Berner Fachhochschule
Haute école spécialisée bernoise
Bern University of Applied Sciences

Module 7281: CPVR1:

Introduction to Computer Perception

Marcus Hudritsch (hsm4)

CPVR1: Introduction to Computer Perception

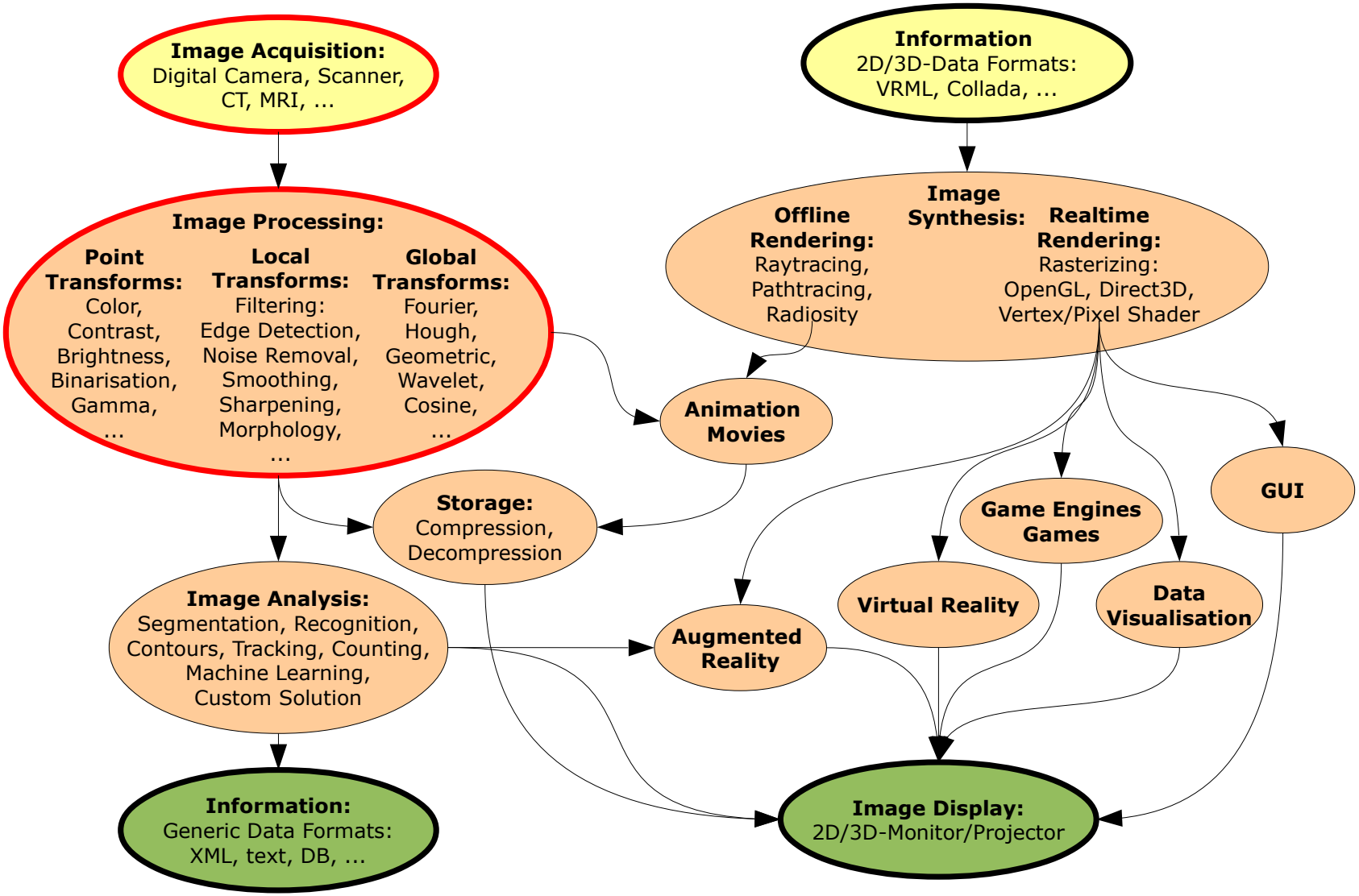
About the Lecturer: Marcus Hudritsch

- Since September 2012:
  - 65% Lectures at BFH in Image Processing & Computer Graphics
  - 35% Applied Research & Development
- 2002-2012 40% Lecturer at FHNW
- 2005-2010 20-80% at CDLab, Murten
- 1997-2004 DB-Developer, Basel
- 1997 Dipl. Ing. Inf. NDS FH
- 1992 Dipl. Arch. ETH
- 1986 Matur in Biel

Computer Vision Process

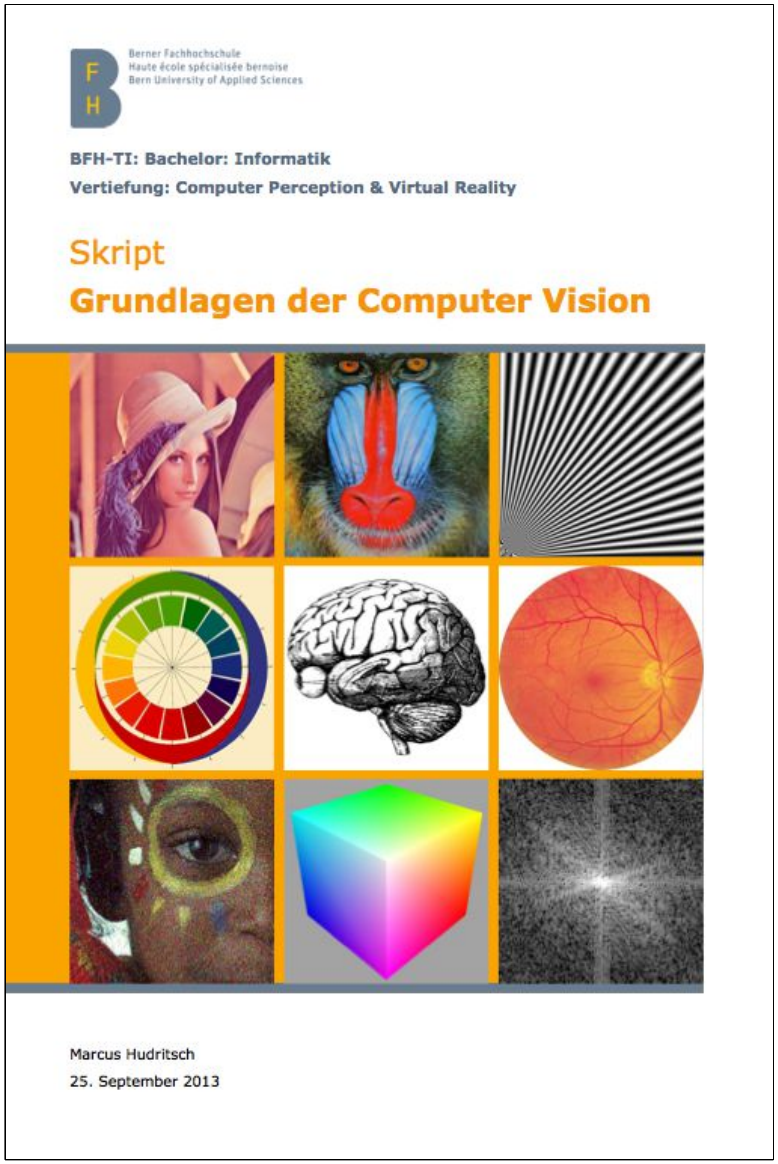
Input \ Output	Image	Description
Image	Image Processing	Image Analysis
Description	Image Synthesis (Computer Graphics)	All other IT

Computer Vision Process



Script

- The script is so far in German
- The slides are in English
- Script & slides are distributed over a shared DropBox folder.
- They are automatically updated
- Do **NOT** work on files in the DropBox folder.
- Copy files first to another folder on your system.
- Please help me and tell me if you see errors.
- The script is in constant renovation
- If you print it, print it chapterwise. Not all at once.



