University of British Columbia

CPSC 414 Computer Graphics

Displays, Devices II

Week 12, Wed 19 Nov 2003

News

- extra office hours in lab
  - 5:15-6:15 today

- project 3 **draft** out

Display Technologies recap

- CRT: Cathode Ray Tubes
- LCD: Liquid Crystal Displays
- plasma display panels
- DMD/DLP: micromirror array projectors
- display walls: tiled projector array

Display Wall Discussion

- pros
  - commodity technology
  - can be seamless (theoretically)
- cons
  - geometric alignment solvable
  - colorimetric alignment difficult
  - large space footprint

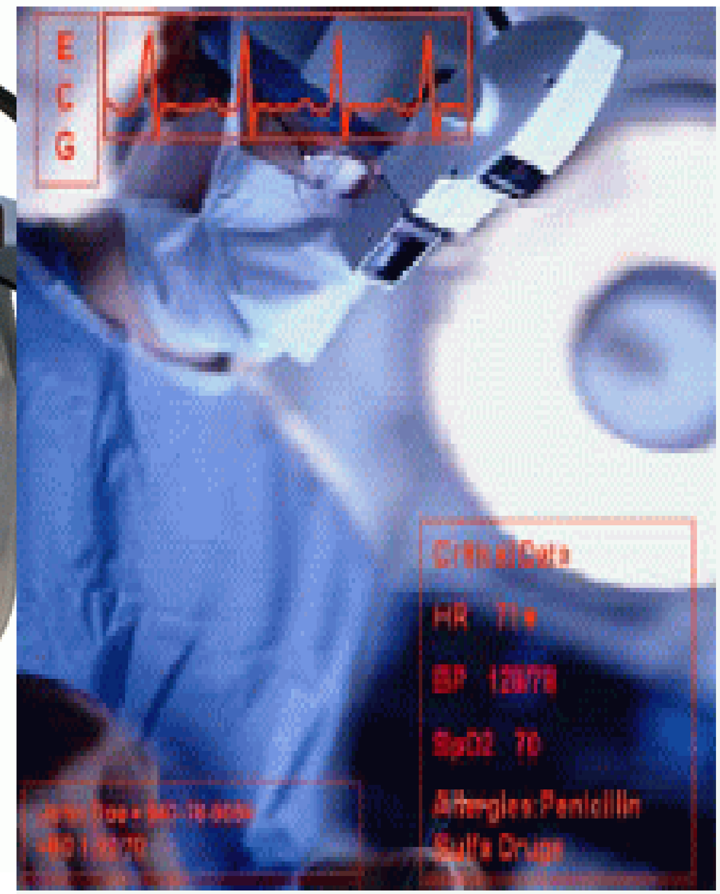
Future: Plentiful Pixels?

- digital wallpaper
  - 300dpi, ubiquitous
  - cheap as paint/wallpaper
- projectors as lightbulbs, flashlights

