CSE 190: 3D User Interaction

Lecture #10: Travel cont'd

Jürgen P. Schulze, Ph.D.

Announcements

- Homework assignment #3 due Friday, February 22nd at 1pm in Sequoia lab 142
  - Grading starts at 12:30
- Reminder: paper presentations
  - Next lecture:
    - Thinh
    - Suman
    - Stephen

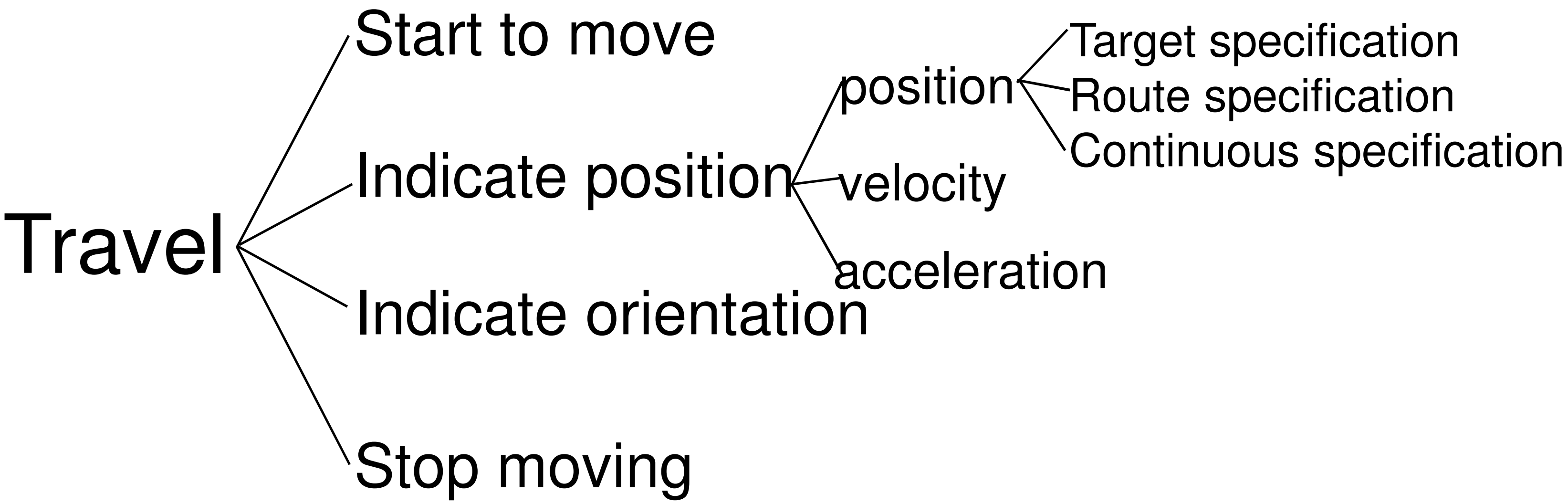
Paper Presentations

- Today:
  - Velu: Touché: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects
  - Haronid: D-Flow: Immersive Virtual Reality and Real-Time Feedback for Rehabilitation
  - Amell: Lightweight Palm and Finger Tracking for Real-Time 3D Gesture Control

Navigation

Travel – Motor Component

Alternate Technique Classification – User Control Level



Travel

Start to move

Indicate position

position

Target specification

Route specification

Continuous specification

velocity

acceleration

Indicate orientation

Stop moving

Travel Techniques

- Physical locomotion (“natural” metaphors)
- Steering techniques
- Route planning
- Target-based techniques
- Manual manipulation
- Viewpoint orientation techniques

