



CS/PSY 4(6)84: Tracking

Chapter 9

- Know 9.0, 9.3 and 9.4
- Skim over 9.1 and 9.2 (tracking 2D/3D)

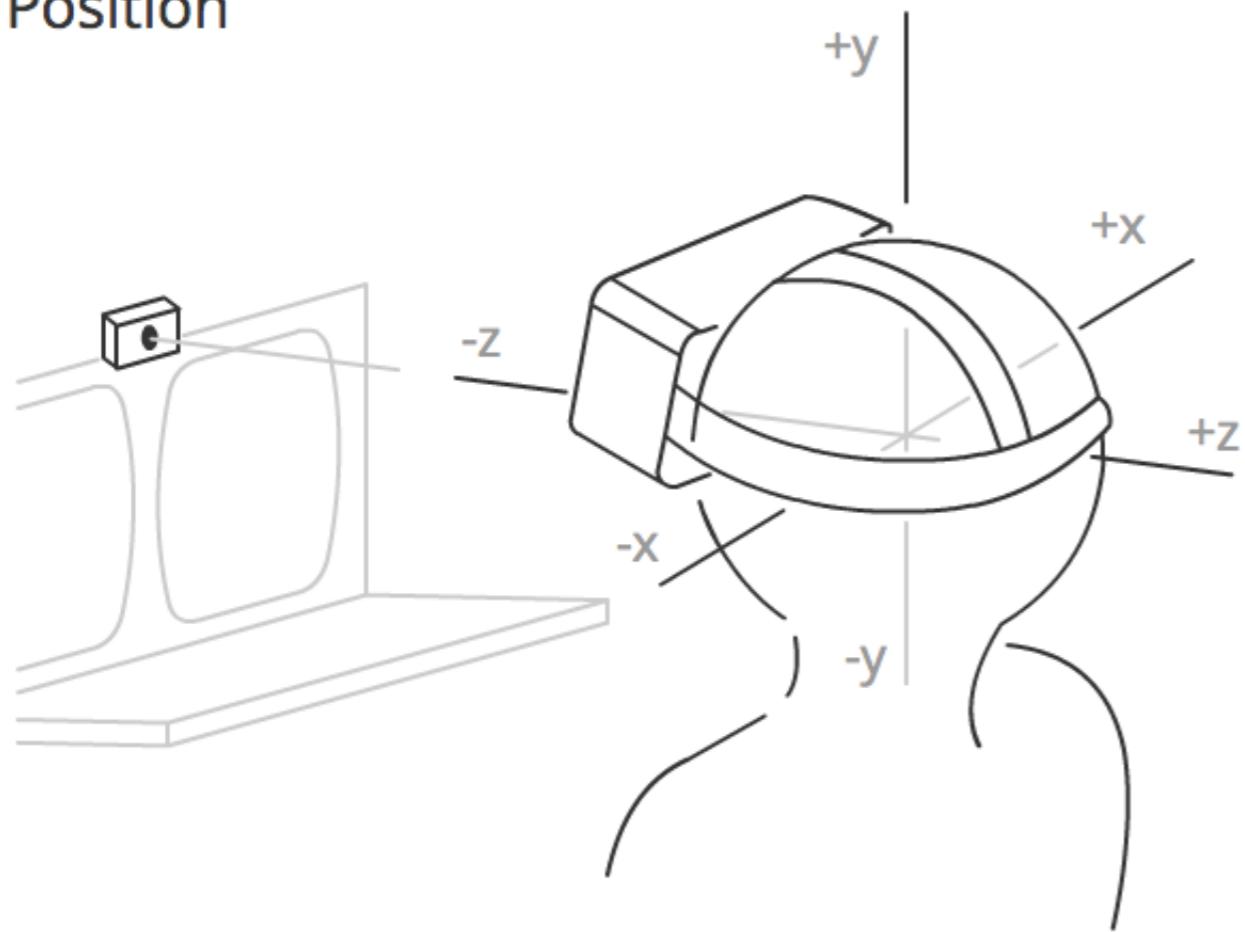
Tracking

- Accurate tracking barrier to bring VR to masses
- The more we can track the better
- Three categories of tracking
 - Sense organs (Vestibular, eyes, ears)
 - Body parts (arms, legs)
 - Environment (obstacles, real world objects)

