3D

Sérgio Pedro
Thien Tran Tao

Why 3D ?

- Representation of the real world
- Better perception

Definition of 3D

- What is « 3D » ?
  - Mathematics
    - Geometric model
    - 3D = length, width, and depth or height
  - Stereoscopy

Stereoscopy

- What is stereoscopy ?
  - any technique capable of recording three-dimensional visual information or creating the illusion of depth in an image
- How ?
  - With a pair of 2-D images

Stereoscopy

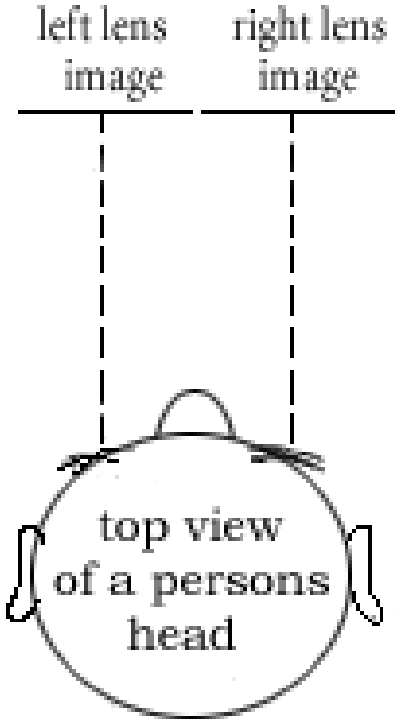
- Stereogram
- Anaglyph image
- 3D computer graphics