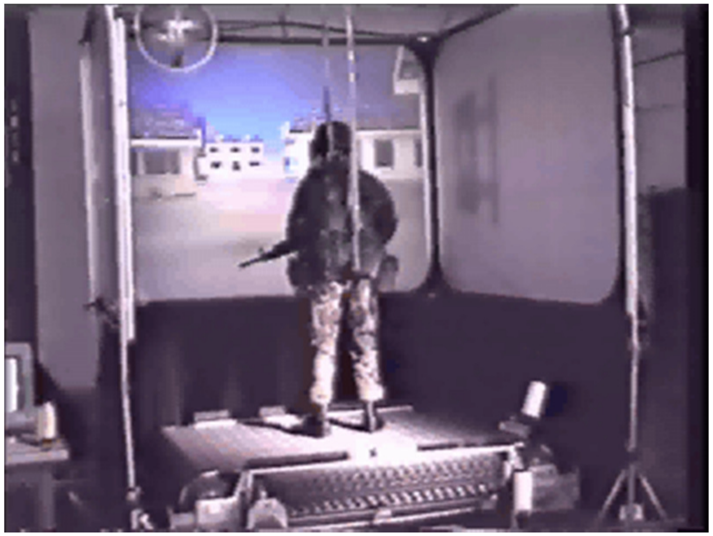
Physical Locomotion Techniques

- Walking techniques
  - Large-scale tracking
  - Walking in place
- Treadmills
  - single-direction with steering (Gait Master)
  - omni-directional
- Bicycles
- Other physical motion techniques
  - Magic carpet
  - Disney's river raft ride

Large Scale Tracking

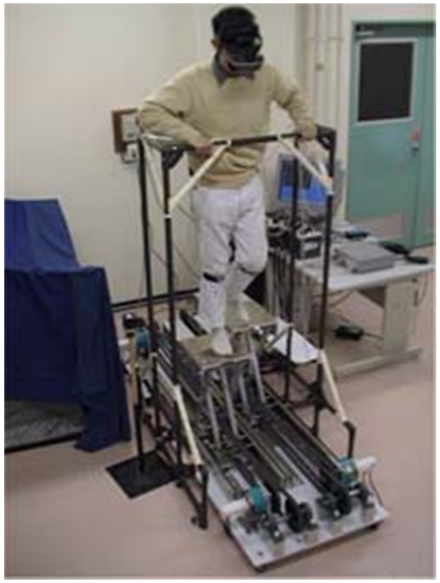
Omni-Directional Treadmill

- Video:
  - http://www.youtube.com/watch?v=BQw1tsgrJOs



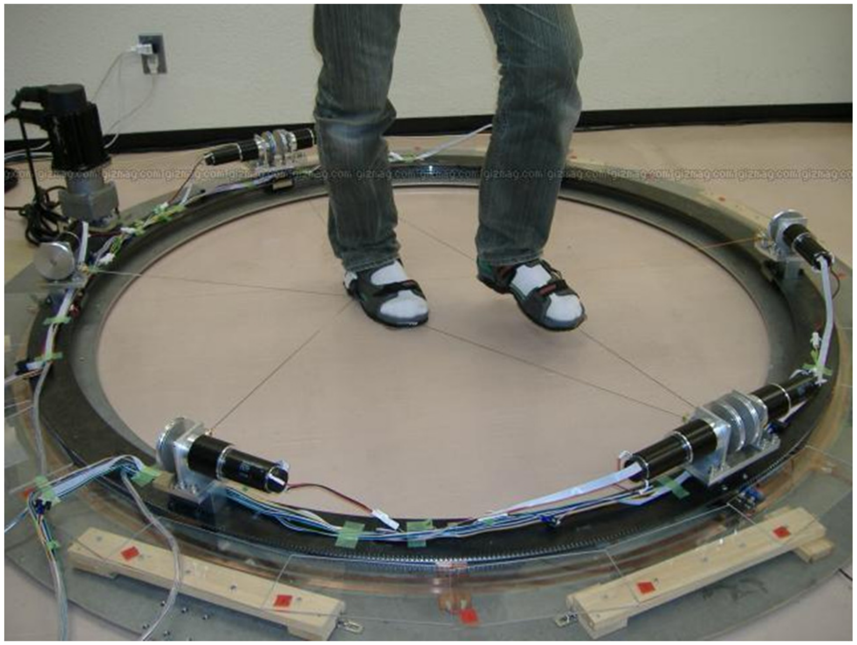
Gait Master

- Video
  - http://www.youtube.com/watch?v=RDDH1iqoDzU



String Walker

- Video from Emerging Technologies, SIGGRAPH 2007
  - http://www.youtube.com/watch?v=hyLKjyL-Dw8



Steering Techniques

- Continuous specification of direction of motion
  - gaze-directed
  - pointing
  - torso-directed
  - camera-in-hand
  - physical device (steering wheel, flight stick)