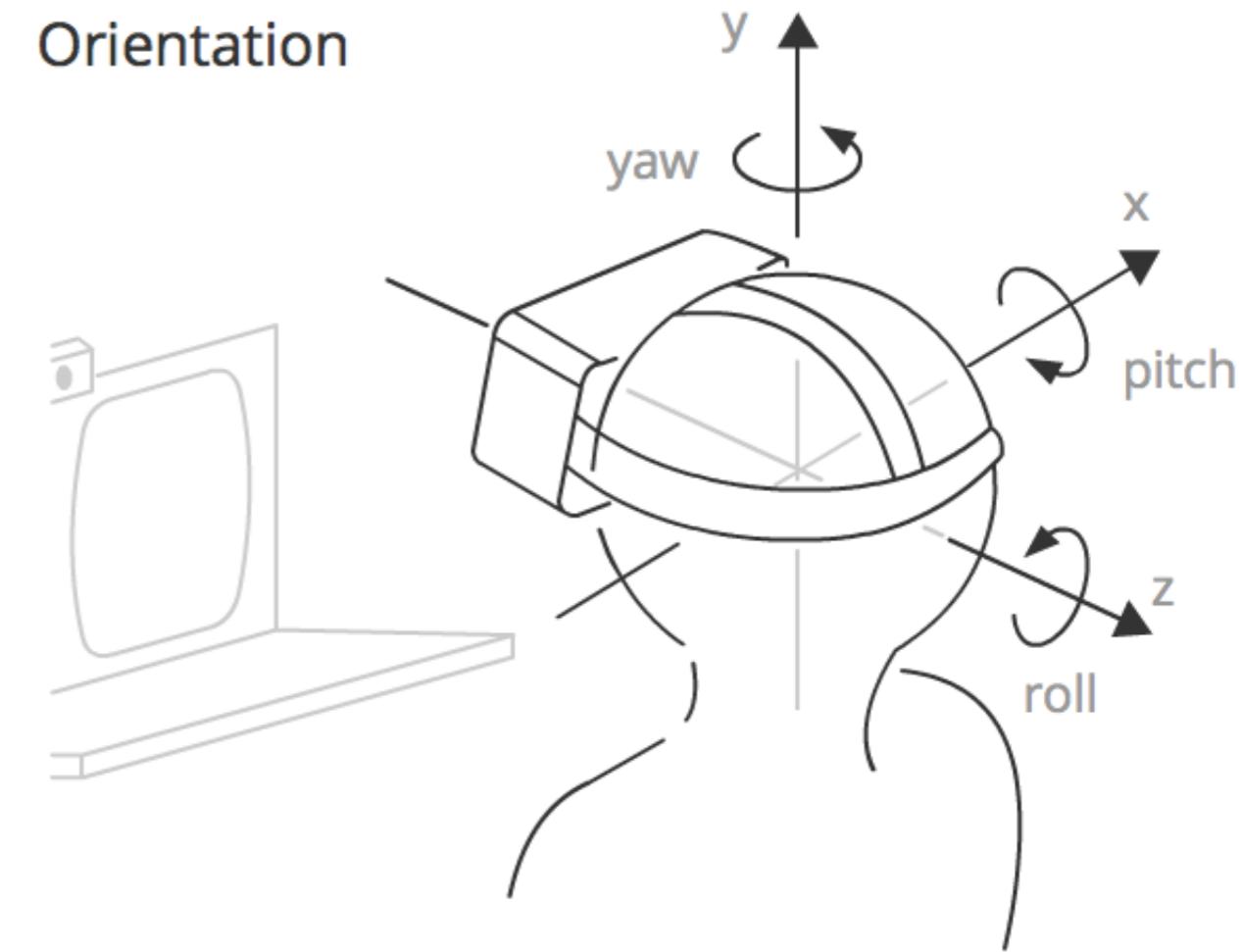
Sense organs

- Head tracking: Most important to avoid visual-vestibular conflict.