Stereogram

- 1838 : Charles Wheatstone

Stereogram

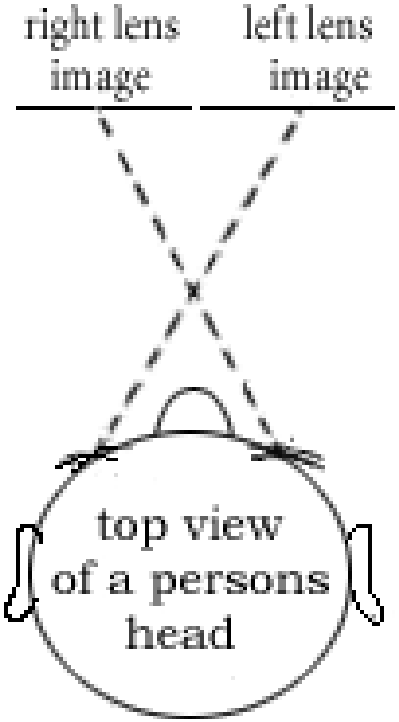
- Parallel viewing



parallel viewing of a stereo pair

Stereogram

- Cross-eyed viewing



x-eyed viewing of a stereo pair

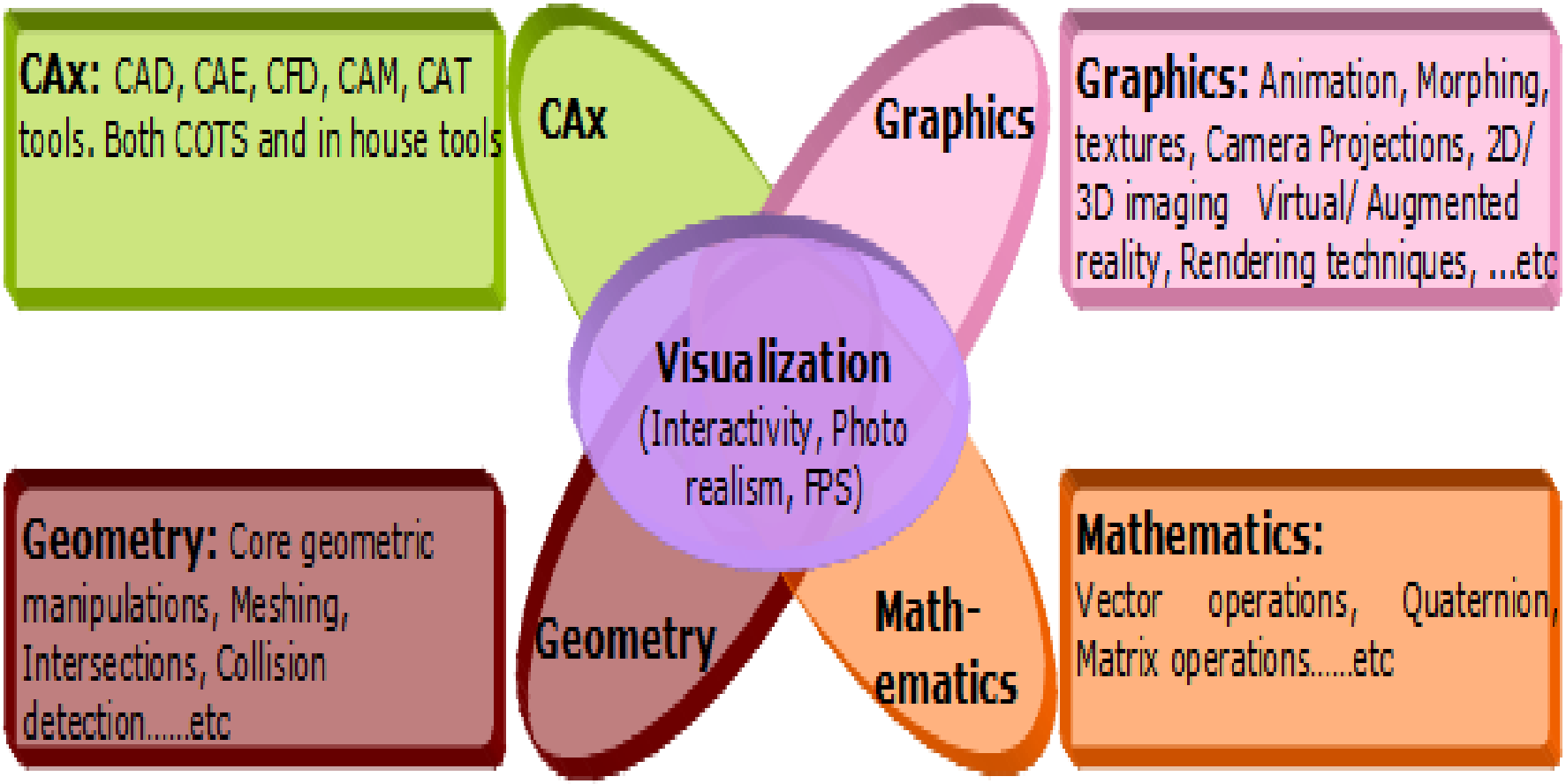
Stereogram