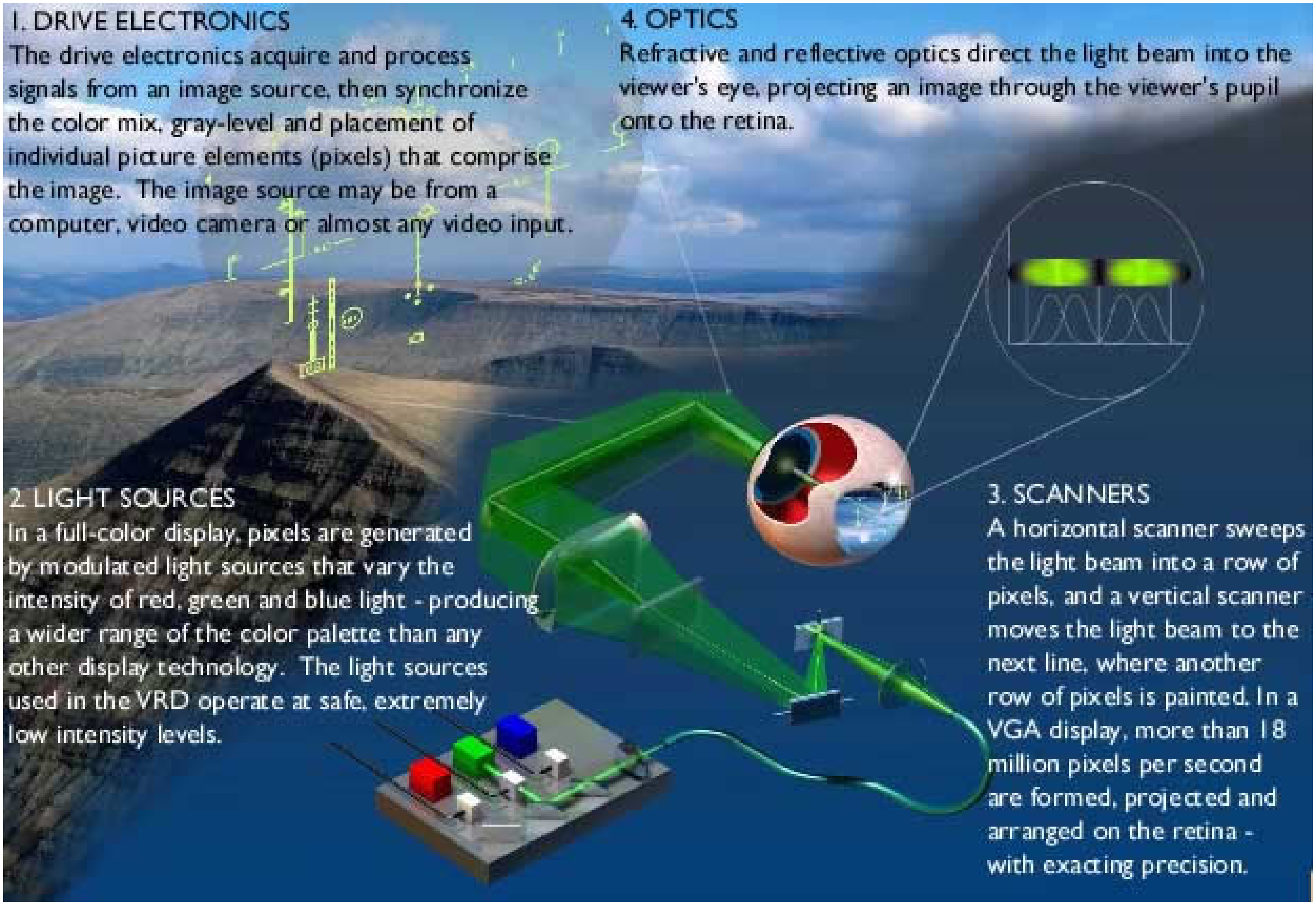
- challenges
  - rendering
  - physical delivery of pixels to displays
    - would need lots of wires

