CSE 190: Virtual Reality Technologies

LECTURE #10: DEGREES OF FREEDOM

Announcements

Monday: Discussion homework project 2

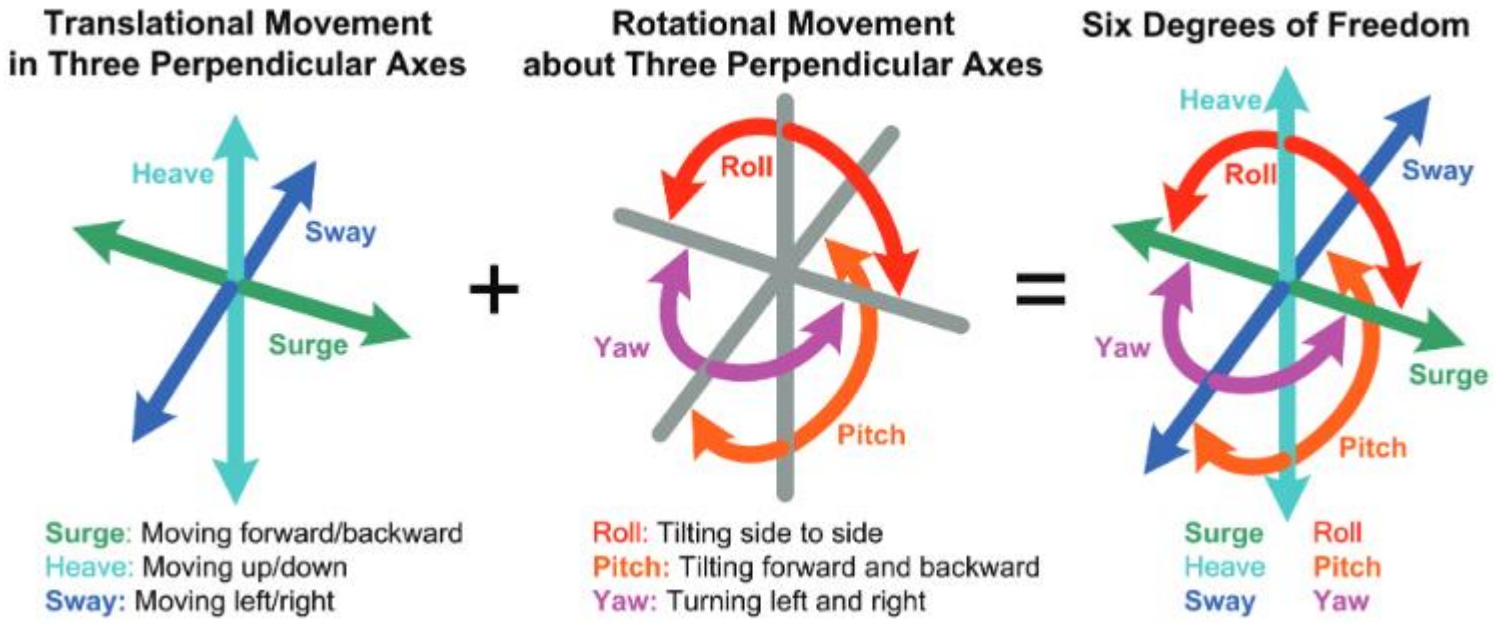
Project 2 due Sunday May 10th at 11:59pm

Today's VR app presentations:

- Jeremiah Johnson: Hardcode
- Daniel Harnanto: Voxel Fly
- Adam Loop: AR Mix
- Lucas Hwang: Google Earth VR

Degrees of Freedom (DOF)