Module CPVR1 FS15: 12:45-16:10, Room N.311

Fr. 20. Feb.: Ch.1: Intro, Ch.2: Basics (Light, Eye)
Fr. 27. Feb.: Ch.2: Basics (Color Models, Tools, ImageJ)
Fr. 6. Mar.: Ch.3: Acquisition, Exercise Billard Tracker

Fr. 24. Apr.: Ch.4,5: Image Stats, Point Op., Exercise
Fr. 1. May.: Ch.6.1: Local Op. (Folding, High- & Low pass)
Fr. 8. May.: Ch.6.2: Local Op. (Morphological & Rank filter)

Fr. 22. May : Ch.7.1: Global Op. (Fourier 1D)
Fr. 29. May : Ch.7.2: Global Op. (Fourier 2D)
Fr. 5. Jun : Ch.7.3: Projekt2 Präsentationen
Übungsbesprechung FT2
Global Op. (Wavelets)

Fr. 12. Jun.: Final Day Biel (no lecture)

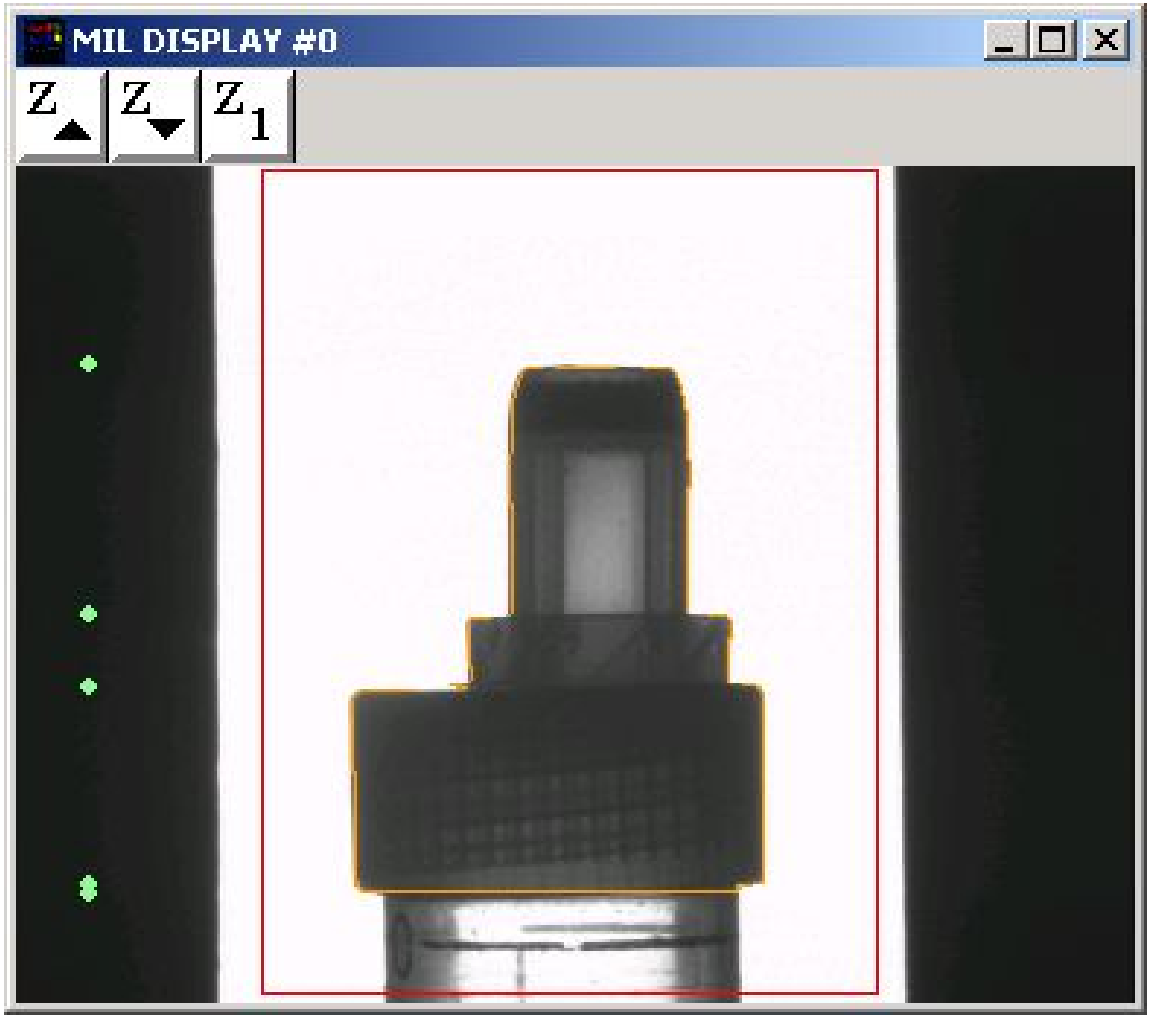
Oral examination after the semester with random questions from two examitators in 30 min.

Module CPVR1: Workload

	Leistung	Studentenstunden	
h pro Credit:	3		
h für 8 Credits:	240		
h Kontaktstudium (KS):	80		
h Begleitetes Selbtstudium (BSS):	80		
h Selbtsstudium (SS):	40		
h Selbtsstudium Prüfung (SS-P):	40		
KS+BSS+SS pro Semester:	200		
Semesterwochen mit Unterricht:	15		
h pro Freitag:	13.33		
h pro Halbtag:	**6.67**		
h KS pro Halbtag:	**2.67**	**2-3 Lektionen à 45'**	
h BSS pro Halbtag:	**2.67**	**2-3 Lektionen à 45'**	
h SS pro Halbtag:	**1.33**	**1-2 Lektionen à 45'**	

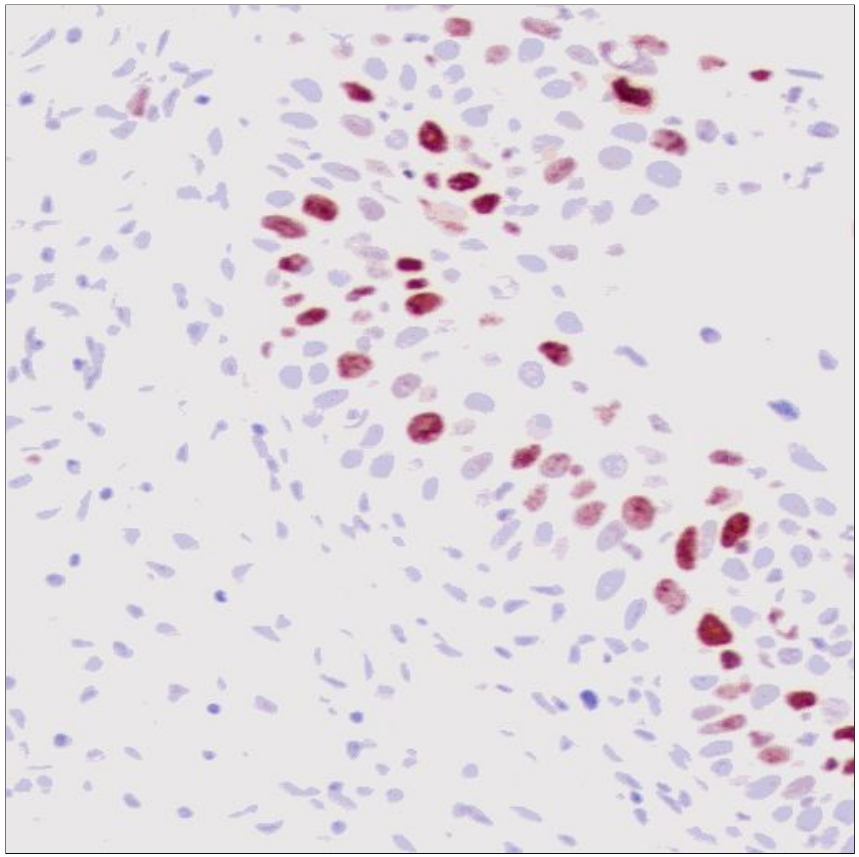
Fields of Digital Imaging: Machine Vision

- Production Automation
- Quality Control

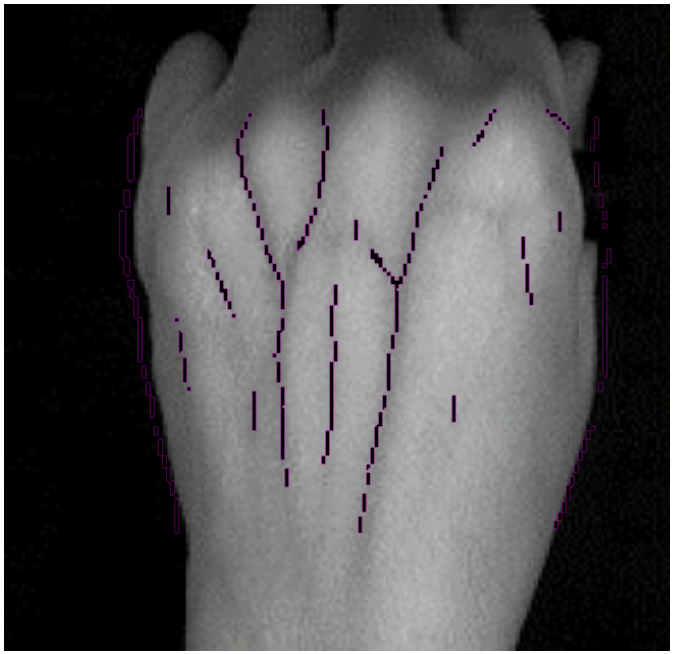


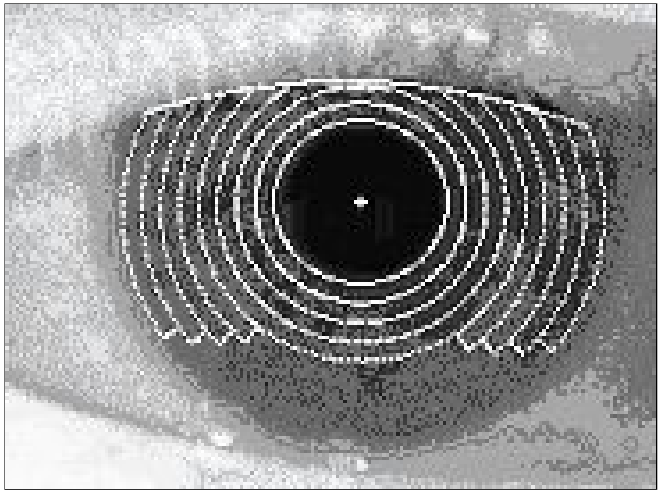
Fields of Digital Imaging: Scientific Analysis