Steering – Gaze-Directed

- Move viewpoint in direction of “gaze”
- Gaze direction determined from head tracker
- Cognitively simple
- Doesn’t allow user to look to the side while traveling

Steering – Gaze-Directed Implementation

- Each frame while moving:
  - Get head tracker information
  - Transform vector *[0,1,0]* in head coordinates to *v=[x,y,z]* in world coordinates
  - Normalize vector
  - Multiply by speed
  - Translate viewpoint by this amount in world coordinates

Pointing Technique

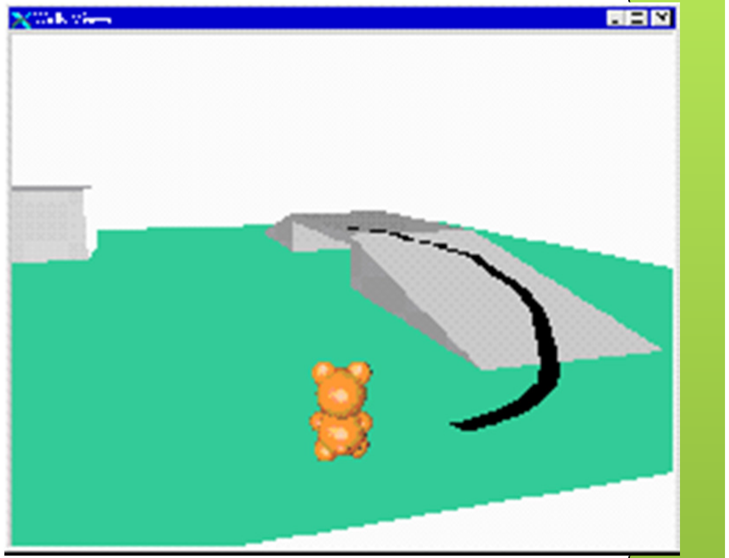
- Also a steering technique
- Use hand tracker instead of head tracker
- Slightly more complex, cognitively
- Allows travel and gaze in different directions – good for relative motion

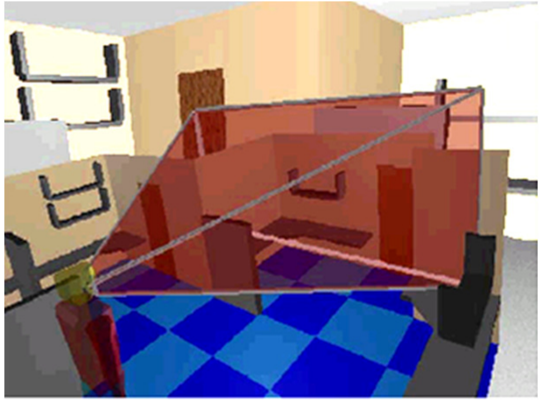
Pointing Implementation

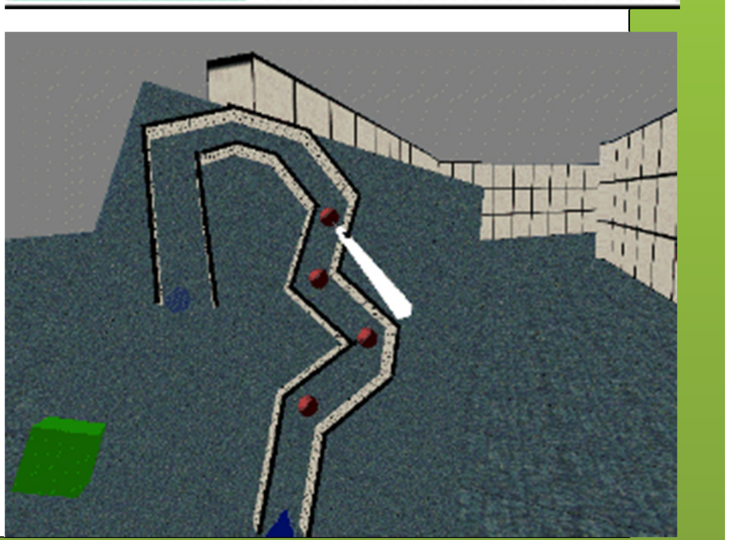
- Each frame while moving:
  - Get hand tracker information
  - Do exactly the same calculations as in gaze-directed steering, only use hand coordinates instead of head coordinates