Mobile Displays

640x480 1” colour
virtual image 2 ft away
3 oz



Mobile Displays

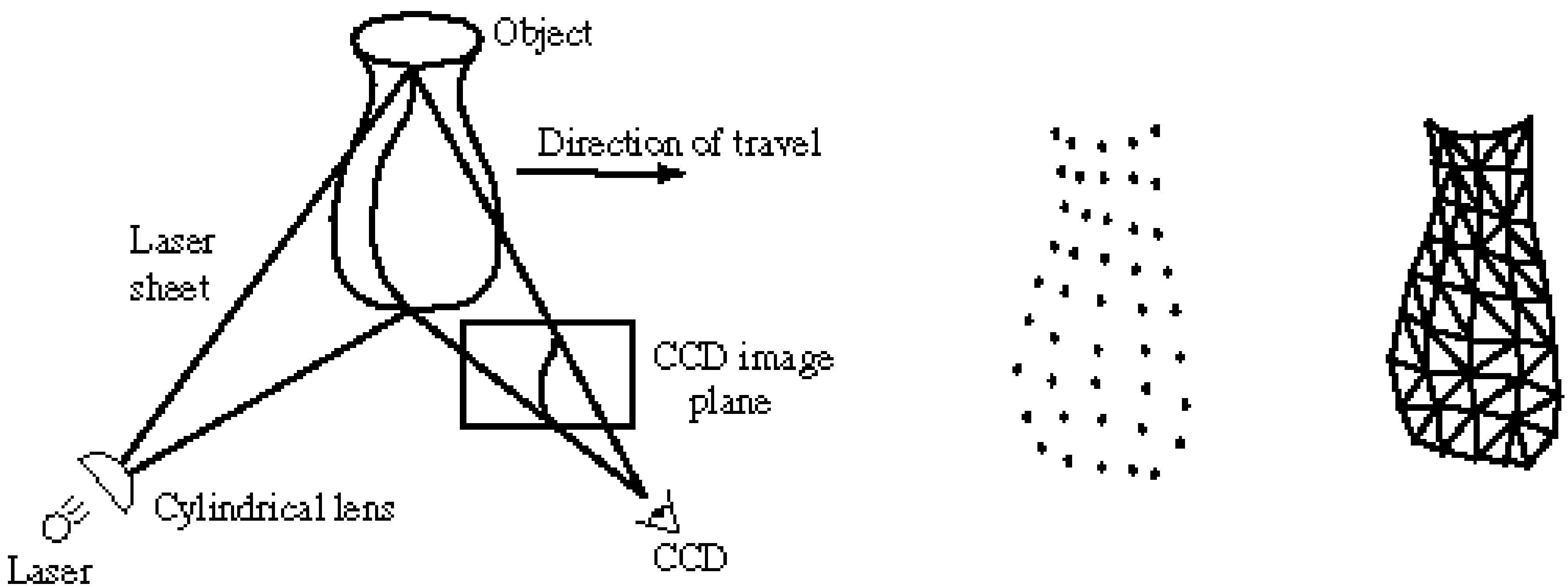


Stereo Displays

- active glasses or active screen
  - autostereoscopic also possible

