

Interaction / Probing



Lecture 12

Interactivity

- Static screen images display only one view of a data set.
- Being able to manipulate a dataset interactively is important in getting a feeling for its spatial structure.

Methods of Interaction

- Two categories of interaction techniques
 - Physical Manipulators
 - Virtual Manipulators
- Physical devices are used to control virtual devices.

Physical Manipulators

- Common devices include:
 - mouse
 - trackball
 - spaceball (6 degrees)
 - dials and buttons
 - digitizing tablet
 - touch screen
 - 3D mouse/trackers
 - data gloves

Physical Manipulators...

- 2D devices use similar paradigms. Movement in XY is converted into motion in 2D/3D space within the computer.
- 2D devices are simpler to operate but can require awkward manipulations to work in 3D space.
- 3D devices, whilst working directly in 3D space have problems including *registration*, *resolution* and *user fatigue*.

Virtual Manipulators

- These convert simple gestures into a range of 2D/3D motions.
- 3D virtual manipulators tend to use familiar paradigms to aid user orientation:
 - trackball
 - fly mode
 - walk mode

Mapping 2D input to 3D space

- Having gone to the effort of converting 3D space into 2D for display, we now have to map back into 3D space...
- How ?
 - Special modifier keys
 - Special 2D directions
 - Virtual trackballs

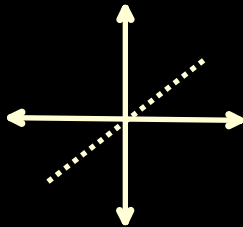
Mapping 2D input to 3D space...

- What needs to be mapped?
- The following are typically required:
 - Translation: XY , XZ , YZ
 - Rotation: Roll, Pitch, Yaw
 - Scale/Zoom (Don't confuse with XZ translation)
- Note: that additional aspects include selecting what is to be rotated. Both cameras and objects may be rotated.

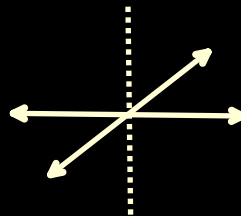
2D to 3D: using Keys

- Simplest technique uses keys or buttons to change the default behaviour. In this case to select a different translation or rotation mode.
- May be used for rotation or translation.
- Translation example: map xy device motion to:

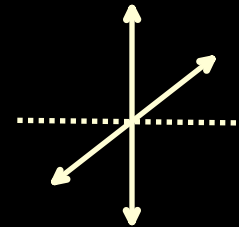
No modifiers: (xy)



Modifier A: (xz)

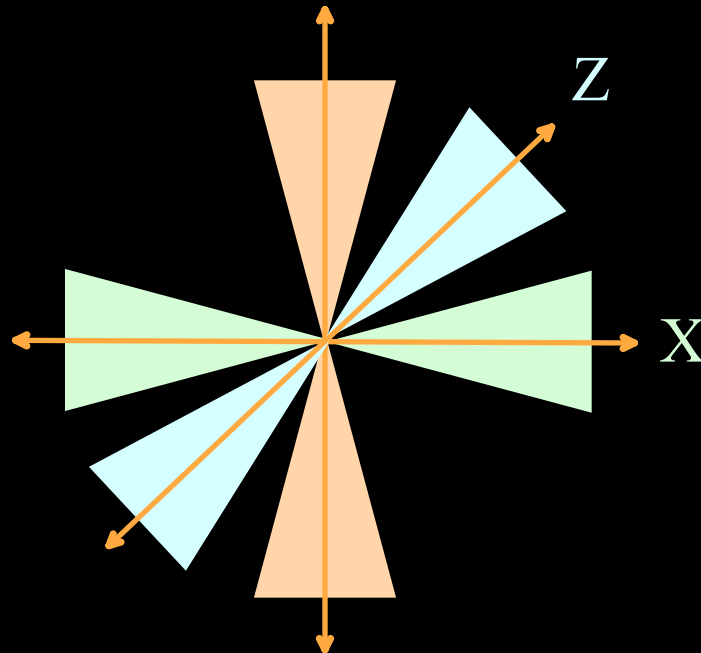


Modifier B: (yz)



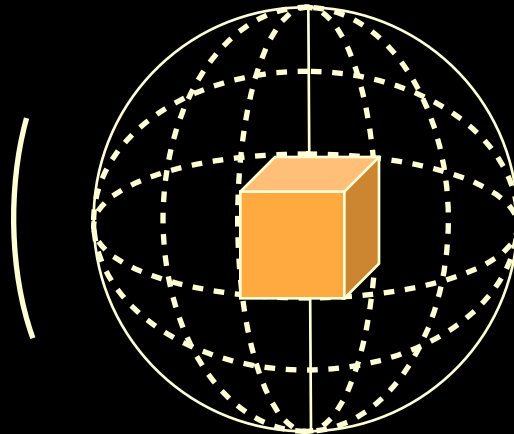
2D to 3D: using Directions

- Treat certain 2D input directions as referring to the Z direction. Generally used for translation/scaling.
- Motion is only accepted within the shaded regions