- Wiggle stereoscopy

Anaglyph images

- 1853 : Wilhem Rollmann

Computer Graphics



History

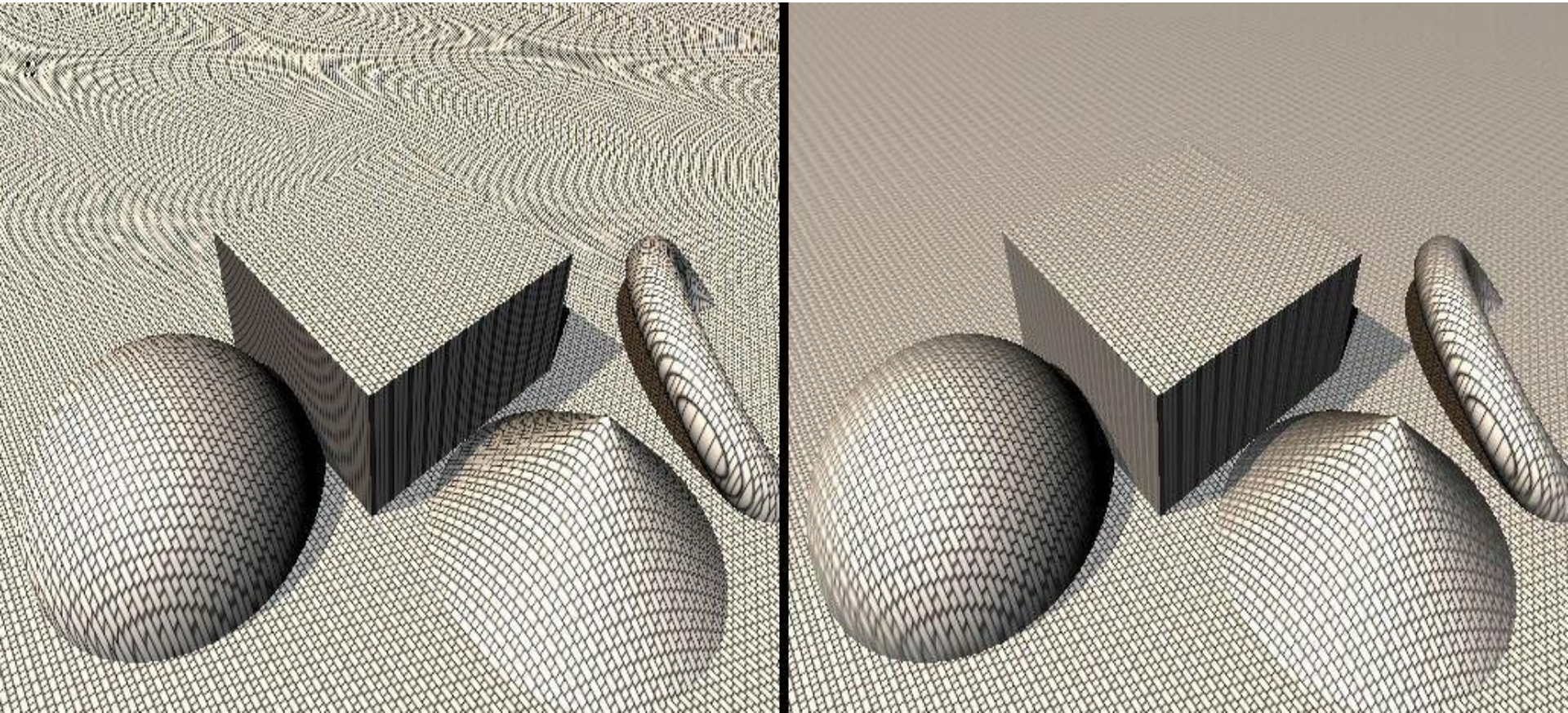
- 1961: Sketchpad
- Early 1970's: Shading and hidden Algorithms
- Late 1970's: NURBS geometric entities
- 1980: *Ray Tracing*.