Position



Orientation

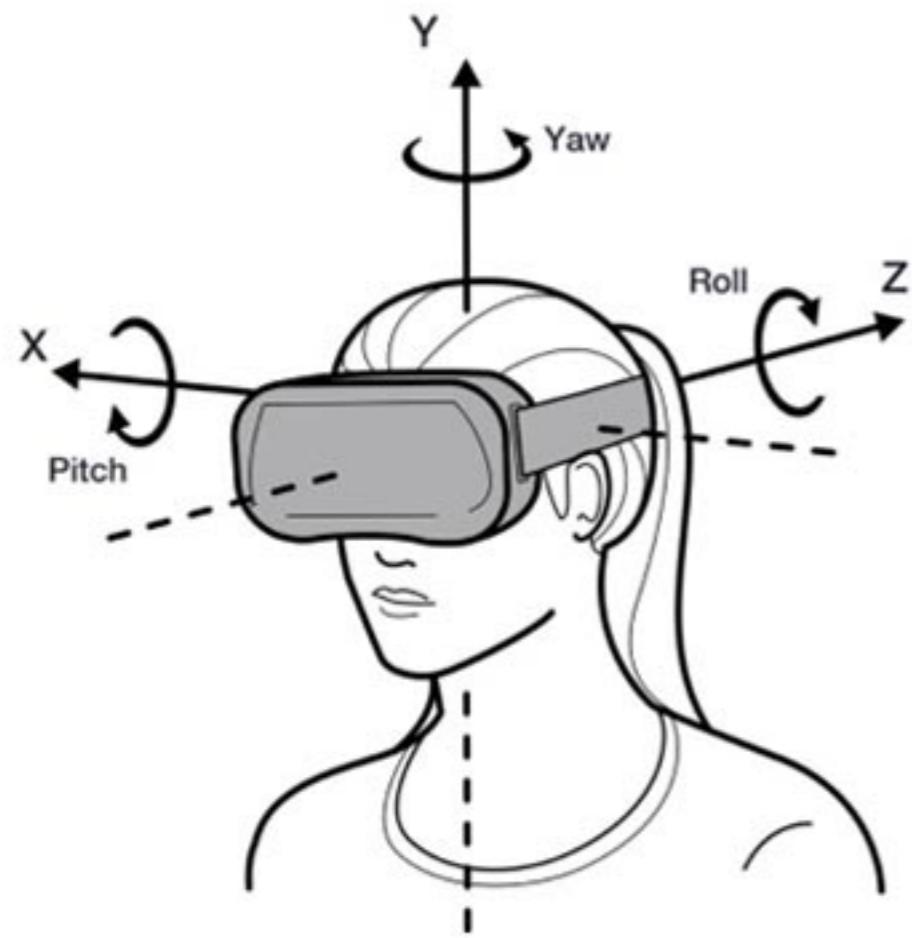


Sense organs II

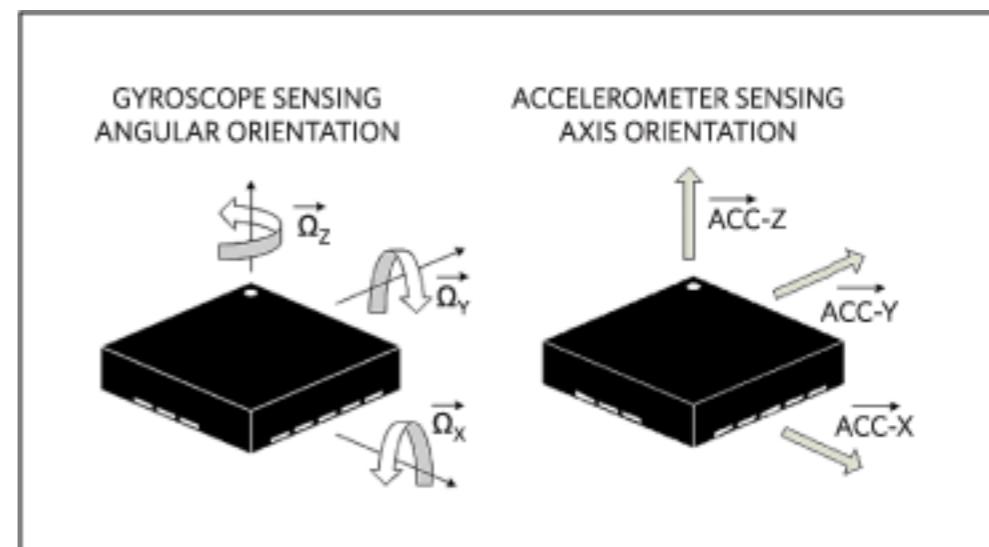
- Eye tracking - foveated rendering



Mobile VR tracking

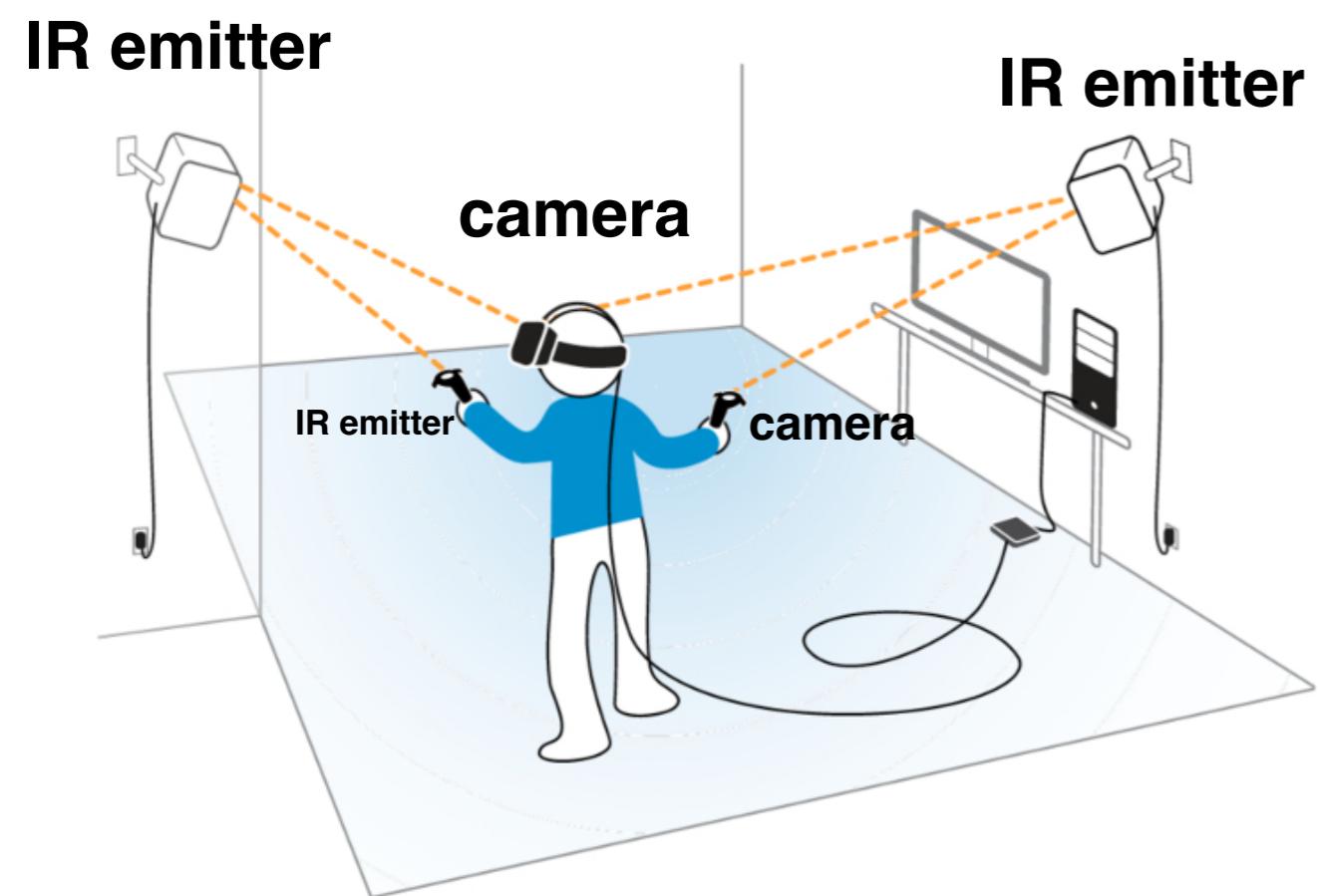


3 degrees of freedom

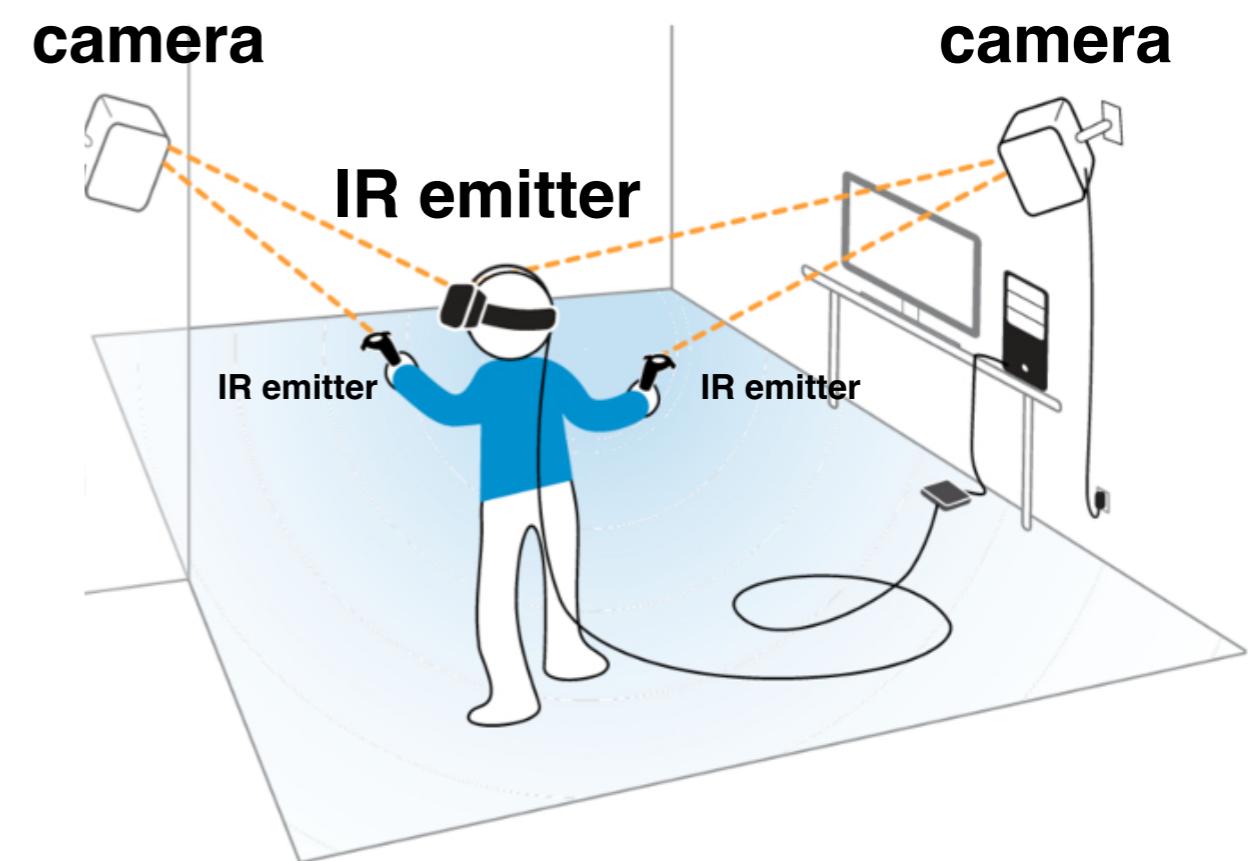


Sixaxis IMU
head tracking only uses gyro

Desktop VR tracking



inside out tracking