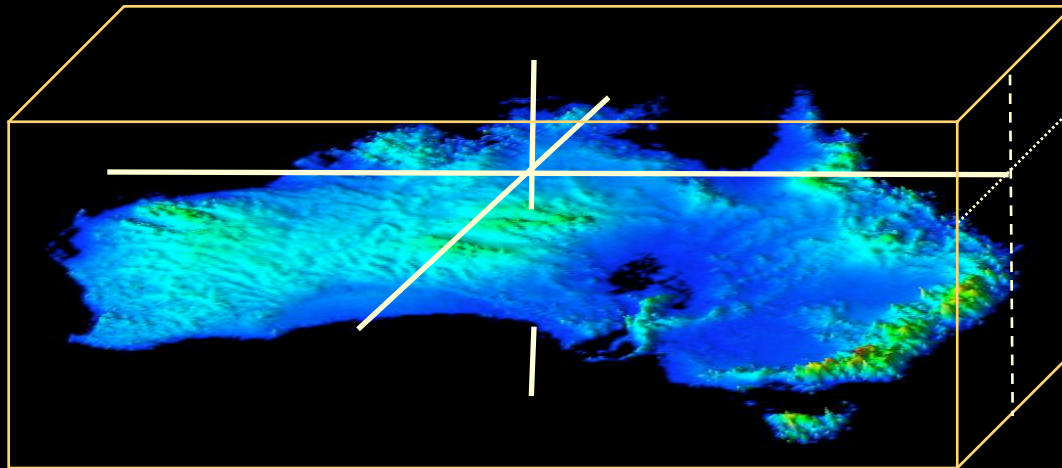
2D to 3D: Trackballs

- Used for rotations.
- Places an imaginary sphere around object to be rotated.
- XY input device motion is mapped into sphere rotations.



3D Cursors

- Now that we can interact in 3D, we need some means of displaying our position in 3D space.
- A technique is required that minimises ambiguity.
- 3D cursors a a good choice.
- Especially good with a bounding box.



Through the Looking Glass



The next step

Immersive Environments

- We can take the user involvement to a higher level by involving more senses.
 - Stereo Imaging
 - Virtual Reality (VR) Headsets
 - VR Caves
 - Haptic devices

Stereo Imaging

- Has been around for a long time using stereo photograph pairs.
- Variety of video technologies:
 - Red Green glasses (“monochrome”)
 - Polarized glasses
 - LCD shutters

Stereo Imaging...

- These assume a fixed (central) user position with respect to the screen.
- Can support multiple viewers but must have common stereo separation parameter and are optimized for one viewing location.
- An alternative individual display technique is a headset which incorporates position sensing.

VR Caves

- Caves provide a surround viewing experience, like headset but support multiple viewers. However they cannot practically support stereo for multiple users.
- Caves are built using multiple projectors and sophisticated geometry distortion correction.

Haptic Devices

- Force Feedback devices.
- Provide the perception of touching the virtual object.
- Actuators on a data glove or joystick style device push back with a force dependent on the user's effort and the virtual object being manipulated.
- Combined with software one can pick up and crack a virtual egg a feel it cracking!