Laser Stripe Range Scanners

- camera records laser stripe
  - second camera records texture image



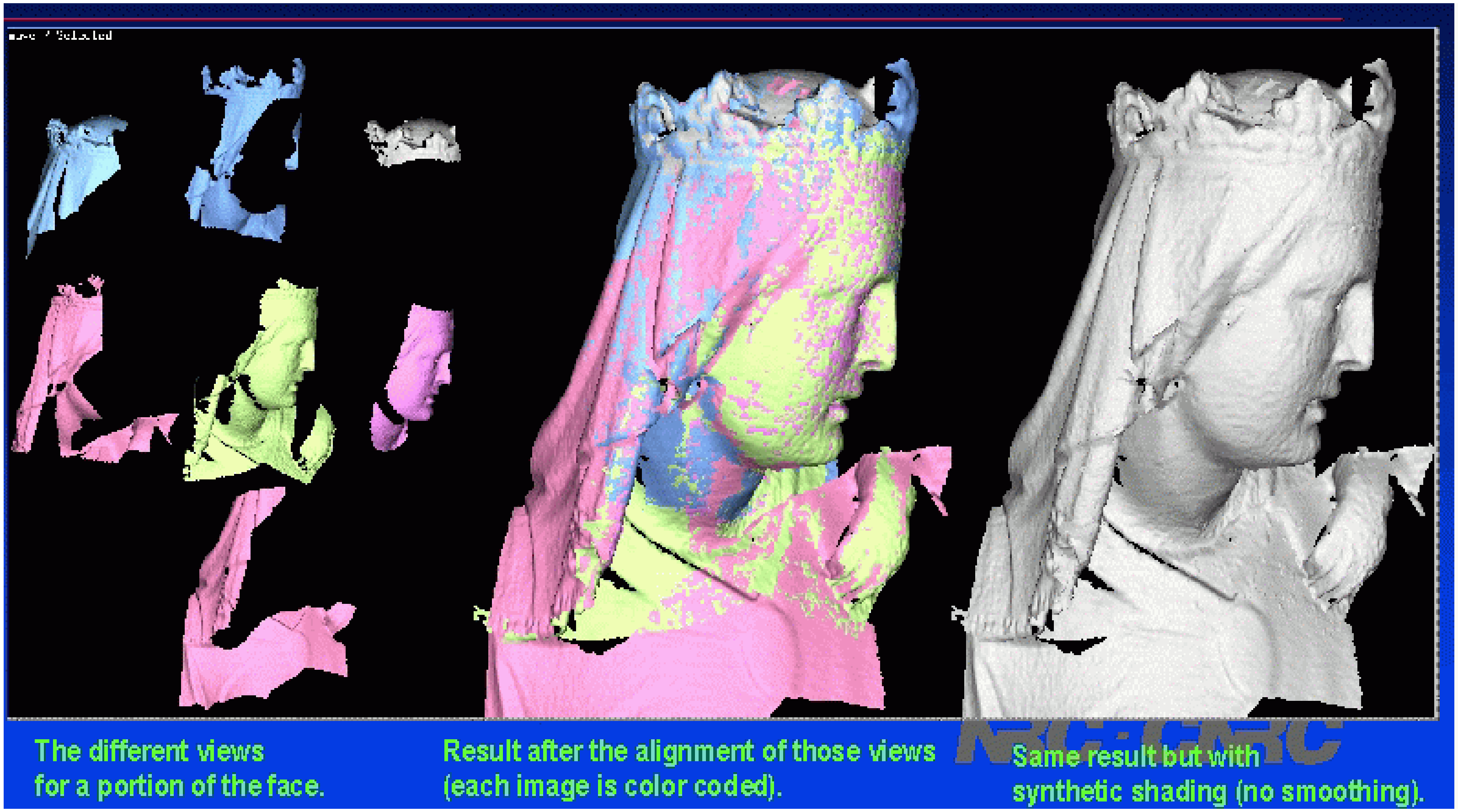
[graphics.stanford.edu/papers/volrange]