Overview

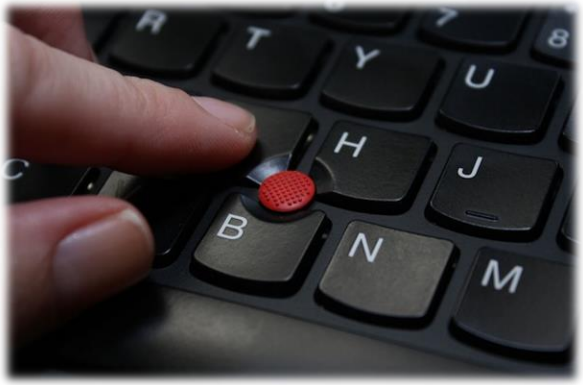

Translational Movement
in Three Perpendicular Axes
Heave
Sway
Surge
Surge: Moving forward/backward
Heave: Moving up/down
Sway: Moving left/right
+
Rotational Movement
about Three Perpendicular Axes
Roll
Yaw
Pitch
Roll: Tilting side to side
Pitch: Tilting forward and backward
Yaw: Turning left and right
=
Six Degrees of Freedom
Heave
Roll
Sway
Yaw
Surge
Pitch
Surge
Heave
Sway
Roll
Pitch
Yaw

Mouse (Relative 2 DOF Position)

2 independent directions control a cursor

Rate of change proportional to force or velocity of motion

Harder to use with larger screen surfaces (e.g., 4k+ or wide screen monitor)



Gyration presentation controller

Touch or Pen-Based Tablets (Absolute 2 DOF Position)

Absolute 2D position
- 2 DOF

Microsoft Surface Dial
- Adds 1 DOF

Absolute 3 DOF Position: GPS

GPS = Global Positioning Satellite system

24 GPS satellites emit synchronized signals

GPS receiver needs to have line of sight connection with 4+ satellites

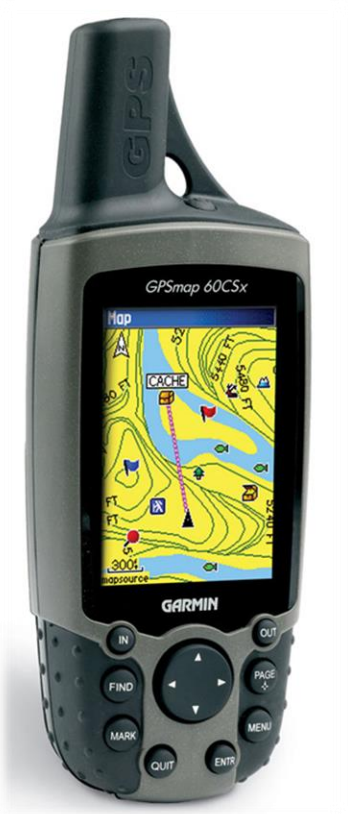
GPS receivers determine exactly how long it takes for the GPS signals to travel from each satellite

Measures:

- Latitude
- Longitude
- Altitude

Does not directly measure:

- Orientation
- Velocity
- Acceleration



Relative 3 DOF Rotation

Low end HMDs

3 rotational directions:

- Roll
- Pitch
- Yaw

6-DOF Relative Devices

Relative position and orientation

Move a cursor around 3D space

Cursor velocity is proportional to directional force

Spaceball

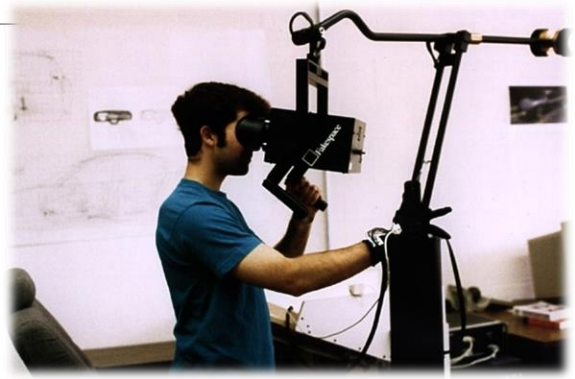
Space Navigator

Mechanical 6-DOF Tracking

Fakespace Boom: doubles as a stereo display. Options:

- Monochrome BOOM 2
- Two primary color (16-bit color) BOOM 2C
- Full color BOOM 3C
- All models are 1280x1024 pixels stereo displays

Geomagic Touch: doubles as a haptic feedback device



Fakespace BOOM

Geomagic Touch

Keyboard,
Game Controller

How many DOF?