Route-Planning

- One-time specification of path
  - draw path
  - points along path
  - manipulating user representation





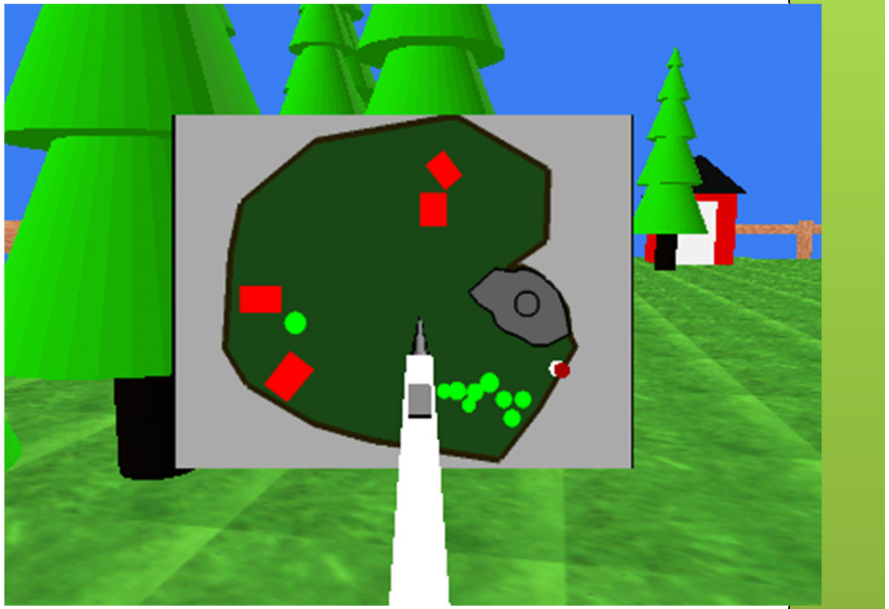


Target-Based Techniques

- Discrete specification of goal
  - point at object
  - choose from list
  - enter coordinates
- Map/WIM-based target specification

Map-Based Travel Techniques

- User represented by icon on 2D map
- Drag icon with stylus to new location on map
- When released, viewpoint animated smoothly to new location



Map-based Travel Implementation

- Must know
  - map scale relative to world: *s*
  - location of world origin in map CS: *$o=(x_o, y_o, z_o)$*
- On button press:
  - if stylus intersects user icon, then each frame:
    - get stylus position in map CS: *(x, y, z)*
    - move icon to *$(x, 0, z)$* in map CS

Map-Based Travel Implementation (cont.)

- On button release:
  - Get stylus position in map CS: *(x, y, z)*
  - Move icon to *(x, 0, z)* in map CS
  - Desired viewpoint: $p_v = (x_v, y_v, z_v)$ where
    - $x_v = (x - x_o)/s$
    - $z_v = (z - z_o)/s$
    - y_v = *desired height at* (x_v, y_v)
  - Move vector: $m = (x_v\text{-}x_{curr}, y_v\text{-}y_{curr}, z_v\text{-}z_{curr})$ * *(velocity/distance)*
  - Each frame for *(distance/velocity)* frames: translate viewpoint by *m*

Manual Manipulation – Grabbing the Air Technique

- Use hand gestures to move yourself through the world
- Metaphor of pulling a rope
- Often a 2-handed technique
- May be implemented using Pinch Gloves

Grabbing The Air Implementation (One-handed)

- On pinch:
  - Obtain initial hand position in world CS: (x_h, y_h, z_h)
- Each frame until release:
  - Obtain current hand position in world CS: (x'_h, y'_h, z'_h)
  - Hand motion vector: $m = ((x'_h, y'_h, z'_h) - (x_h, y_h, z_h))$
  - Translate world by *m* (or viewpoint by –*m*)
  - $(x_h, y_h, z_h) = (x'_h, y'_h, z'_h)$
- Cannot simply attach objects to hand – do not want to match hand rotations

Viewpoint Orientation Techniques

- Head tracking
- Orbital viewing
- Non-isomorphic rotation
- Virtual sphere