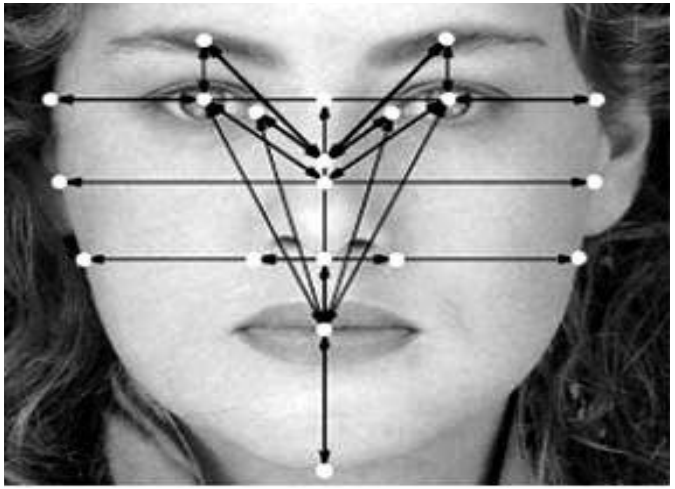
Fields of Digital Imaging: Scientific Analysis



Fields of Digital Imaging: Identification







Fields of Digital Imaging: Image Restauration

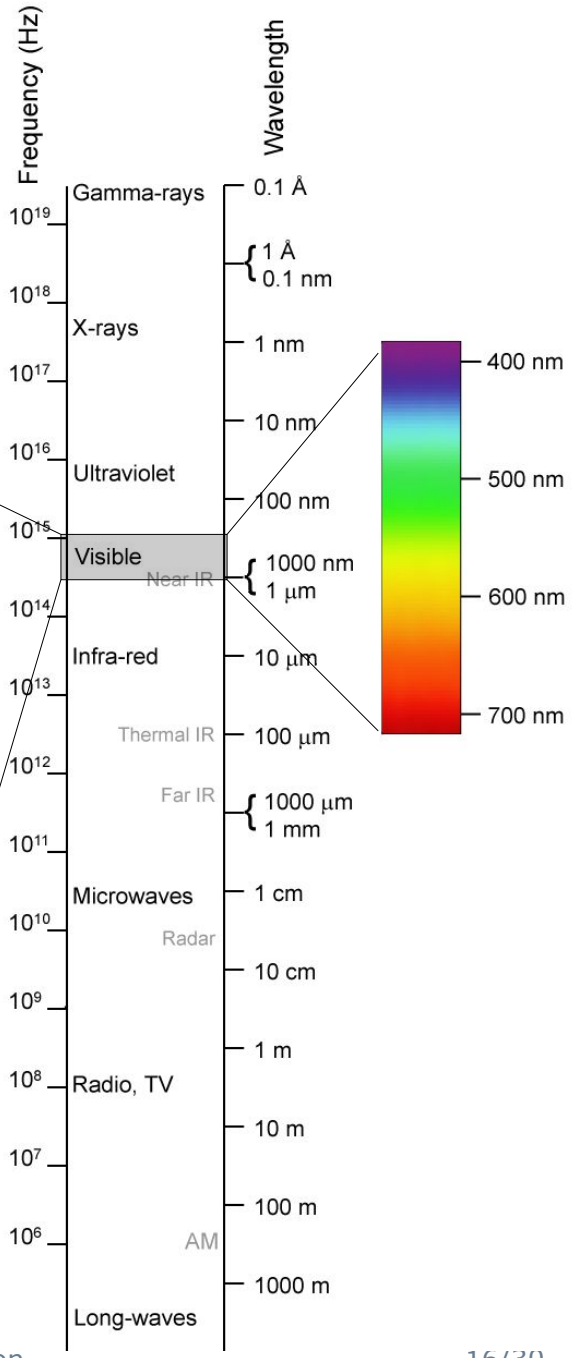
Fields of Digital Imaging: Traffic Surveilance

Fields of Digital Imaging: Tracking Billiard

Fields of Digital Imaging: Tracking Billiard

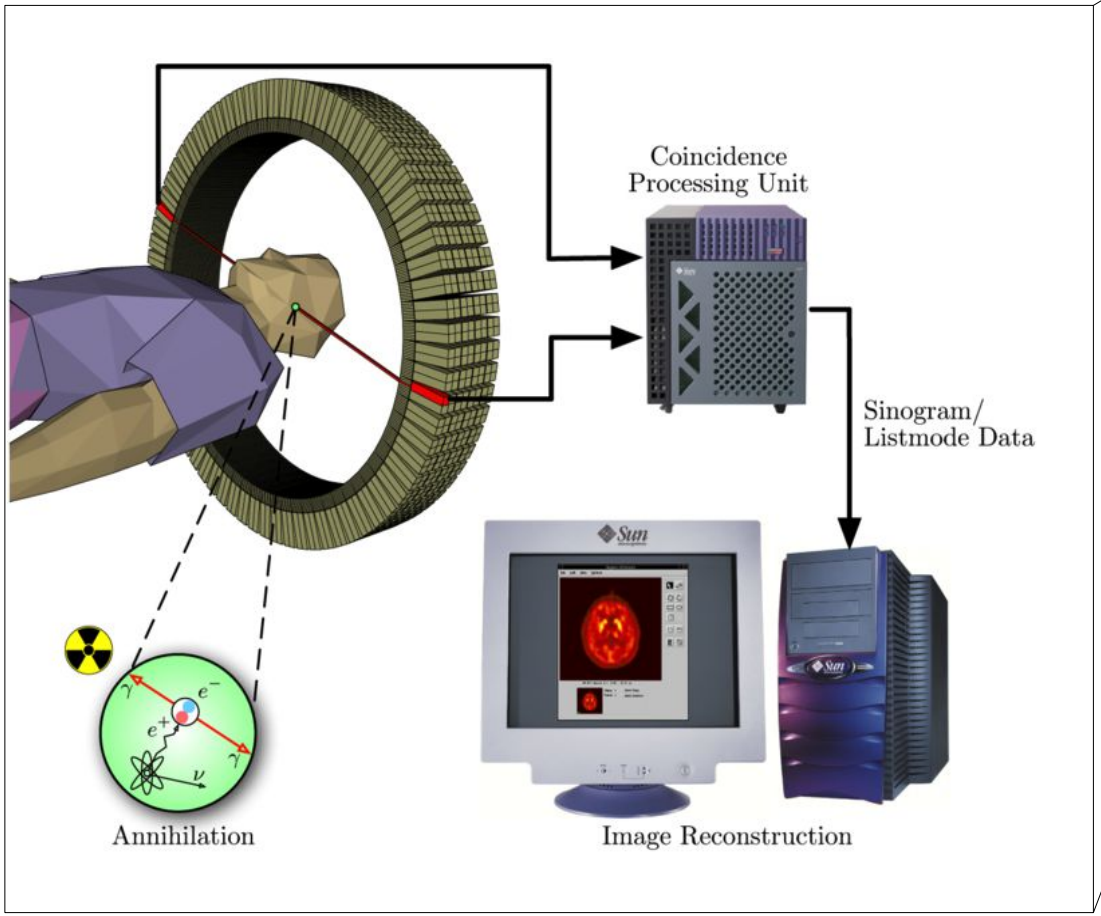
Fields of Digital Imaging

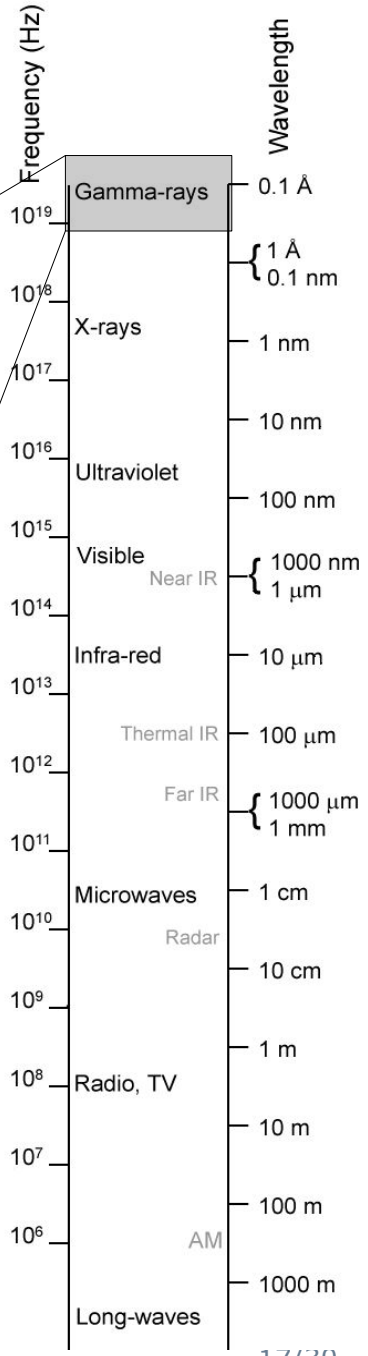
- Most digital images are based in the **visible part** of the **electromagnetic spectrum.**
- The human eye can only see that small range between 400nm and 700nm



