Universal 3D Interaction Tasks

- **Navigation**
  - Travel – motor component
  - Wayfinding – cognitive component
- Selection
- Manipulation
- System control
- Symbolic input
Wayfinding

- Cognitive process of defining a path through an environment
  - use and acquire spatial knowledge
  - aided by natural and artificial cues
- Common activity in our daily lives
- Often unconscious activity (not when we are lost)

Information for the Wayfinding Task

- Landmarks
- Signs
- Maps
- Directional information
Transferring Spatial Knowledge

- Want to transfer knowledge to the real world
  - training
  - planning
- Navigation through complex environments to support other tasks

Wayfinding in 3DUIs

- Difficult problem
- Differences between wayfinding in real world and virtual world
  - unconstrained movement
  - absence of physical constraints
  - lack of realistic motion cues
- 3DUIs can provide a wealth of information
Wayfinding as Decision Making Process

Wayfinding and Travel

- Exploration
  - browsing environment
  - useful in building cognitive map

- Search
  - spatial knowledge acquired and used
  - naïve search – not enough info in cognitive map
  - primed search – use of cognitive map defines success

- Maneuvering
  - uses very little of cognitive map
Wayfinding and Spatial Knowledge

- **Landmark knowledge**
  - visual characteristics of environment
  - shape, size, and texture
- **Procedural knowledge**
  - sequence of actions required to follow a path
  - requires sparse visual information
- **Survey knowledge**
  - topographical knowledge
  - object location/distance/orientation

Egocentric and Exocentric Reference Frames

- **Egomotion** – feeling we are the center of space
- **Egocentric** – first person
  - relative to human body
- **Exocentric** – third person
  - relative to world
- **Build up exocentric representation of world**
  - survey knowledge
- **Use egocentric when exploring for first time**
  - landmark/procedural knowledge
User-Centered Wayfinding Support (1)

- **Field of view**
  - small FOV can inhibit wayfinding
    - user requires repetitive head movements
    - lack of optical flow in periphery

- **Motion cues**
  - enable judgment of depth and direction
  - supports dead reckoning (backtracking of user’s own movement)
  - cue conflicts can hinder cognitive map development

- **Multisensory Output**
  - audio
  - Tactile maps

User-Centered Wayfinding Support (2)

- **Presence (feeling of “being there”)**
  - assumed to have impact on spatial knowledge
  - closer to real world

- **Search strategies**

![Search strategies image]
Environment-Centered Wayfinding Support

- Environmental design
- Artificial aids

Environmental Design (1)

- World’s structure and format can aid in wayfinding
- Legibility techniques
  - divide large scale environment into parts with distinct character
  - create simple spatial organization
  - include directional cues to support egocentric/exocentric reference frames
  - often repetitive
Environmental Design (2)

Environmental Design (3)

- Natural environment
  - horizon, atmospheric color, fog, etc...
- Architectural design
  - lighting
  - closed and open spaces
- Color and texture
Artificial Cues

- Maps
- Compasses
- Signs
- Reference objects
- Artificial landmarks
- Trails

Maps (1)
Maps (2)

Maps (3)
Maps (4)

Compasses
Signs

Reference Objects

- Objects that have well known size
  - chair, human figure, etc...
- Useful to estimate distances
Artificial Landmarks

- Local – help users in decision making processes
- Global – seen from any location

Trails

- Help user retrace steps
- Show what parts have been visited
Next Class

- System Control
- Readings
  - 3DUI Book – Chapter 7