outside in tracking

desktop VR tracking



IR leds



photo diodes

sensor fusion: combination of inertial + positional tracking

<https://www.youtube.com/watch?v=J54dotTt7k0>

Standalone tracking



<https://www.youtube.com/watch?v=lg3nGzxQ8Ec>

Tracking



Marker-based



Marker-less



Hand tracking



htc Vive



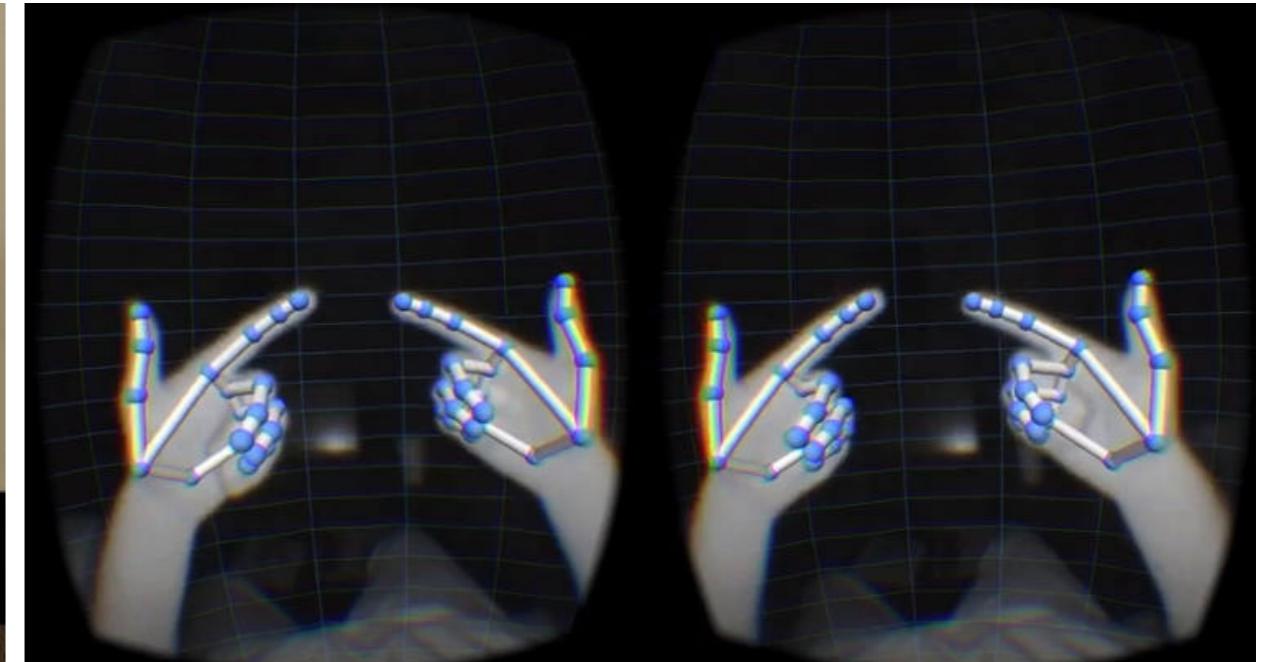
Oculus rift

