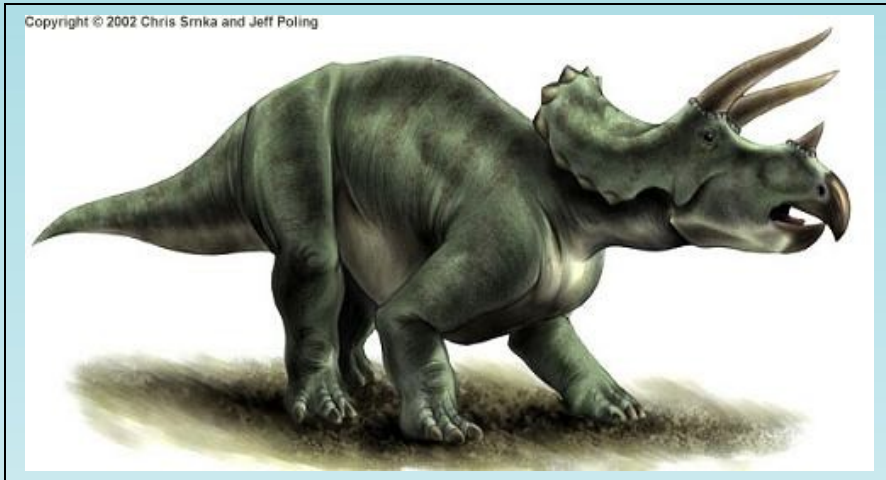
Computer graphic image of the human skull

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

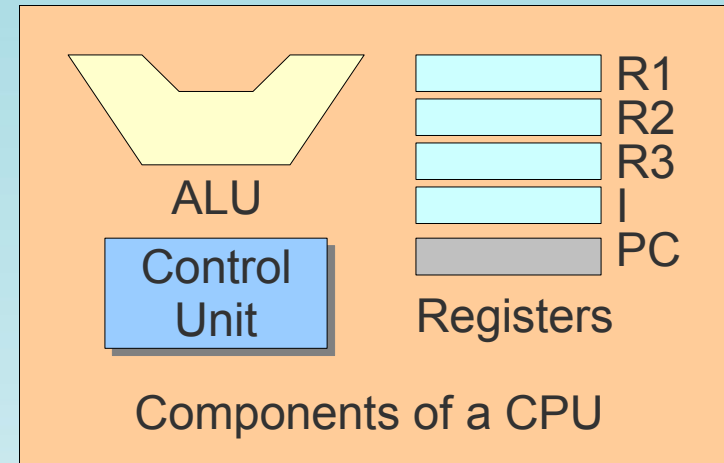
- Computer vision: using computers to realize biological vision functions
 - * Recognition, analysis, understanding, segmentation, classification
 - * Include low-level and high-level processing
 - # Low level: general image processing functions
 - # High level: applications of artificial intelligence 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-exposure 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