Fields of Digital Imaging

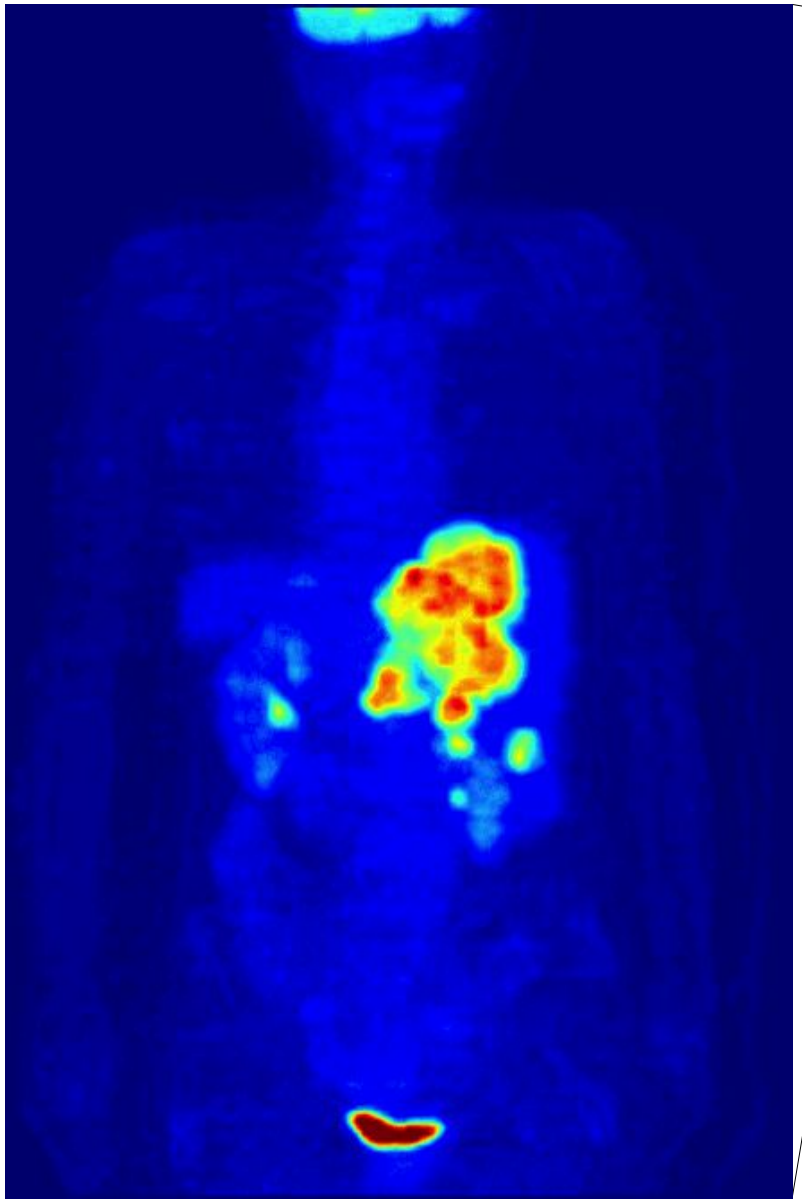
- Sensors exist for almost all ranges in the electromagnetic spectrum.
- Gamma rays are used in **Positron Emission Tomography** (**PET**)

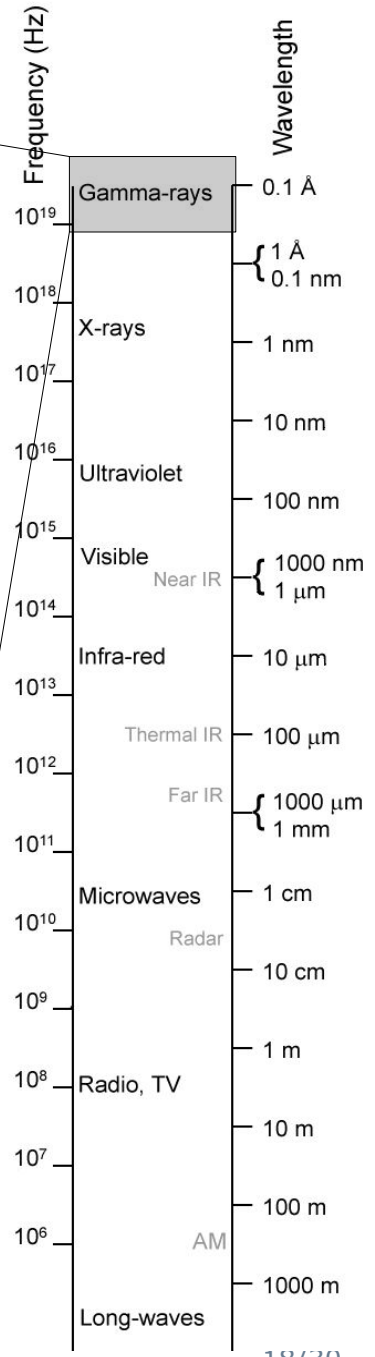




Fields of Digital Imaging

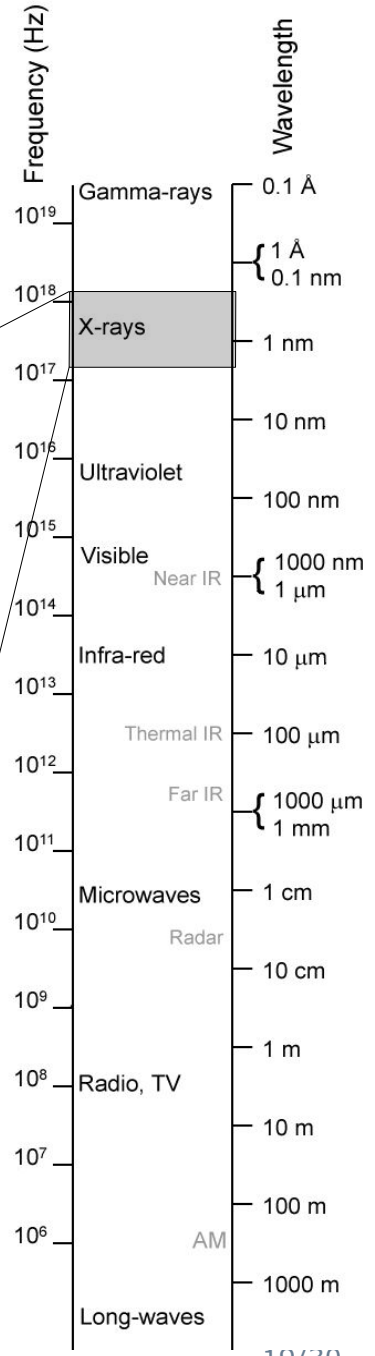
- PET-Images show regions bright where high glucose consumption is going on.
- It is mainly used for cancer detection





