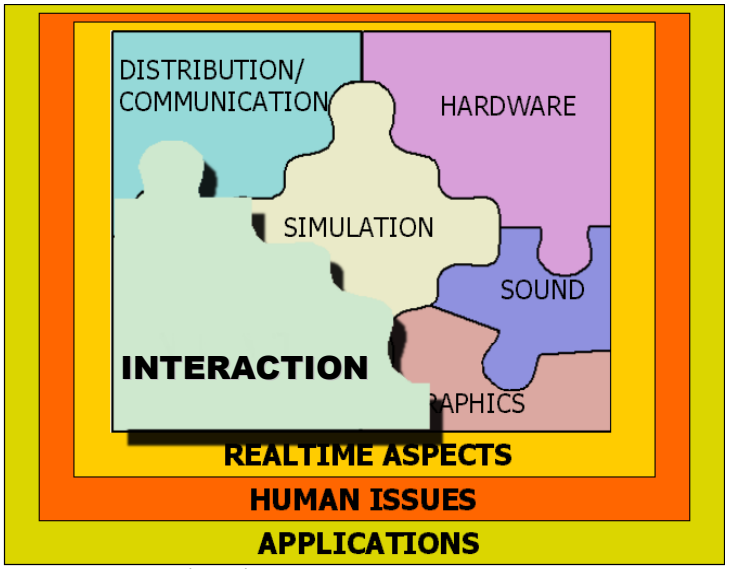
# VR – Interaction






# Interaction

- Well we have a Virtual Environment
- What can we do in it?
- Tasks
  - Navigation
    - Change view and user location
  - Selection
    - Picking objects to control, releasing the
  - Manipulation
    - Property change (scale, color, …)
  - System control
    - Other commands to application & interface
- As it is a Virtual Environment, we can do whatever we want to. No physical limits!

# Problems in 3D

- What makes 3D interaction difficult?
  - Spatial input
  - Lack of constraints
  - Lack of standards
  - Lack of tools
  - Lack of precision
  - Fatigue
  - Perception



# Navigation

- The process of moving from one location to another
  - Travel
    - To move
  - Wayfinding
    - To find
- Involves knowing or discovering
  - Where you are
  - Where you want to go
  - What is along the way
  - What is the ”best” path
- Navigation in VE usually improves with higher levels of presence.

# Navigation Tasks

- Travel
  - Actions taken to get from one place to another
  - Ex. Steering a car, pressing on the break and accelerator pedal.
  - The easy way: one-to-one mapping with the physical world (1m = 1m)
  - What if we are travelling in a galaxy? 1m = 500lightyear?
  - One-to-one is intuitive requires no special action from the user
  - Likely that the virtual environment's size will exceed the tracked area. Leads to new ways of travelling



# Navigation Tasks

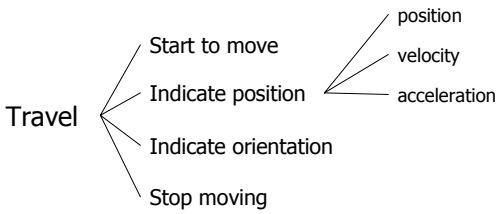
- Wayfinding
  - Cognitive elements of wayfinding
  - Planning a path
  - Revising the plan while travelling
  - Working with the "cognitive map"
    - Often set of compinents related spatially
    - Paths (walkways, passages, main streets)
    - Edges (walls, fences, highways)
    - Landmarks (towers, statues, distinctive buildings)
    - Districts (identified areas of town)

# Travelling

- Flying
- Driving
- Teleportation
  - Can lead to disorientation
- Two important parameters to move through a VE
  - Speed
  - Direction of Motion

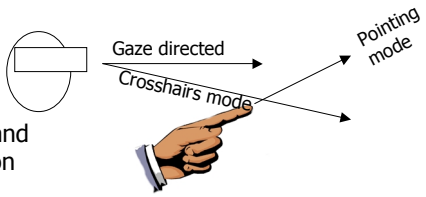


# Classification of travelling



# Travelling - Orientation

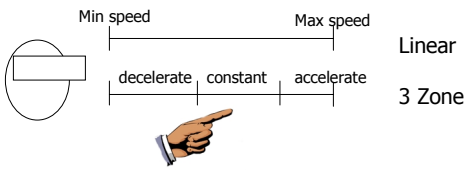
- Direction of motion
  - Hand directed
    - Position and orientation of the hand determines the direction of motion
    - Physical controls
      - Steering wheels
      - Joysticks
    - Virtual Controls
      - Implement virtual controls like wheels, buttons, etc…
      - Problem without haptics
    - Object driven
      - Users position is controlled by objects in the VE
    - Goal driven
      - List of options are displayed as text/icons
      - Virtual maps, point at map leads to transportation to that place






# Interaction - Velocity

- Speed
  - Constant speed
    - Speed could be scaled upon the size of the VE
  - Constant acceleration
    - Starts at low speed suitable for short travels in local environment, continues to accelerate as user continues to fly/move. Speed grows exponentially. Reaches large areas.
  - Hand controlled



# Travelling - Velocity

- Physical controls
  - Devices for controlling the speed
    - keyboard
    - Dials
    - Voice control
    - Pedals
- Virtual controls
  - Menus, sliders, throttles, ...