Techniques

- 2D GUIs and 2D Graphics

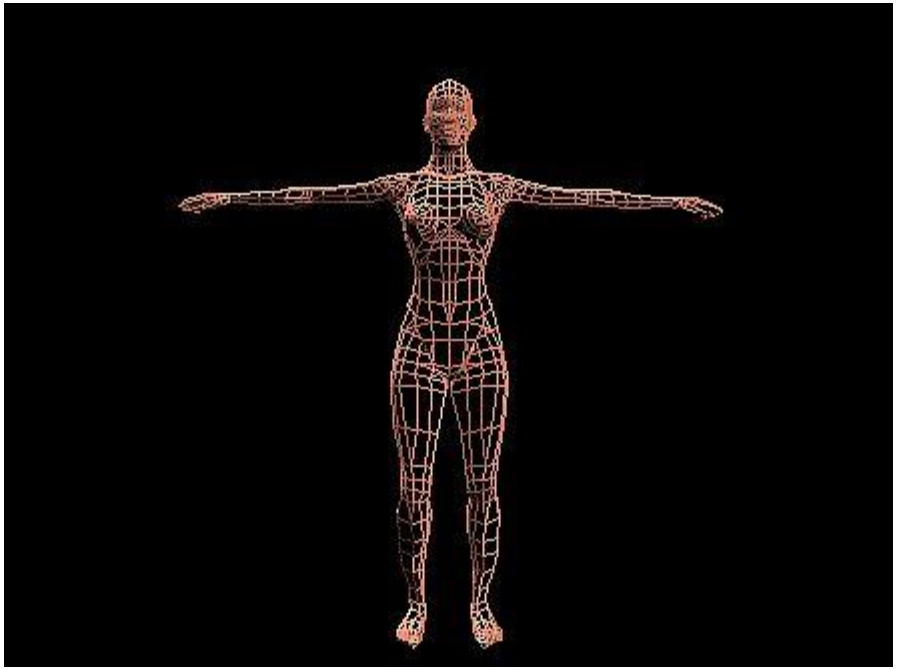
Techniques

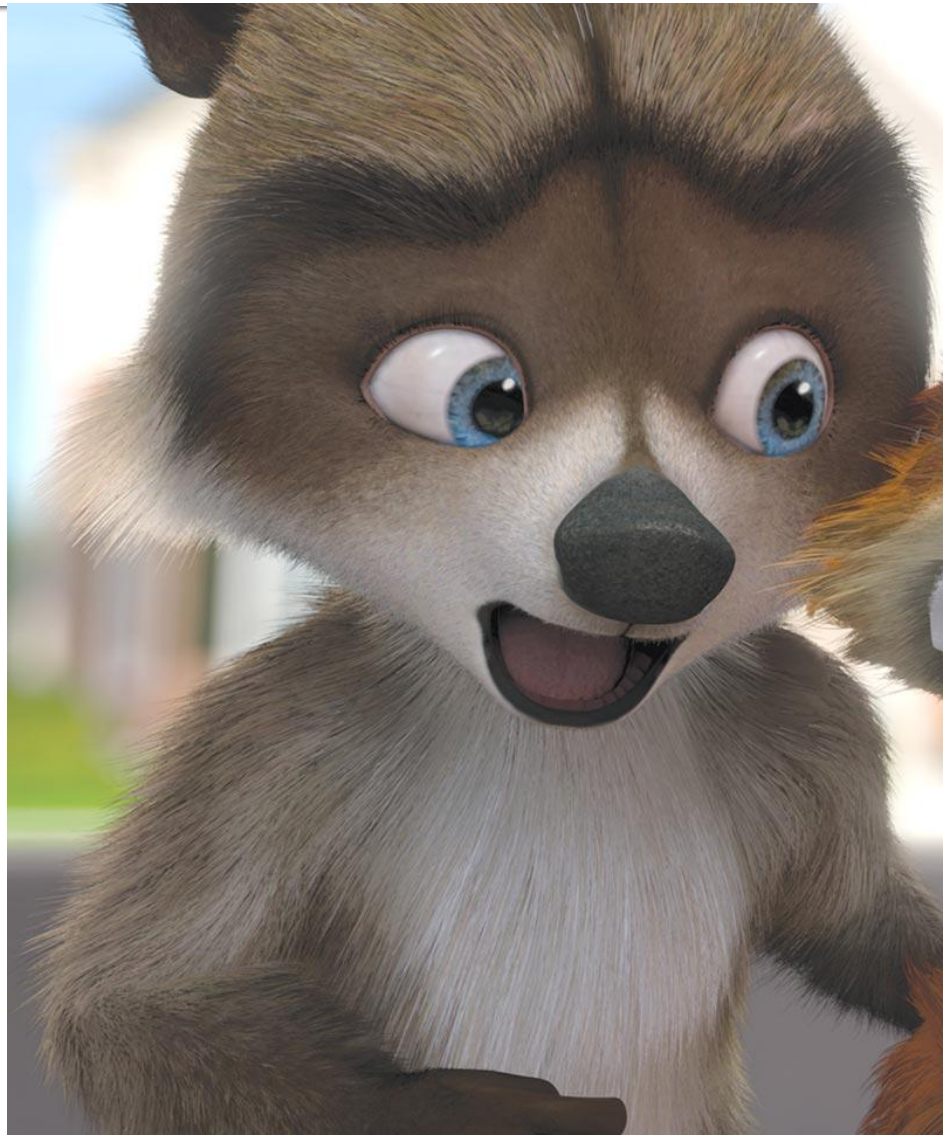
- Mipmapping



Techniques

- Animation



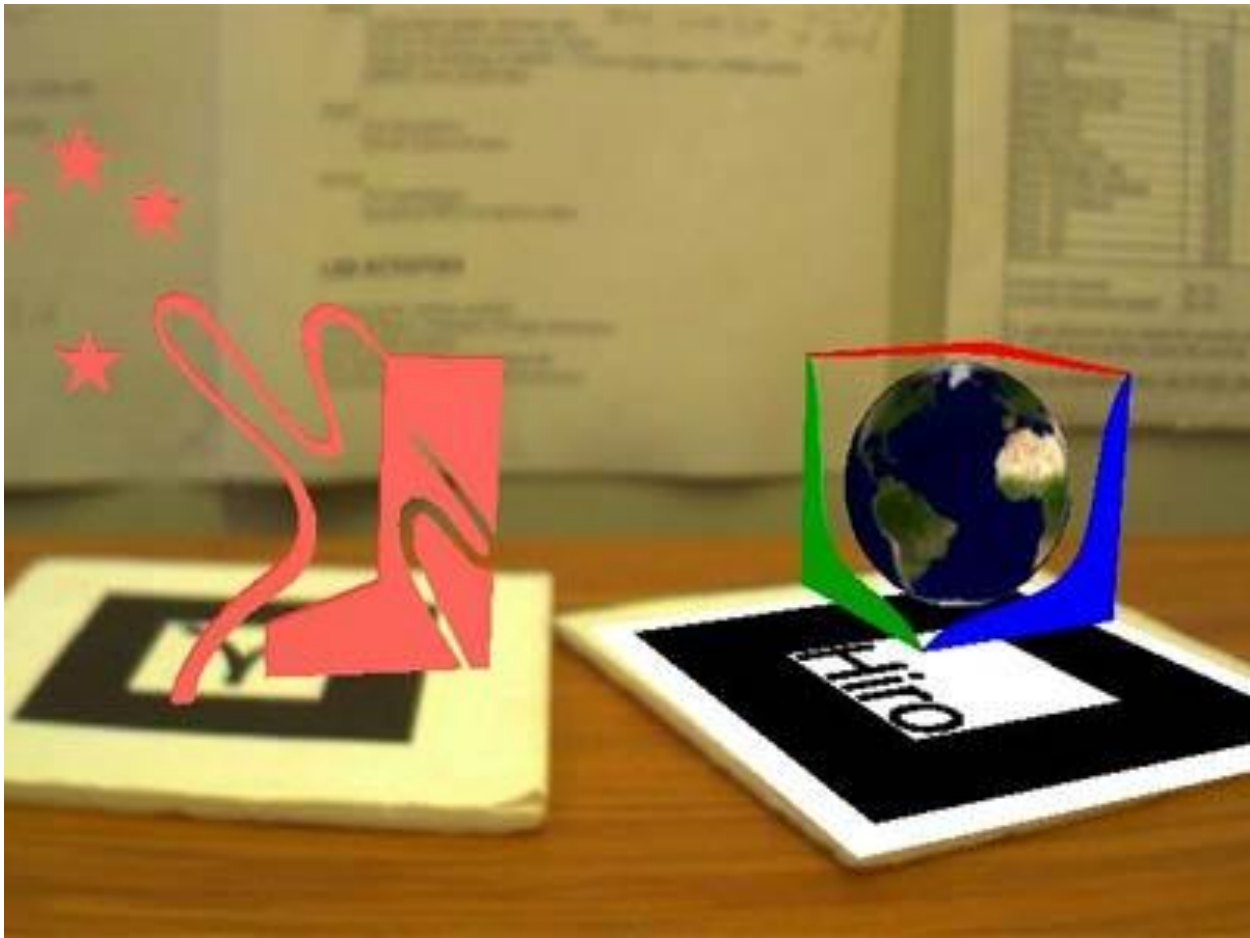


Techniques

- Virtual Reality

Techniques

- Augmented Reality



Holography

- 1947 : Dennis Gabor
- Principe : recording the light scattered from an object
- How to do it : http://fr.youtube.com/watch?v=XtvAhL1lzOI
- Example : *"Help me, Obi-Wan Kenobi; you're my only hope"*

Applications

FOR FUN

- Cinema
- TV
- Games

MORE SERIOUSLY

- Research
  - Medicine
  - Biology
  - Etc.

Cinema

- The Power of Love
  - First 3D Movie
  - In Los Angeles on 1922
- Earliest known film that utilized:
  - Dual strip projection
  - Anaglyph glasses

Golden Era of 3D

- Began in 1952
  - First color stereoscopic feature
  - *Bwana Devil*
  - Was projected dual-strip, with Polaroid filters

And continues ..