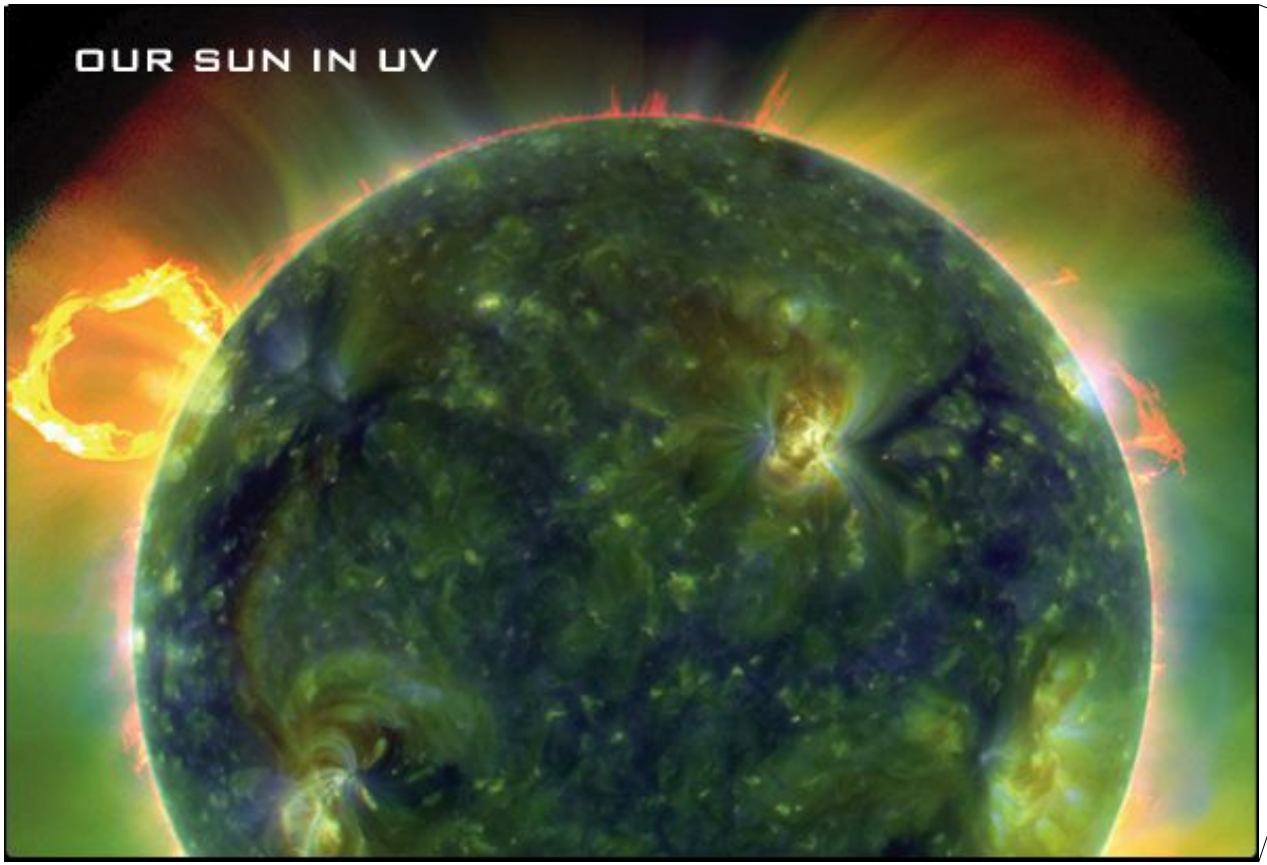
Fields of Digital Imaging

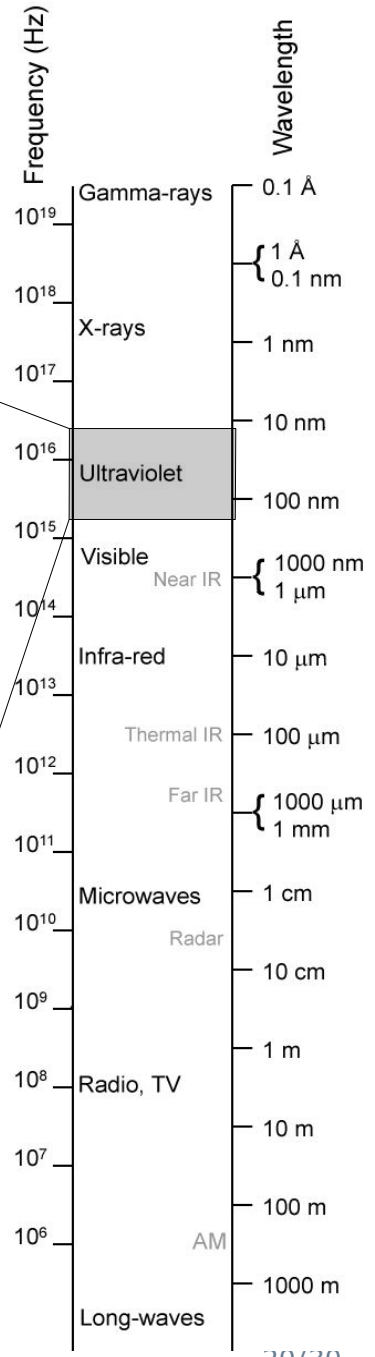
- **X-Rays** are used in Computer Tomography and X-Ray imaging.
- X-Ray images show regions brighter the less x-rays can penetrate the cells



Fields of Digital Imaging

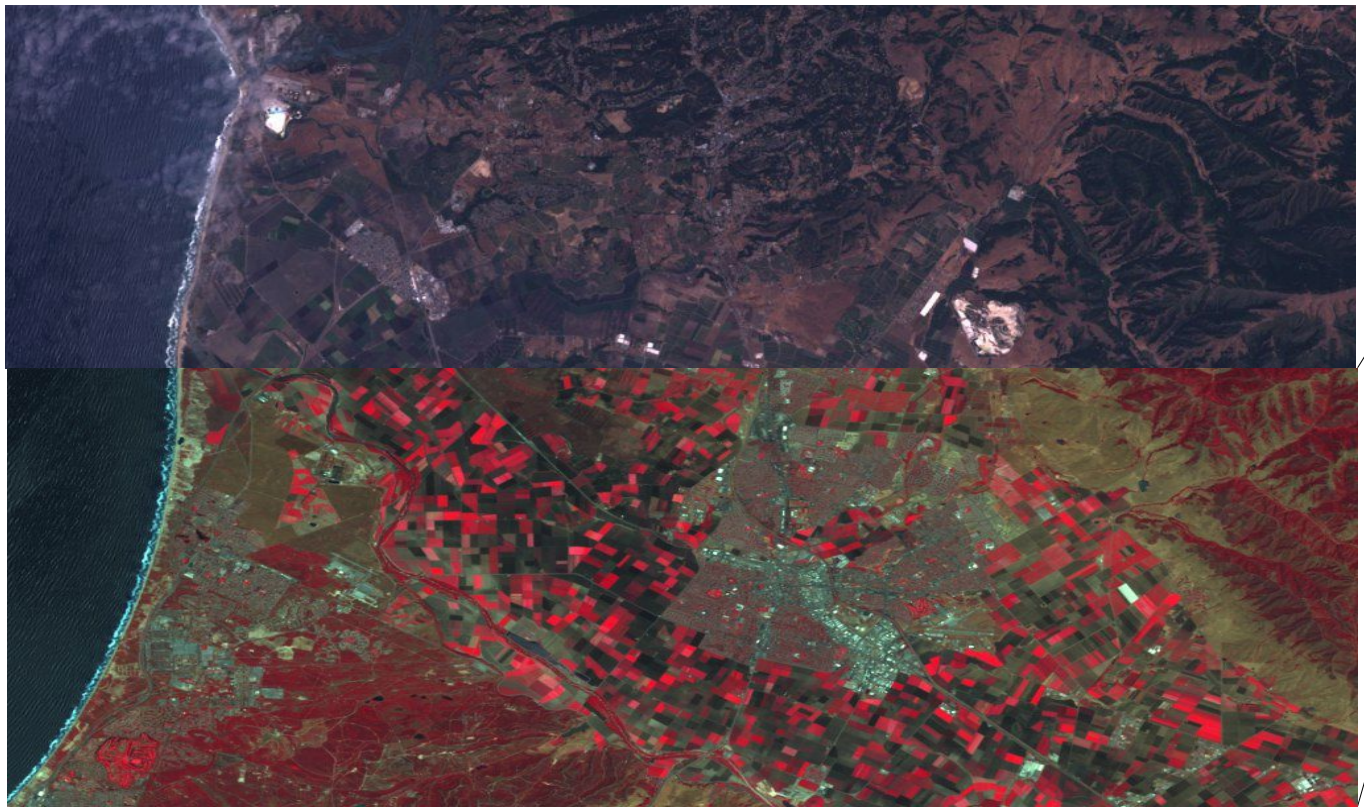
- **Ultraviolet-Light** images can be used in many scientific observations such as in biology, astronomy and technical maintenance.

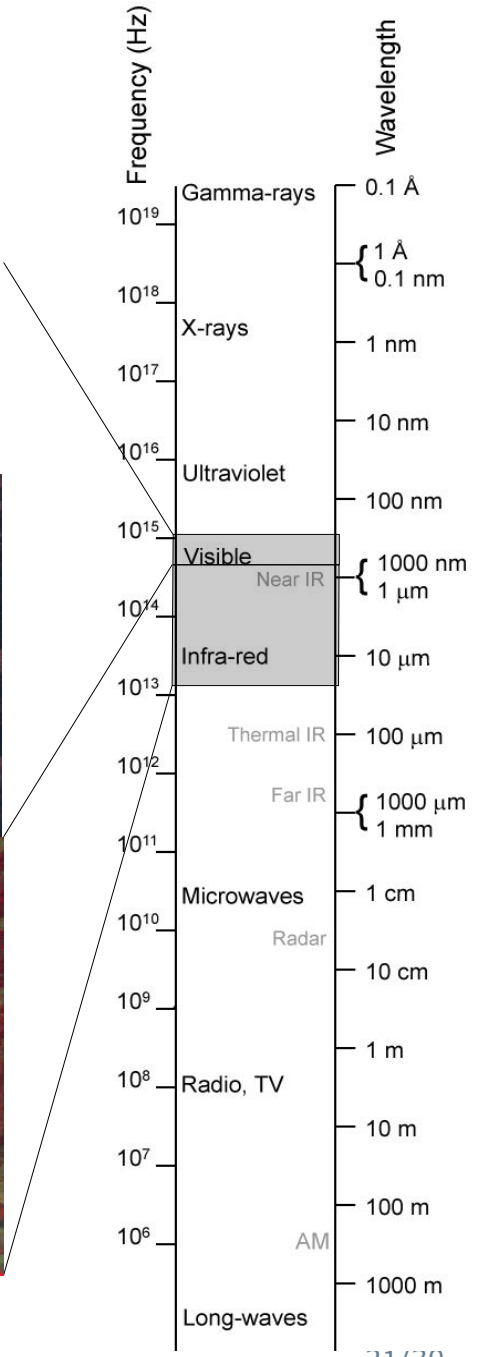




Fields of Digital Imaging

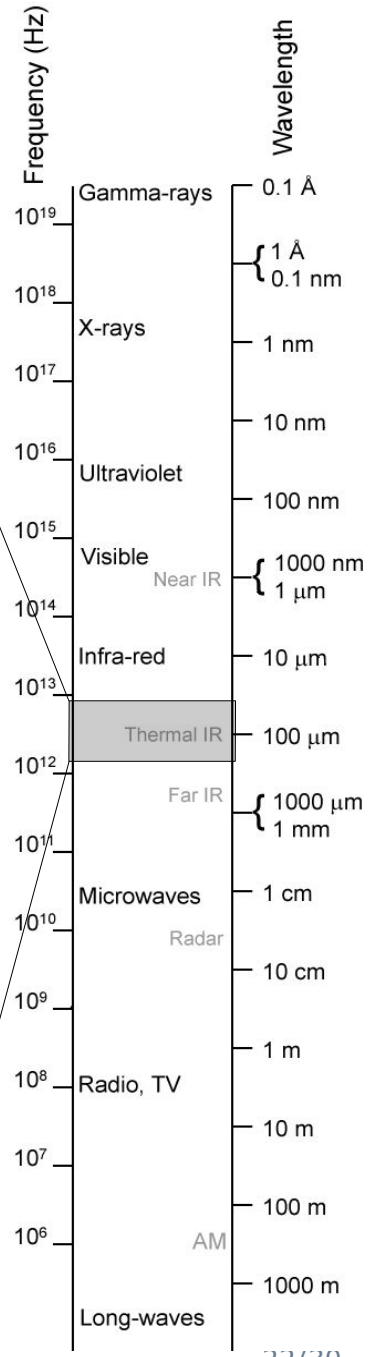
- **Near infrared & infrared** images are used in many scientific visualizations.