Laser Stripe Range Scanners

Cyberware

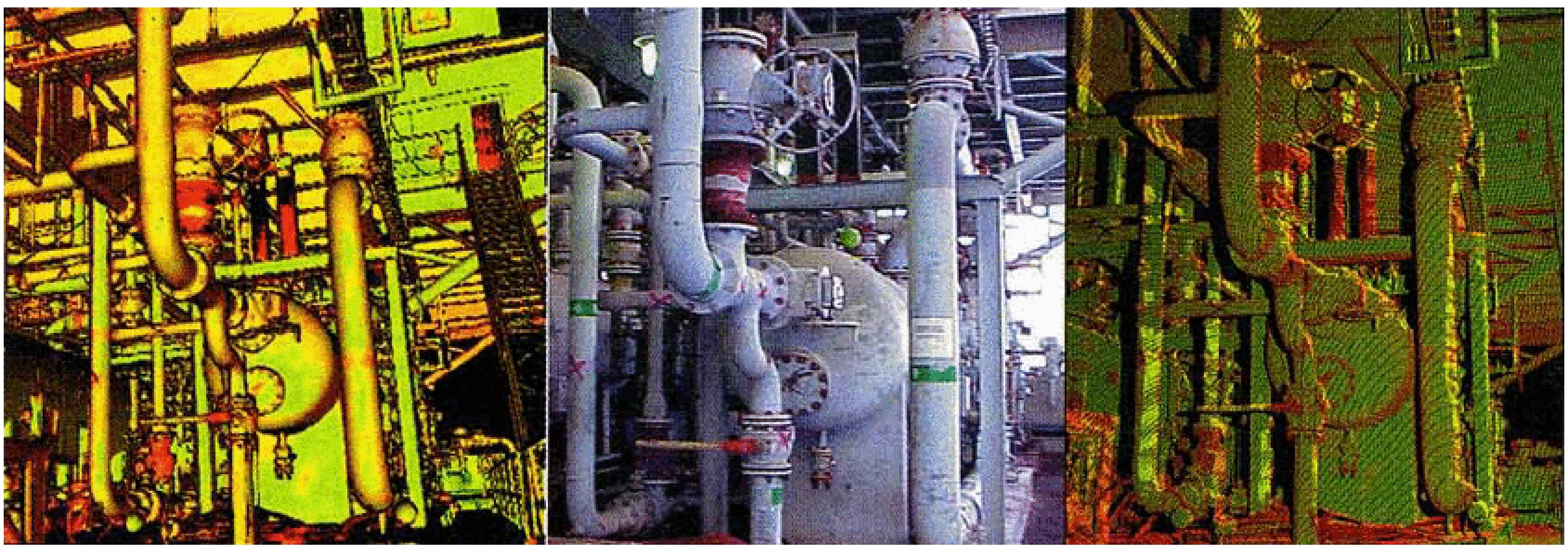
BIRIS

Laser Stripe Range Scanners

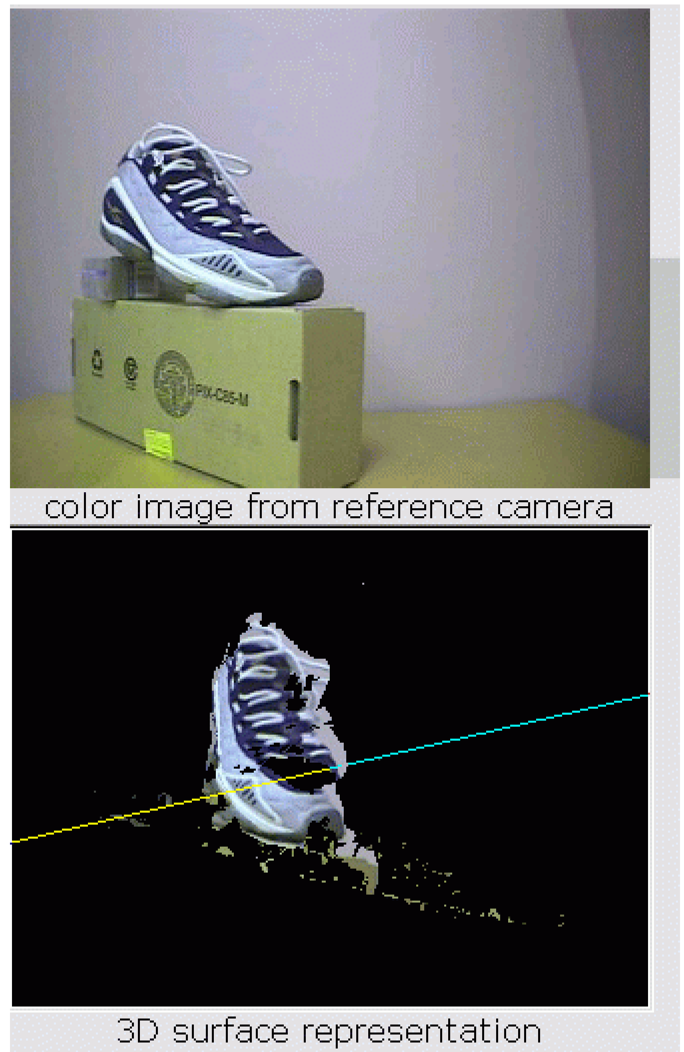


Laser Time-of-Flight Scanners

- Cyra
  - picosecond clock rates

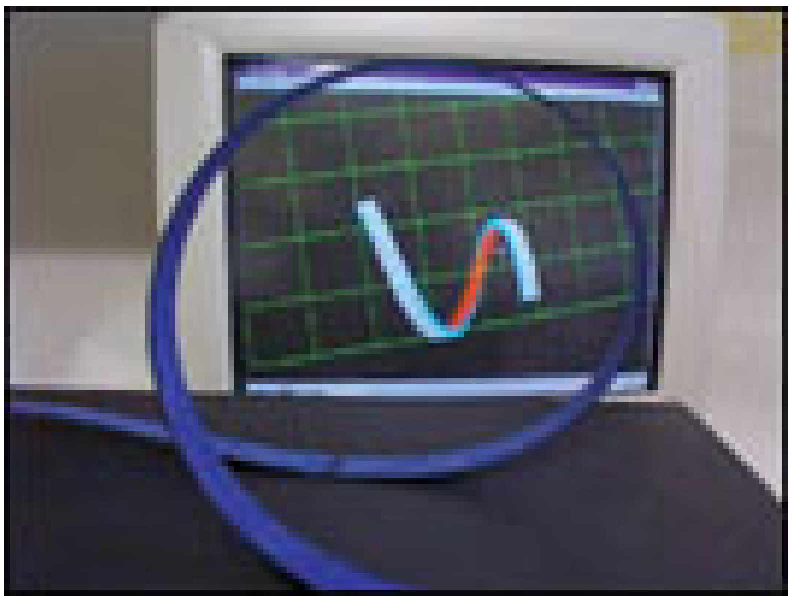


Depth from Stereo



Shape Tape

– fiber-optic based bend-and-twist sensor