sensor fusion: combination of inertial + positional tracking

Hand tracking



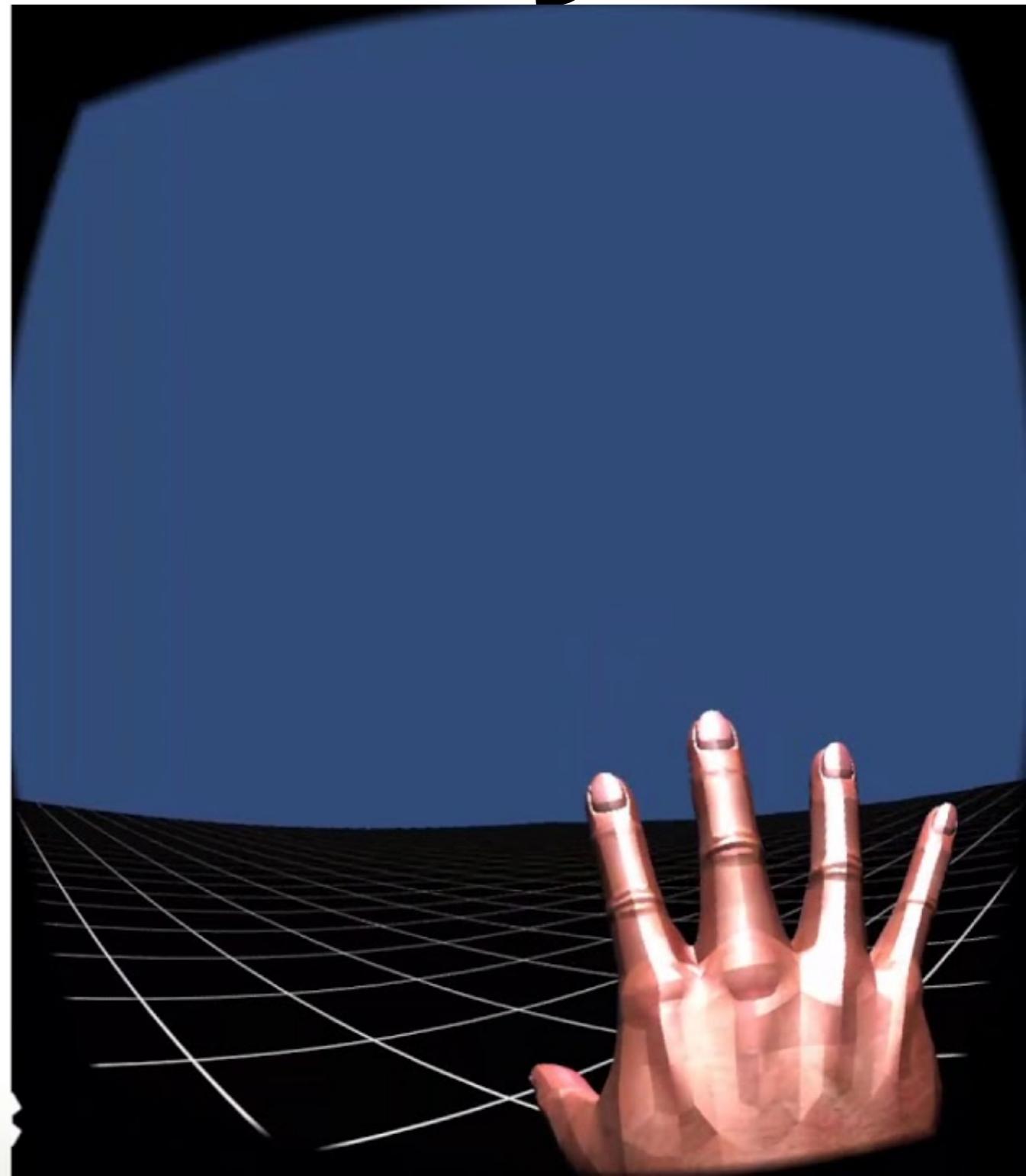
leap motion



lack of tactile feedback?

<https://www.youtube.com/watch?v=rnICGw-0R8g>

Early hand tracking



facial expression tracking



Full body VR tracking

Full-Body
VR Suit



Full body VR tracking



Manus VR | Xsens Edition
manus-vr.com/xsens