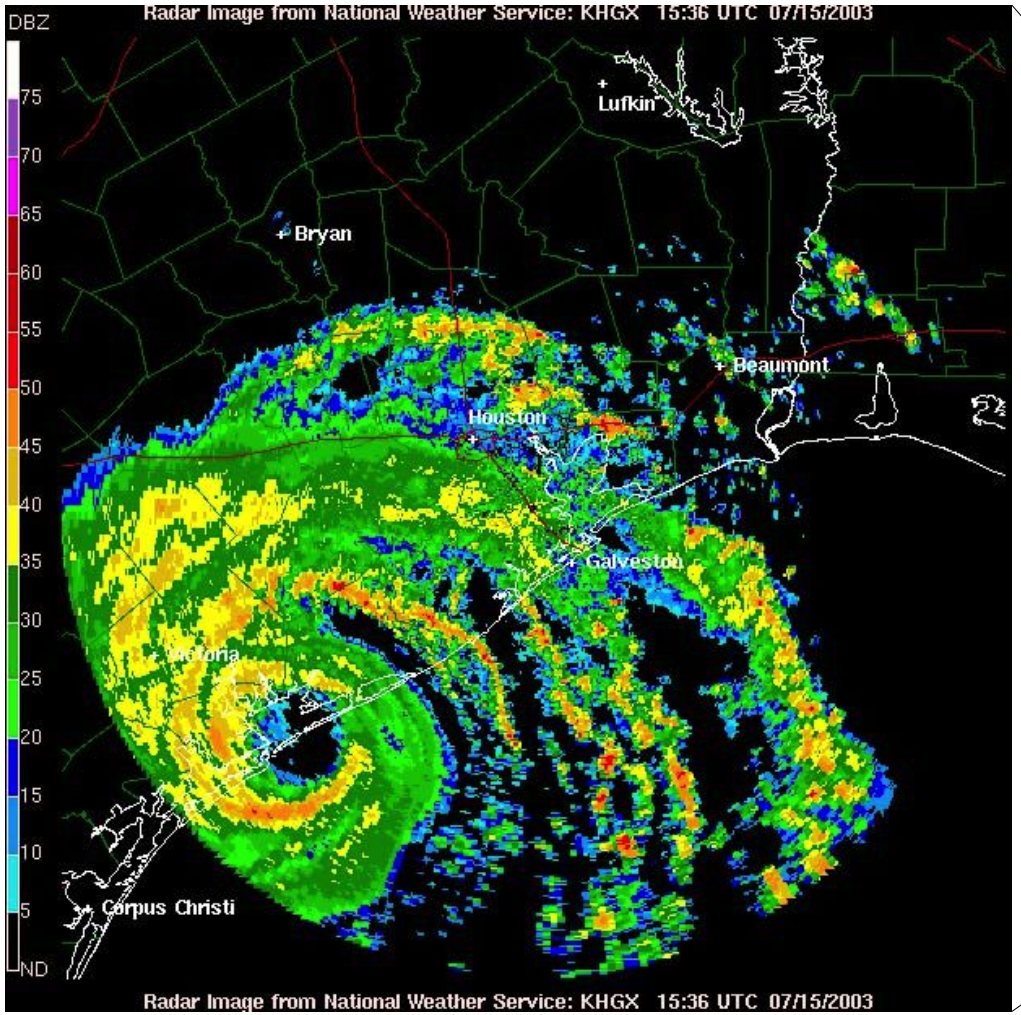
Fields of Digital Imaging

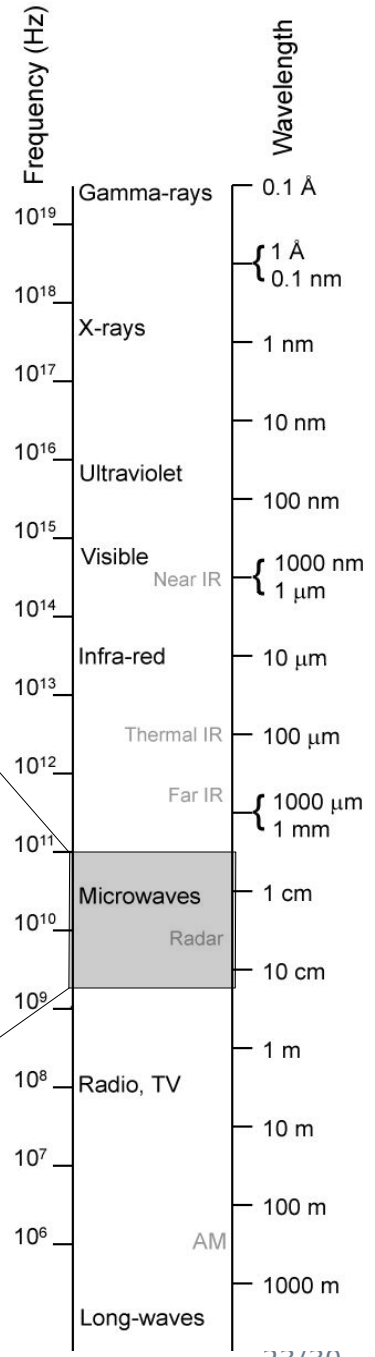
- **Thermal infrared** imaging can be used to visualize heat



Fields of Digital Imaging

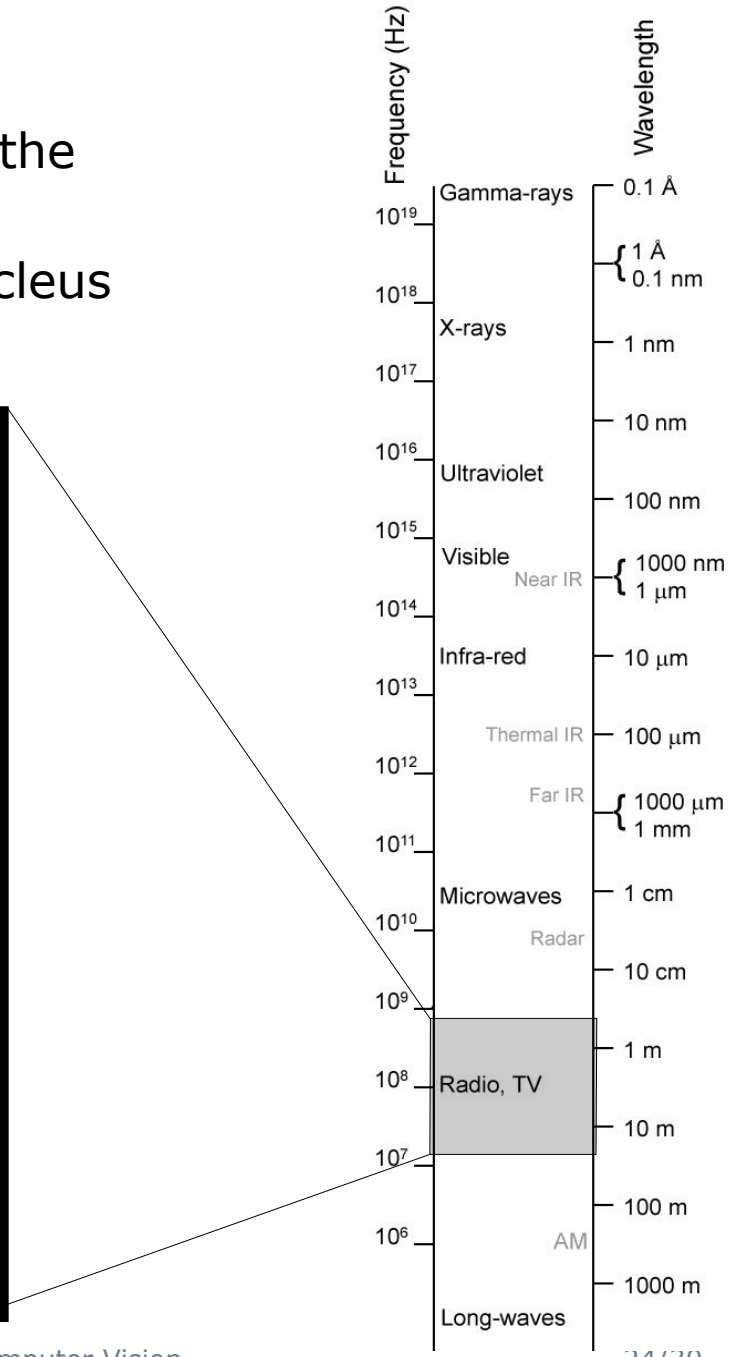
- **Radar images** in the **microwave** band are mainly used for meteorological imaging:





Fields of Digital Imaging

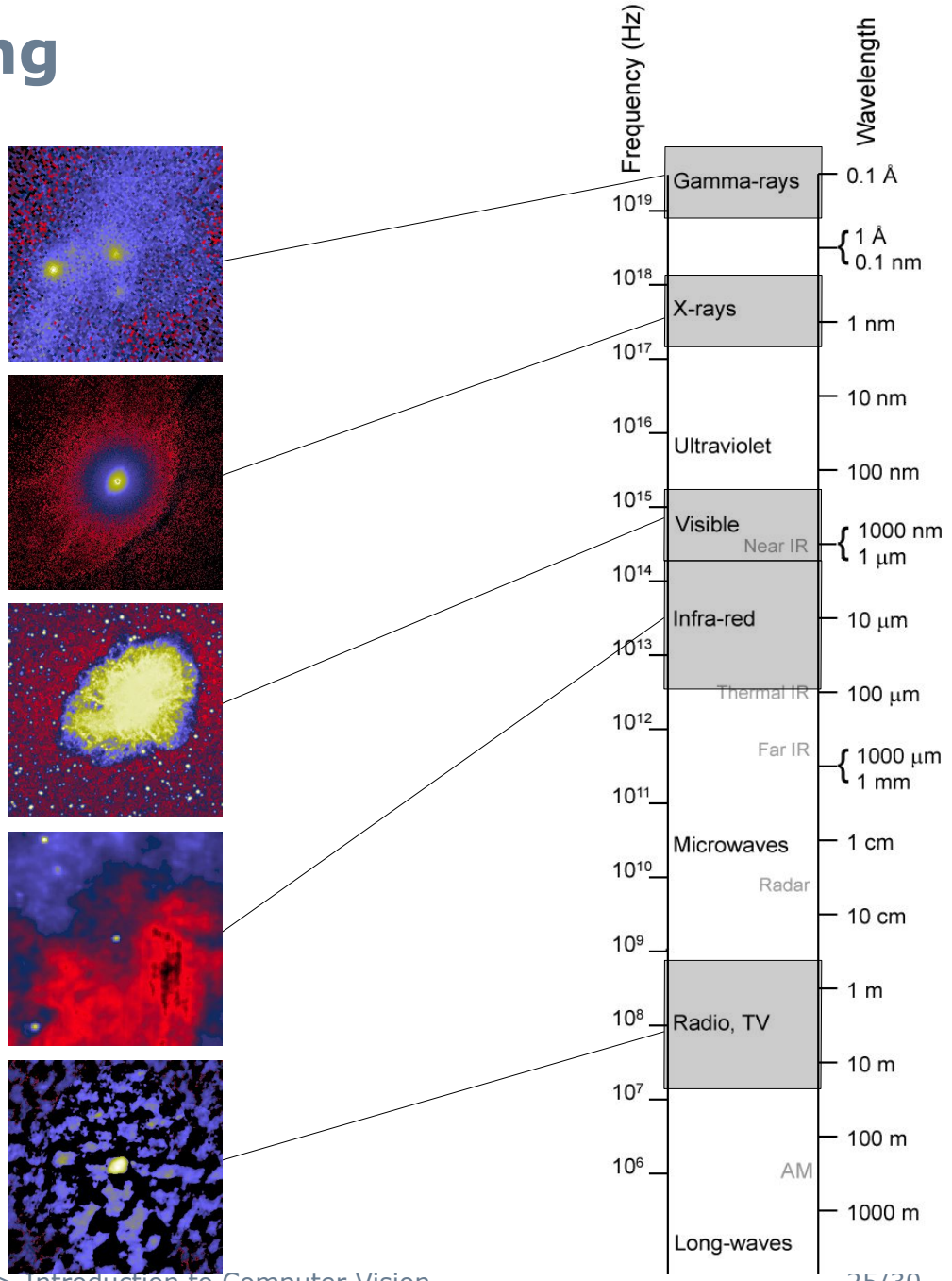
- **MRI (Magnetic Resonance Imaging)** in the radio band are often used in diagnostics.
- MRI measure the radio frequency of the nucleus spin of H_2O molecules:



Fields of Digital Imaging

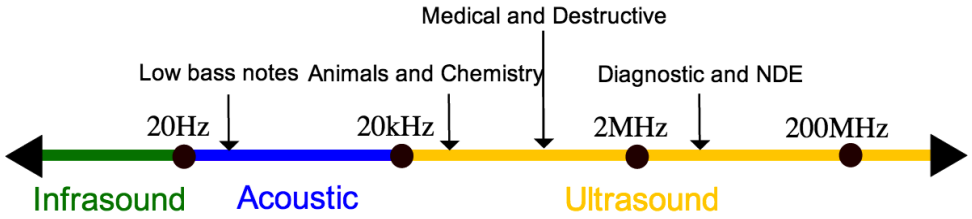
- Telescopes for astronomical imaging often take often images in all band:

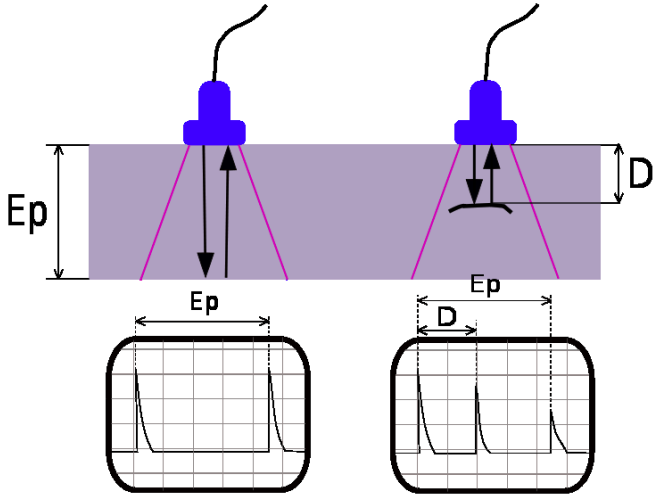
  Images: Crab Pulsar, NASA



Fields of Digital Imaging: Sonographic Imaging

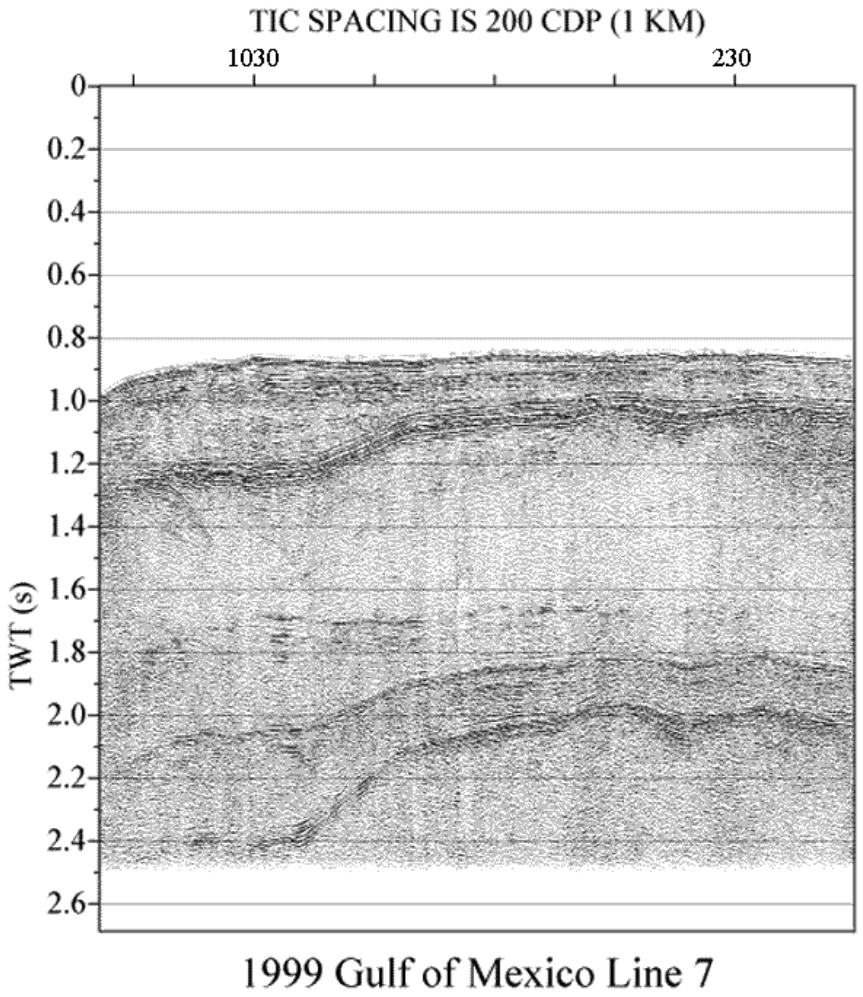
- **Ultrasound images** are created with sound waves at 2MHz.
- Image data is based on the measurement of the reflected sound signal.