- With Walt Disney Studions in 1953
  - *Melody*
- With Universal-International in 1953
  - *It Came from Outer Space*
- With 20th Century Fox
  - *Inferno*

Decline of Golden Era

- Why ?
  - Two prints had to be projected simultaneously
  - The prints had to remain exactly alike after repair

Otherwise

  - The picture became virtually unwatchable and accounted for headaches and eyestrain

Revival of 3D Cinema

- *The Mask (1961)*
  - Filmed in 2D, but only with anaglyph glasses the people could see some scenes of the movie.
- *Andy Warhol's Frankenstein (1973)*

IMAX 3D

- Image MAXimum
- How works ??
  - Uses two camera lenses
  - Separated by an inter-ocular distance of 64mm/2.5“
- Polarization or LCD Shutter Glasses

Polarization

- The left and right eye images are polarized perpendicular to each other
- With special glasses, each human eye only can see the correspondent side of the image

LCD Shutter Glasses

- With these glasses, at an high frame rate, each human eye only can see the appropriate side of the image.
- On side of the glasses remains opaque, instead the other become transparent.

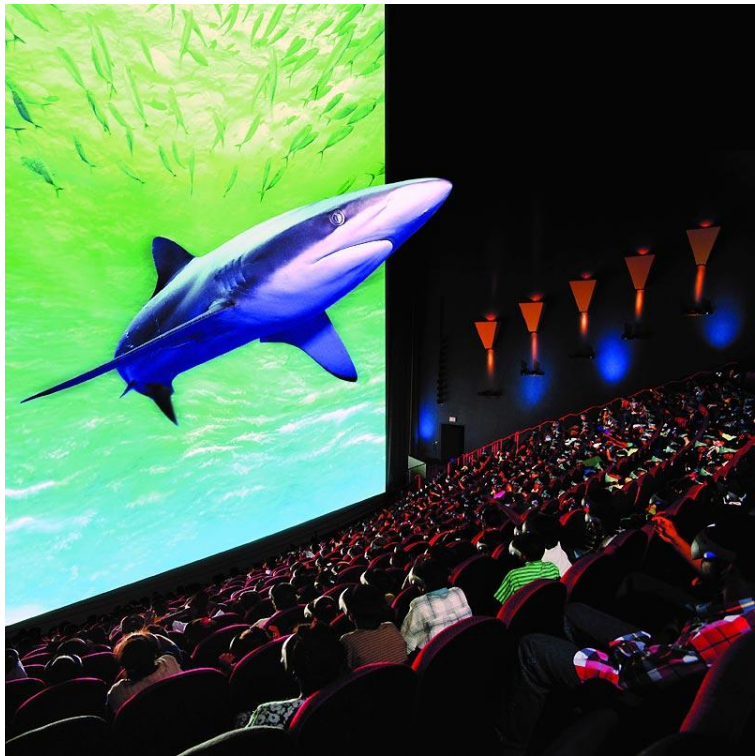
Problems with that

- 3D effect does not extend past the boundaries of the physical screen.

- An inherent difference between our eyes and the film format .

IMAX Digital 3D

- Simulates a 3D view and uses new digital technology
- *Shrek Goes Fourth 3D*, will be the first movie with this technology



RealD

- *Chicken Little (2005)*, First Movie to use this technology.
- Single projector
- Circularly polarize the right and left eye frame
- Liquid-crystal screen