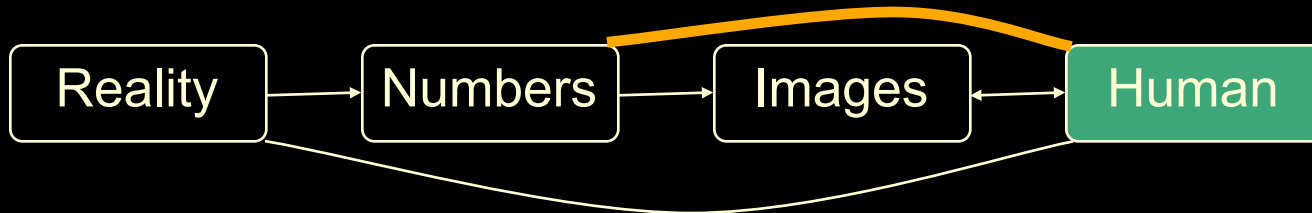
Probing



Data Feedback

Probing

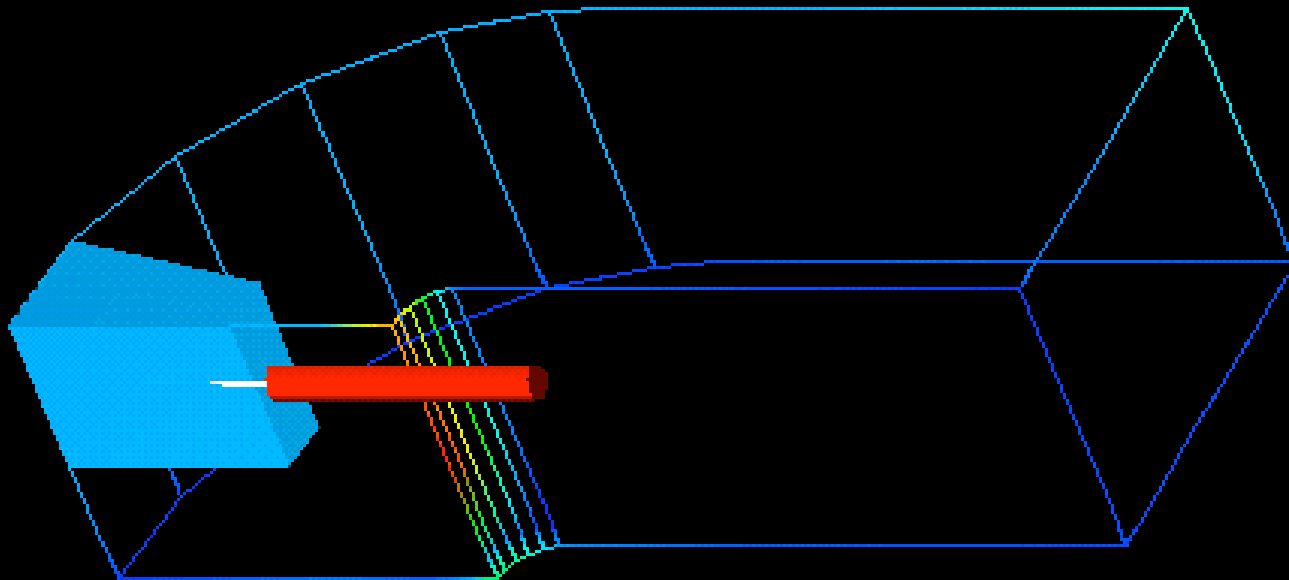
- Probing is one method of making the link from a visualisation back to the raw numbers.
- It gives a user confidence that what they are seeing truly represents the numbers (if not the real world!)



Probing

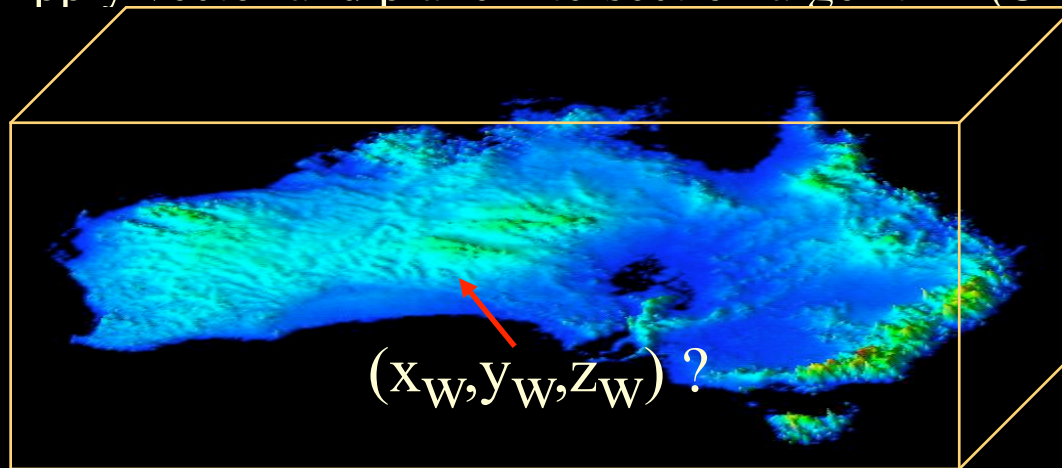
- Interactive probing of a mesh

```
Position:  -2.23317  0  2.42129  
Value:    6.19469
```



Surface Picking

- A single point in 2D maps to multiple potential points in 3D space.
- How to map a screen pixel onto a 3D surface point?
 - 1) Use the inverse *viewing transformation* (2D \rightarrow 3D)
 - 2) Apply vector and plane intersection algorithm (CPU intensive)



End

Lecture 12