Haptics

3D Printers

- spread layer of powder
- print binder solution
- vacuum away loose powder

4.5 hrs printing,
$100 printing cost
electroplated

[Z Corp]

3D Printers

printing telephones?
etc.

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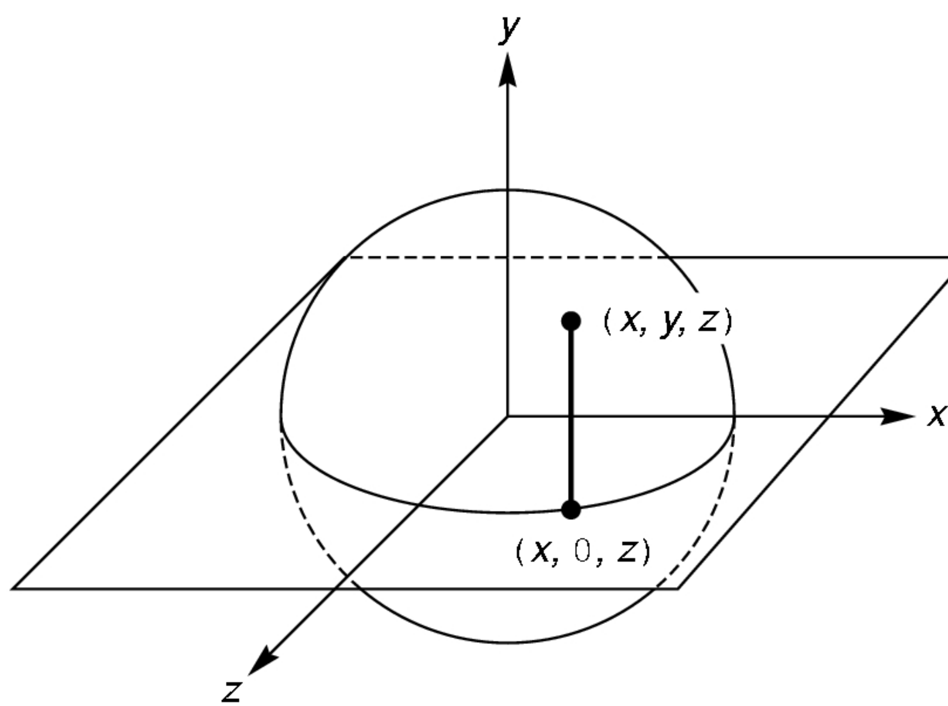
Virtual Trackball