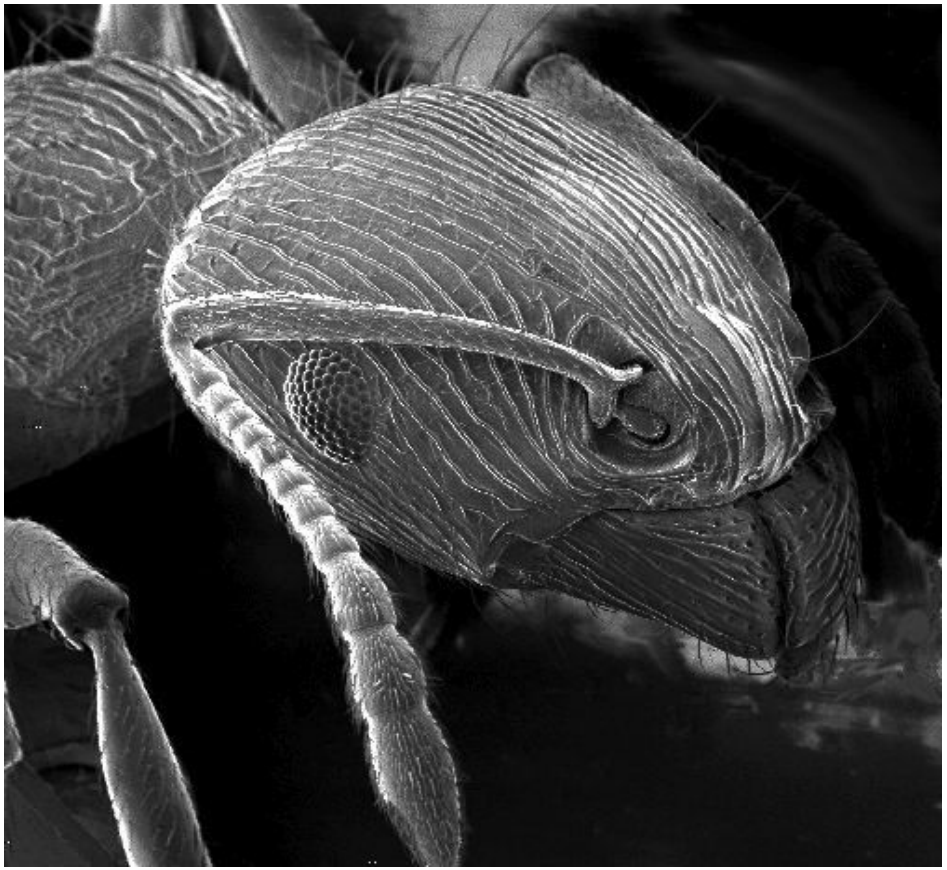
Fields of Digital Imaging: Sonographic Imaging

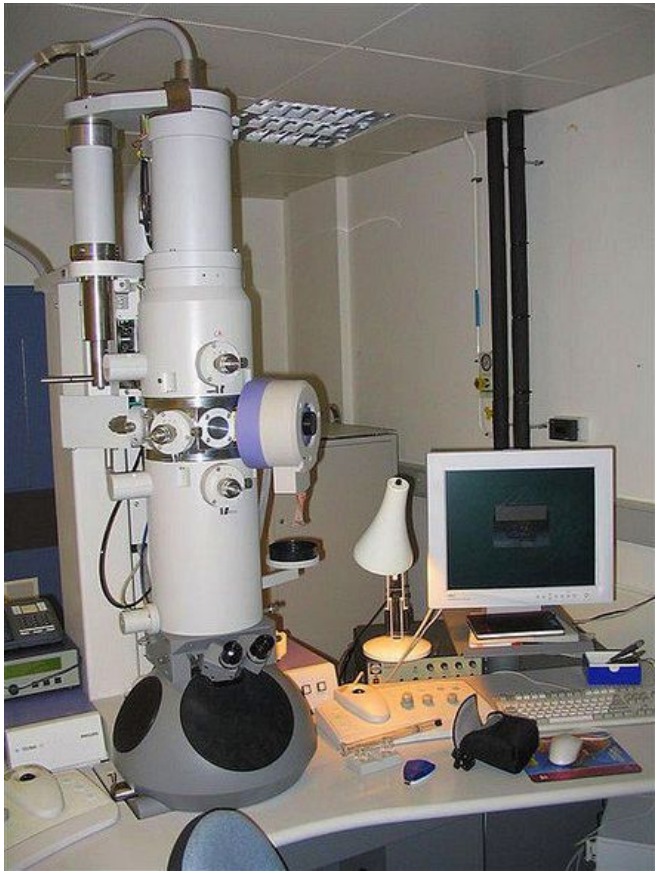
- **Reflection seismology** can be used to create crosssection images from the underground.
- The images are base on the reflection of shock waves.



Fields of Digital Imaging: Electron Microscope

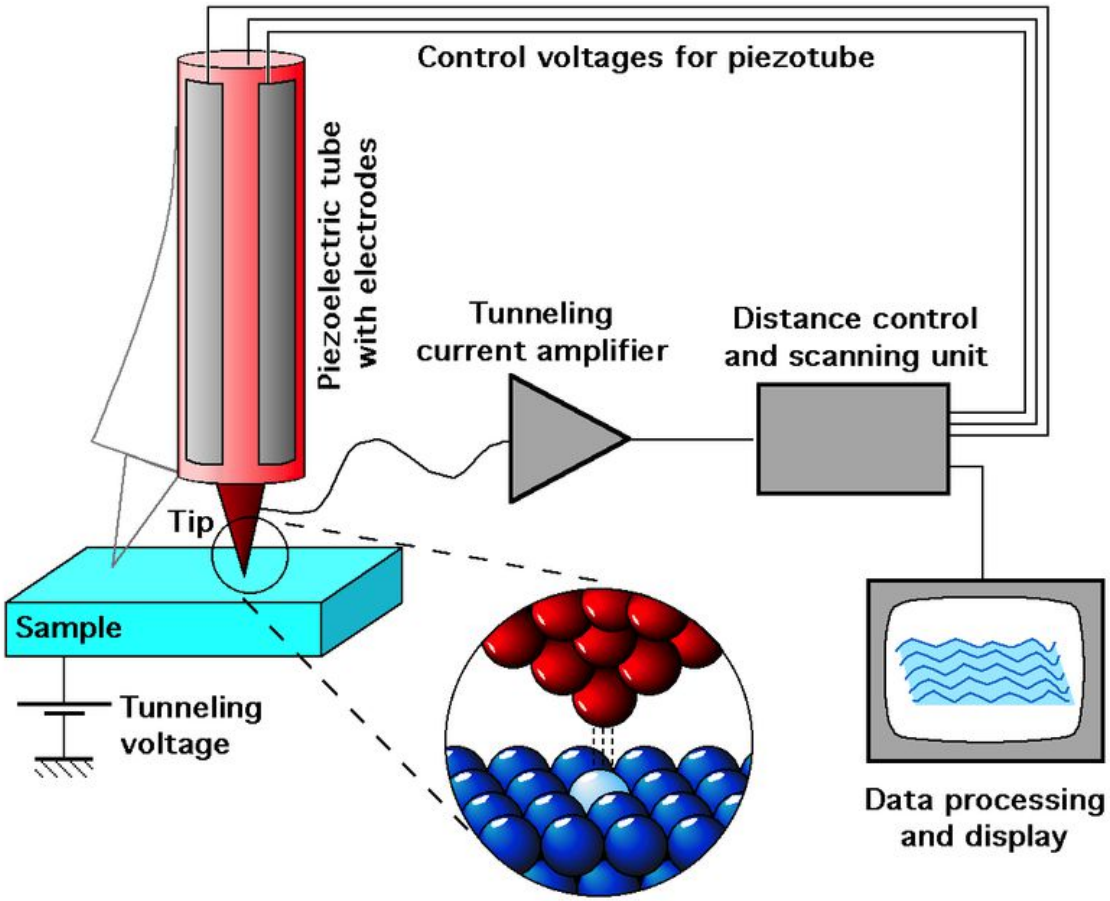
- An **electron microscope** (**EM**) uses an **electron beam** intead of light to illuminate an object and produce a magnified image.
- Electrons have wavelengths about 100'000 times shorter than visible light photons.

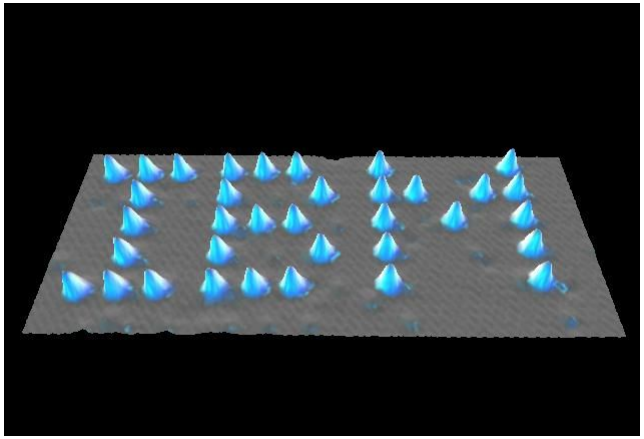




Fields of Digital Imaging: Scanning Tunnel Microscopy

- A **scanning tunneling microscope** (**STM**) is an instrument for imaging surfaces at the atomic level.
- Its development in 1981 earned its inventors, Gerd Binnig and Heinrich Rohrer at IBM Zürich, the Nobel Prize in Physics in 1986





Fields of Digital Imaging: Optical Coherence Tomography

- **Optical coherence tomography (OCT)** is an interferometric image acquisition technique using near-infrared light.
- The signal is based on the reflected light of the subsurface structures.
- The penetration depth is 1-3mm
- The accoustic pendant is the sonography.