# Travelling

- Walking techniques
- Threadmills
- Bicycles

VMC/Disney Magic Carpet

# Interaction - Selection

- Selection
  - A way of indicate the target of desired interaction
  - Local vs. distance selection
    - Local
      - Objects close to the user, in reach of the hand
    - Distance
      - Gaze directed
      - Ray cast selection
      - Voice input
      - Selection from list of objects
  - Always important to tell the user which objects are current!



# Interaction - Manipulation

- Manipulation
  - Specification of an objects position/orientation
  - Hand specified
    - Grab and move
    - 1-1 correspondence to the hand
  - Physical controls
    - Joystick
    - Dials
    - Sliders
  - Virtual control

# Interaction - Scaling

- Center of rotation
  - Hand centered rotation (as if it was in your hand)
  - Rotation around objects center (good if you are away from the object for a overview picture.
- Scaling
  - Can be used for movement
    - Scale down the world, move physically to the new position, scale up the world again.
  - Center of scaling
    - The point which all objects move towards when you scale down.
    - Hand centered
    - Object centered

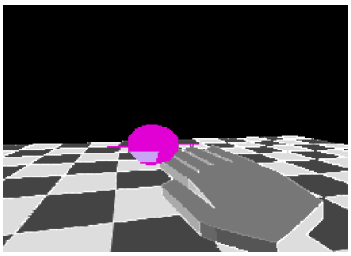


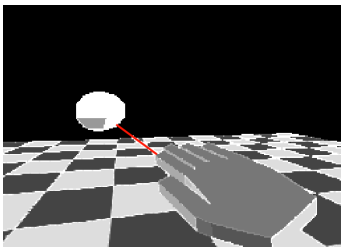
# Interaction - Scaling

- Scaling factor
  - Uniform
    - Scale equally along all three axis
  - Non-uniform
    - Have to specify x, y, z scale-factor
  - Hand controlled
  - Physical
  - Virtual

# Interaction - Comparison

| Advantages | Disadvantages |
|---|---|
| **Simple Virtual Hand** | |
| •Most natural | • Limited area of reach |
| **Ray-casting (Bolt 1980)** | |
| •Objects can be selected at any distance<br>•Natural, requires little effort | •Difficult to select small objects and far away objects<br>•Position and rotation constrained |

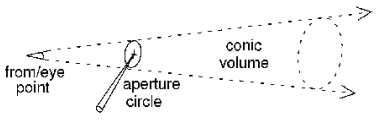






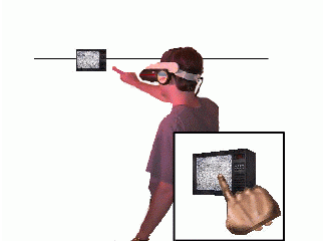
# Interaction - Comparison

| Advantages | Disadvantages |
|---|---|
| **Flash light (Liang, 1994)** | |
| •Selection of small objects is easier at any distance | •Disambiguation is needed if several objects fall in spotlight |
| **Aperture (Forsberg, 1996)** | |
| •Interactive and intuitive object disambiguation<br>•Selection is completely 2D | •Selection is completely 2D<br>•Manipulation is still difficult |



# Interaction - Comparison

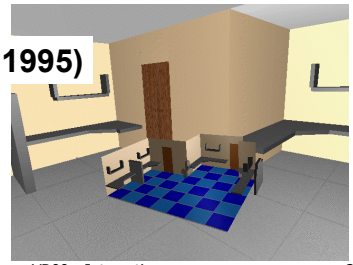
| Advantages | Disadvantages |
|---|---|
| **Sticky Finger (Pierce, 1997)** | |
| •Easy selection | •Manipulation is difficult |
| **Fishing reel (Bowman, 1997)** | |
| •Controls distance in manipulation | •Needs extra control device<br>•Separates manipulation degrees of freedom |





# Interaction - Comparison

| Advantages | Disadvantages |
|---|---|
| **Go-Go (Poupyrev, et. al. 1996)** | |
| •Seamless 6DOF manipulation with a large range of distances | •Manipulation range is still limited<br>•Overshoot with large distances |
| **Miniature world (Stoakley et. Al. 1995)** | |
| •Different viewpoints and scales<br>•Gives viewpoint person in context | •Occludes environment<br>•slows down frame-rate |



# Interaction - Speech

- Speech input
  - Provides compliment to other modes of interaction
  - Ideal for multimodal interaction
  - Many issues:
    - Continuos vs.. one-time recognition
    - choice and placement of microphone
    - training vs.. no training
    - handling of false positive recognition
      - Recognition of something you don't want
    - Surrounding noise interference



# References

- *The Art and Science of 3D Interaction*, Bowman et. al. Tutorial 2, 1999 IEEE Virtual Reality Conference, Houston.