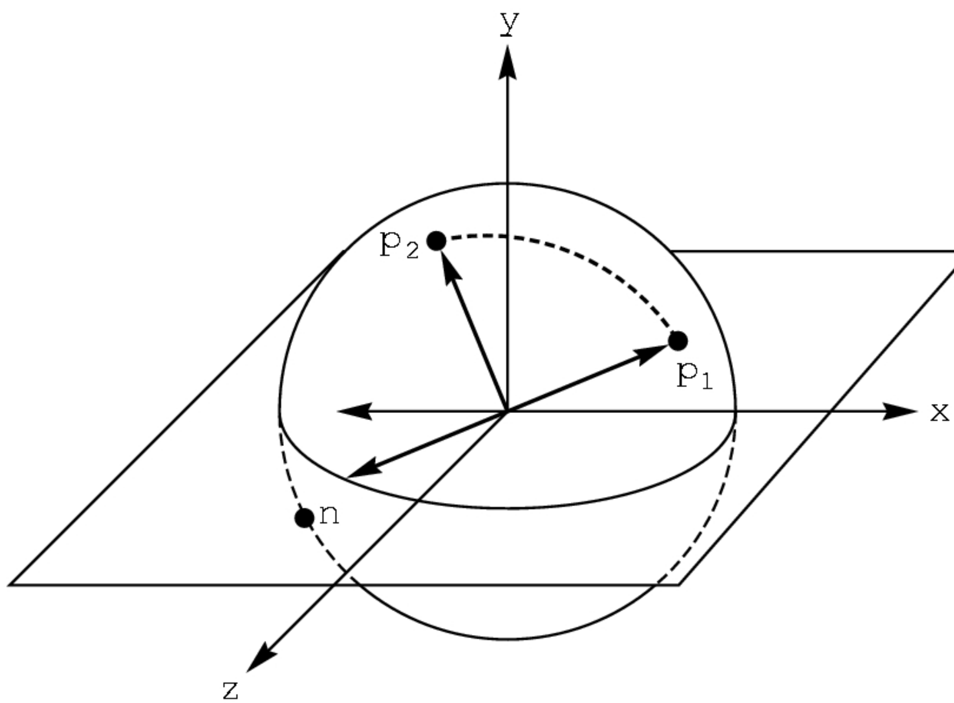
Virtual Trackball

- imagine a trackball embedded in screen
  - cs.calvin.edu/CS/352/02Graphics/lectures/primer-demo.exe
- if I click on screen, what point on trackball am I touching?



Trackball Rotation Axis

- If I move the mouse from $\mathbf{p_1}$ to $\mathbf{p_2}$, what rotation does that correspond to?



Virtual Trackball Rotations

- Rotation about the axis $\mathbf{n} = \mathbf{p_1} \times \mathbf{p_2}$
- Angle of rotation: use

  $\mathbf{p_1} \bullet \mathbf{p_2} = |\mathbf{p_1}|\ |\mathbf{p_2}| \cos \theta$
- Fixed point: if you use the [-1, 1] cube, it is the origin

Virtual Trackball

- can we use the mouse to control the 2-D rotation of a viewing volume?
- imagine a track ball
  - user moves point on ball from (x, y, z) to (a, b, c)
- imagine the points projected onto the ground
  - user moves point on ground from (x, 0, z) to (a, 0, c)

Trackball

- movement of points on track ball can be inferred from mouse drags on screen

- inverse problem
  – where on trackball does (a, 0, c) hit?
  – ball is unit sphere, so $||x, y, z|| = 1.0$
  – $x = a$, $z = c$, y = solve for it

Trackball

- user defines two points
  - place where first clicked X = (x, y, z)
  - place where released A = (a, b, c)
- ball rotates along axis perp to line defined by these two points
  - compute cross produce of lines to origin: (X – O) x (A – O)
- ball rotates by amount proportional to distance between lines
  - magnitude of cross product tells us angle between lines
    - (dot product too)
  - $|\sin \theta| = ||\text{cross product}||$
- compute rotation matrix and use it to rotate world