Full body VR tracking



<https://www.youtube.com/watch?v=-PSNlAWc5Ro>

Low cost -VR tracking

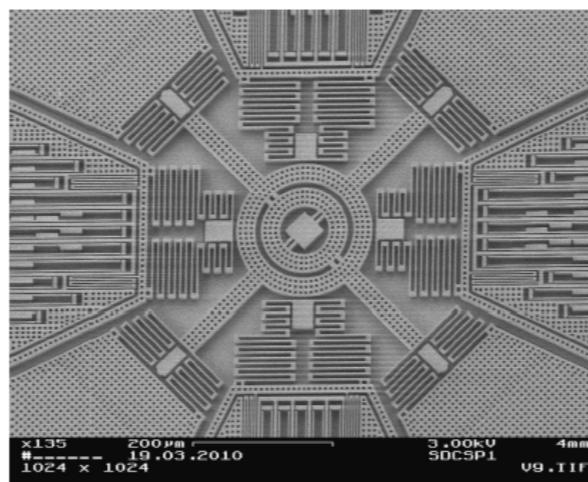
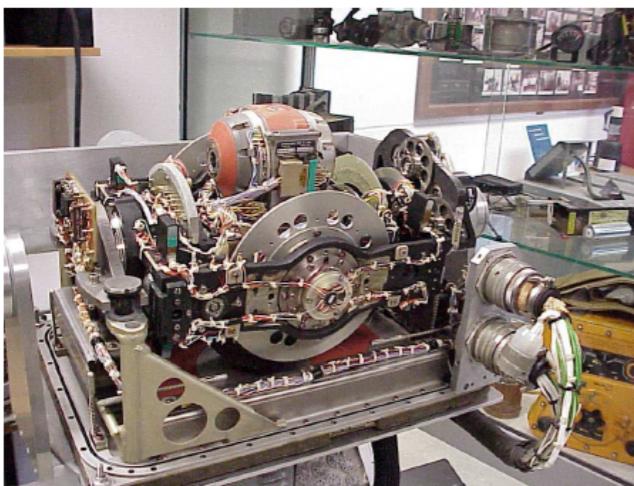


Tracking approaches

	Inertial	Camera	Mechanical	Acoustics
Cost	Low	Medium	High	Low
Accuracy	Lowish	High	High	Low
Range	Wearable	fixed/ wearable	fixed/ Wearable	Wearable / low
Computational	Low	High	Low	Low