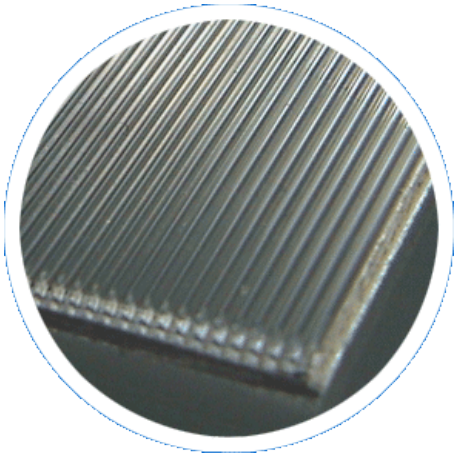
TV

- Already exist and commercialize

- Combination of stereography and alioscopy

TV

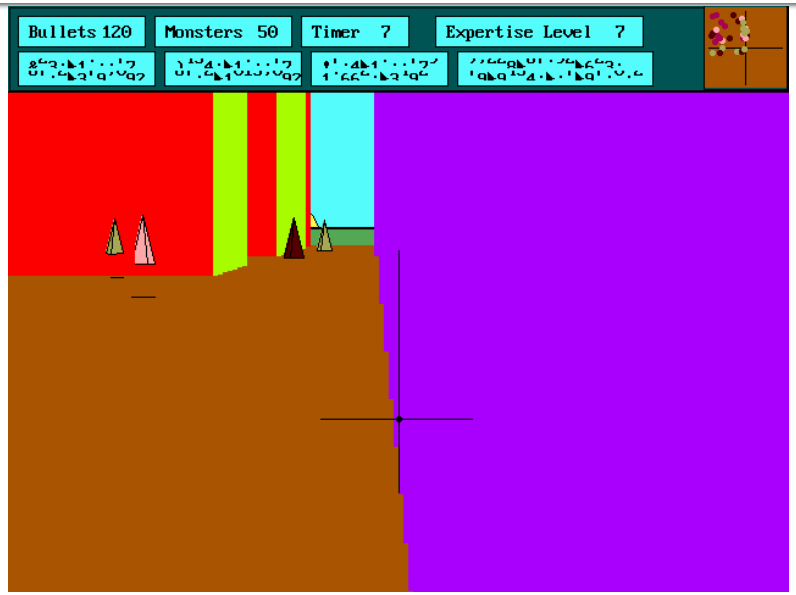
- What is alioscopy ?
  - lenticular lens based technology
  - videos combining 8 different points of view of a scene



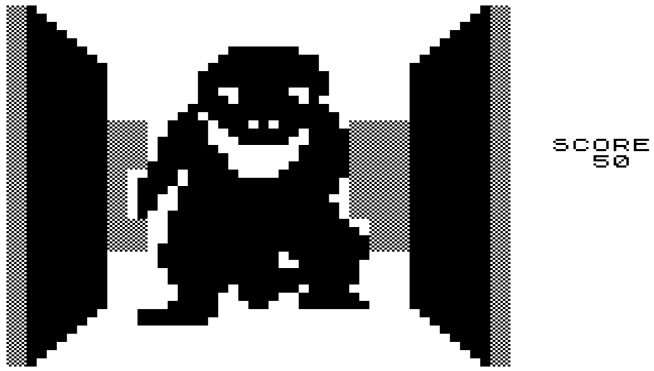
Games

- First 3D Game
  - MazeWar (1974)

    on Imlac PDS-1



- First 3D PC Game
  - 3D Monster Maze (1981)



Revolution of 3D Games

- How?
  - With the first 16-bit computers
- When?
  - In 1992, with Wolferstein 3D

Pushing the limits

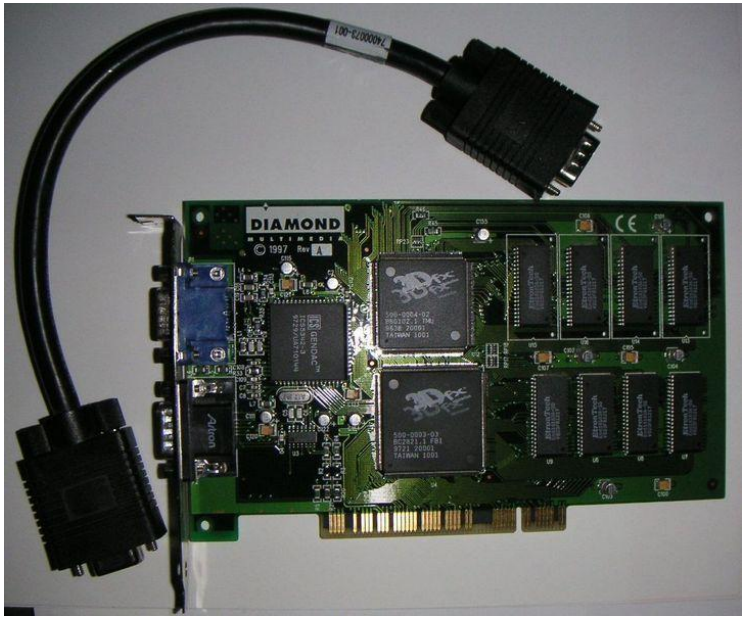
- Doom (1993)
  - Higher resolutions
  - Textures on the floor and on the roof
  - Rooms are no more flat
    - Full of steps and rises