IMU-based Tracking

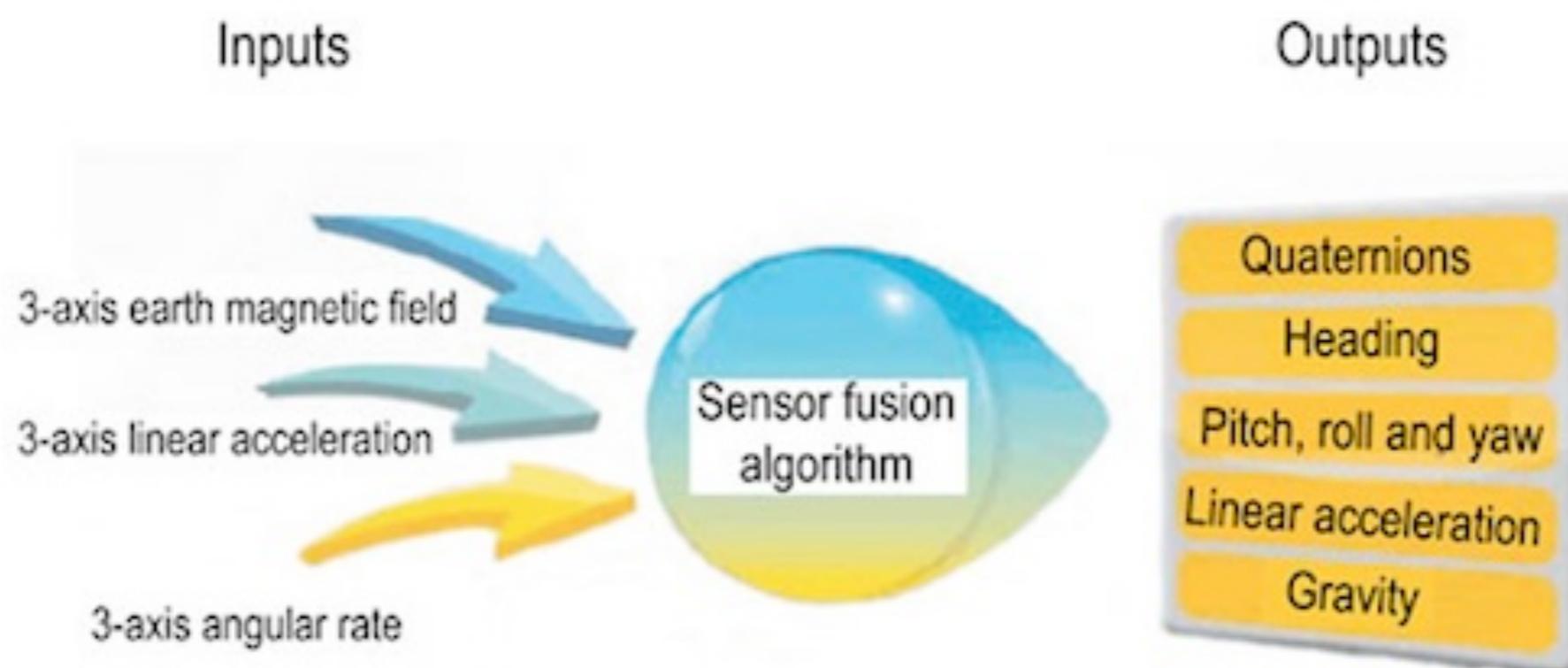
- IMU - inertial measurement unit
 - Micro-Electro-Mechanical Systems (MEMS)
 - Accelerometer -> gravity plus linear acceleration
 - Gyroscope -> angular velocity
 - Magnetometer -> magnetic north



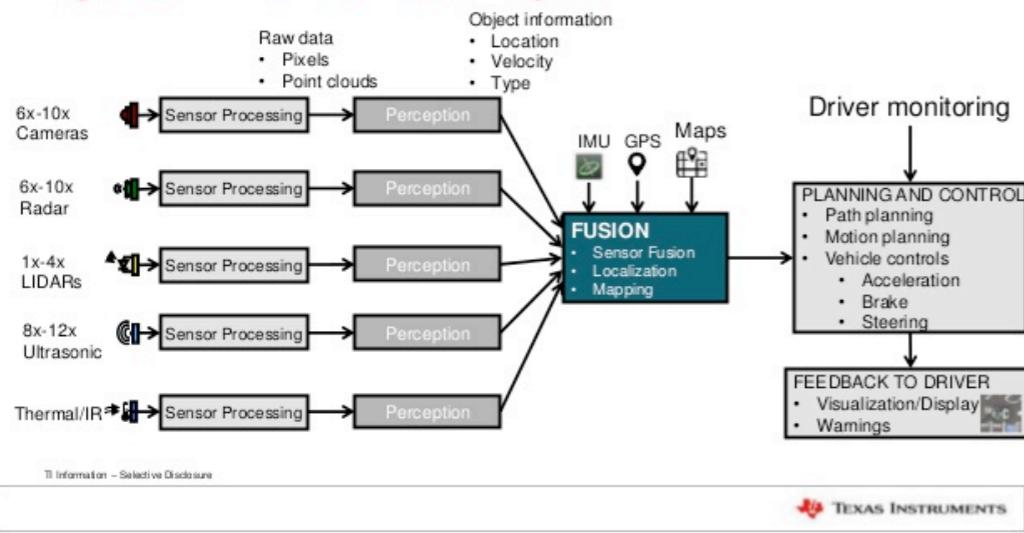
Problems IMUs 2d/3d tracking

- Drift (noise, error grows over time)
- Calibration (cheap sensors poor calibration)
- Integration (how much moved sample rate)
- Registration (find initial orientation)
- Drift correction (sensor fusion/ periodic calibration) Kalman filters.

Sensor fusion



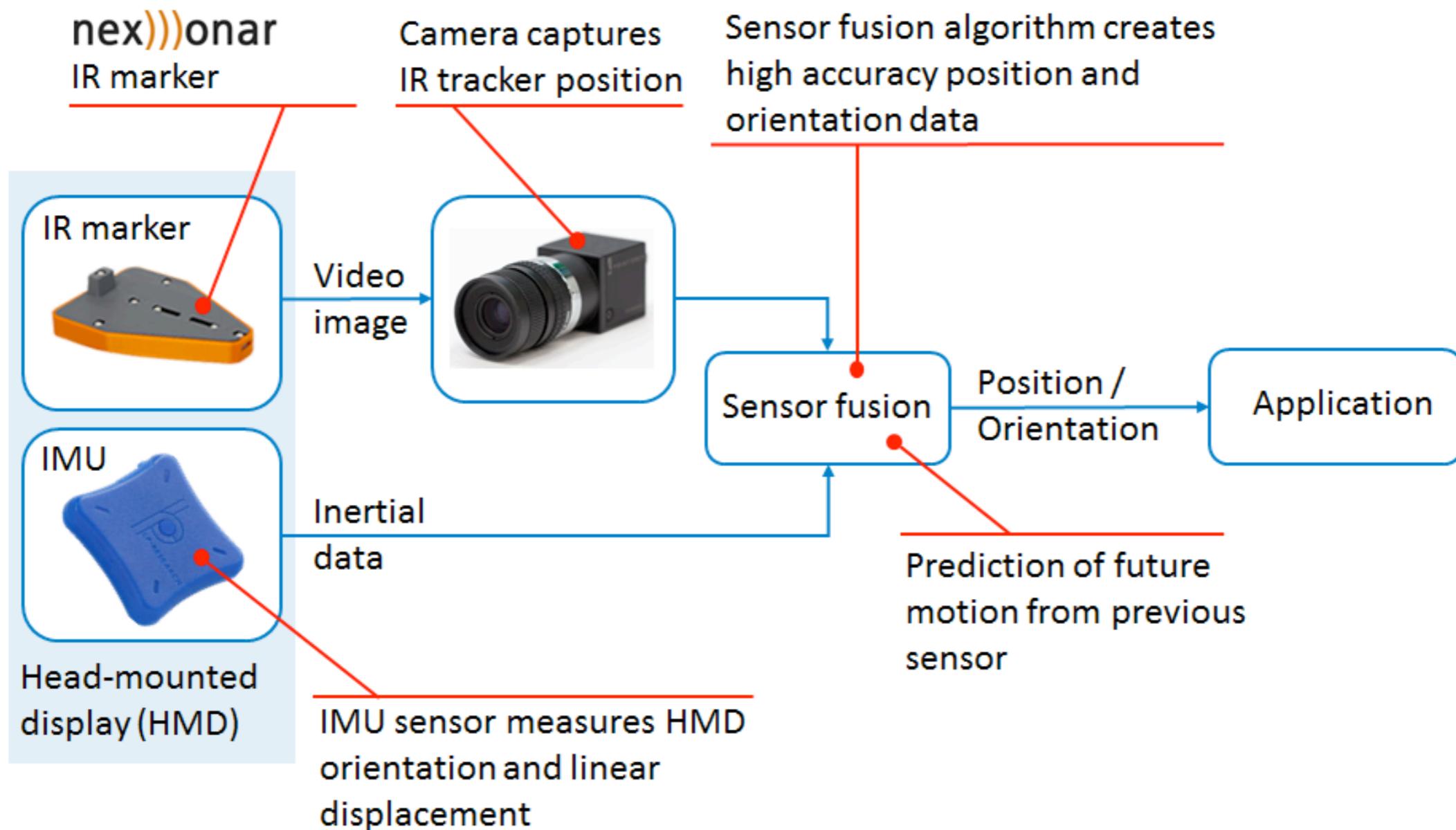
Algorithm view of fusion system



sensor fusion



Sensor fusion



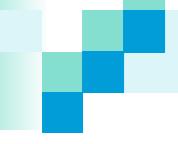
Sensor fusion indoor navigation



Vive Tracking



- IMU + IT tracking (sensor fusion)



How accurate??





Summary

- Latency important for tracking, low latency higher presence
- Various techniques
- Future: biometric tracking (heart rate)