New breakthrough

- In 1996, with Quake
  - Not only the motion and the rooms were in 3D, but every in-game model was fully 3D
  - New features:
    - Mipmapping
    - Dynamic scene lighting

Evolution in hardware and software

- Hardware
  - First 3D Accelerator - Voodoo from 3Dfx (1997)



- Software
  - Open GL: starts to be used

by game developers

And the result …

- Quake II (1997)

Another evolutions in 3D Games

- Microsoft started development of the DirectX
- The concept of a GPU (Graphic Processor Unit) created in 1999 with Nvidia GeForce256

DirectX 10

- Call of Juarez

- Far Cry 2

- Microsoft Flight Simulator X

Medicine

- There are 3 main areas of 3D in Medicine
  - Medical Education
  - Surgical Simulation and Planning
  - Virtual Endoscopy

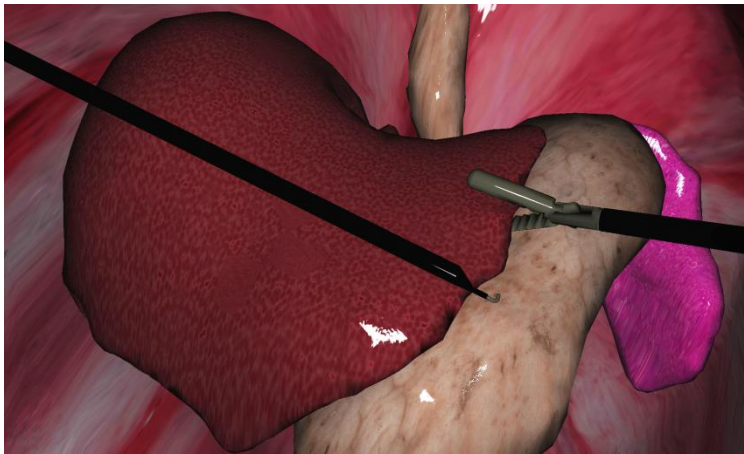
Medical Education

- Teaching of Anatomy
  - Constructing of 3D Body Models
  - With the help of Virtual Reality, we can visualize the organs around or inside them
- Can be used also to experiment

http://www.revver.com/video/271555/medical-medicine-3d-animation-diamedrip/

Surgical Simulation and Planning

- Since early 1990's different teams developed VE environments
- Newest one: Cyberscalpel, by NASA
  - For example, a student/doctor can practice how to reconstruct the upper and lower jaws, in a patient that suffers of cancer of the jaw



Virtual Endoscopy

- The Traditional Endoscopy:
  - Endoscopic procedures are invasive
  - The patients are subject to many complications
  - The cost of a typical endoscopy is expensive
- Virtual Endoscopy:
  - Fuses Computed Tomography with advanced techniques for rendering 3D images similar to those obtained with typical endoscopy
  - Non-invasive
  - Less expensive than typical endoscopy

What about the future of 3D ?

References

Stereoscopy
Wikipedia documents : http://en.wikipedia.org/wiki/Stereoscope
The image processing handbook - John C. Russ

Computer Graphics
Evolution of Computer Graphics - Sathyanarayana K. and Ravi Kumar G. V. V
http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4626981&isnumber=4626968

Holography
Wikipedia documents : http://en.wikipedia.org/wiki/Hologram
Optical Holography - P. Hariharan :
http://books.google.com/books?id=tatDuLRw6hIC&printsec=frontcover&dq=holography&hl=fr#PPR15,M1

Games
Wikipedia document : http://en.wikipedia.org/wiki/History_of_video_games#1990s
3D Engines in games – Introduction - Michal Valient :
http://pisa.ucsd.edu/cse125/2006/Papers/Introduction_to_3d_Game_Engines.pdf

Cinema
Wikipedia documents : http://en.wikipedia.org/wiki/3-D_film http://en.wikipedia.org/wiki/Animation_software

Medicine
Applications of Virtual Environments in Medicine – G.Riva
http://www.cybertherapy.info/MIM_0161_Riva.pdf