Ready Player One

# Video Games

## Tracking

CS 415: Game Development
(Virtual Reality Module)

Professor Luciano Soares

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# Tracking technologies

Mechanical

Electromagnetic

Acoustical

Inertial (accelerometers, gyroscopes)

Optical

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# Mechanical tracking from Sutherland HMD

The first ever HMD used a mechanical tracking solution to identify user's head pose

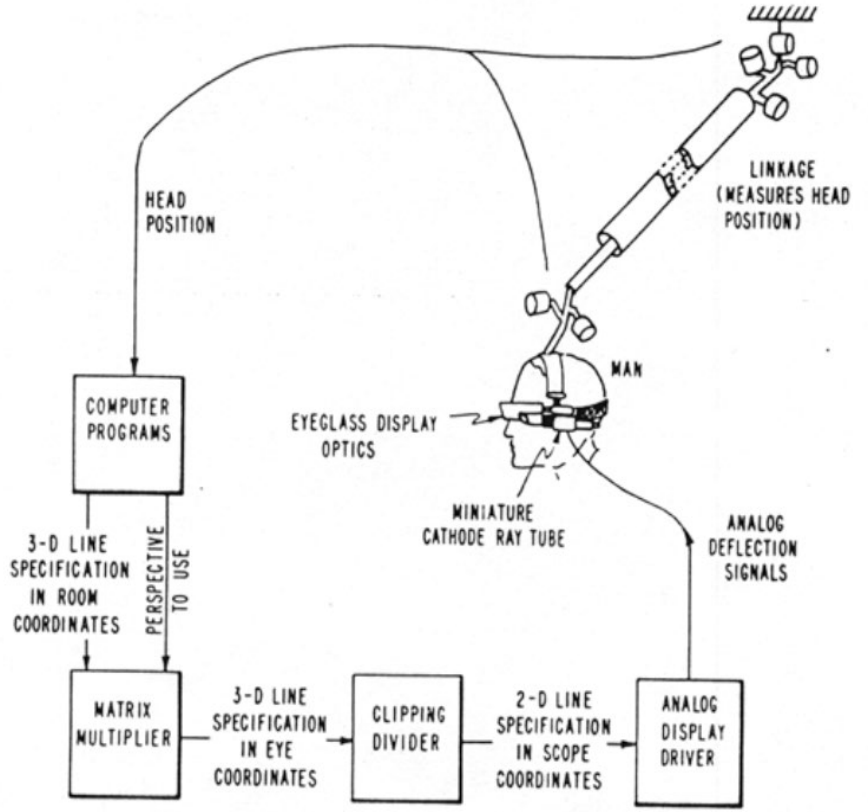


FIGURE 1—The parts of the three-dimensional display system

Reference: Ivan E. Sutherland. 1968. A head-mounted three dimensional display. In Proceedings of the December 9-11, 1968, fall joint computer conference, part I (AFIPS '68 (Fall, part I)). Association for Computing Machinery, New York, NY, USA, 757–764. https://doi.org/10.1145/1476589.1476686

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# The Sword of Damocles

Reference: Ivan E. Sutherland. 1968. A head-mounted three dimensional display. In Proceedings of the December 9-11, 1968, fall joint computer conference, part I (AFIPS '68 (Fall, part I)). Association for Computing Machinery, New York, NY, USA, 757–764. https://doi.org/10.1145/1476589.1476686

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# Mechanical Tracking - Encoders

Encoders:

Absolute and Incremental Encoders

Types

- Linear Encoders
- Rotary Encoders
- Angle Encoders

Sensing

- Optical
- Magnetic
- Capacitive

**Rotary Encoder**

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# Mechanical

Articulated arm paradigm

**Problems:**

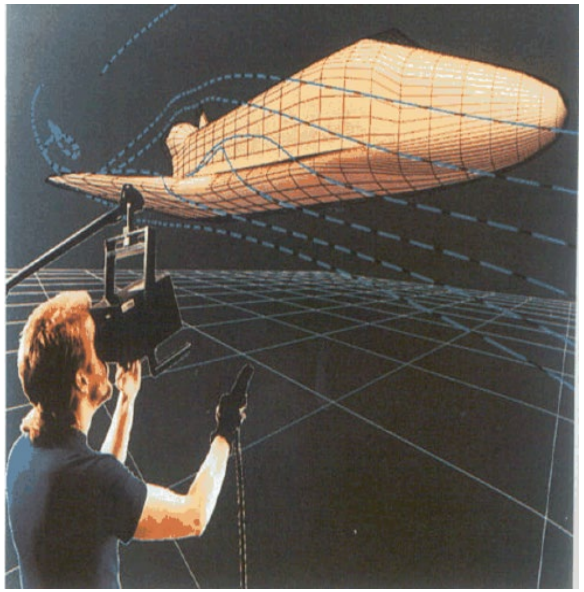
Limited by the size of the articulated arms

User stuck in the system

**Example:**

Fake Space Labs BOOM

**Fakespace Boom**





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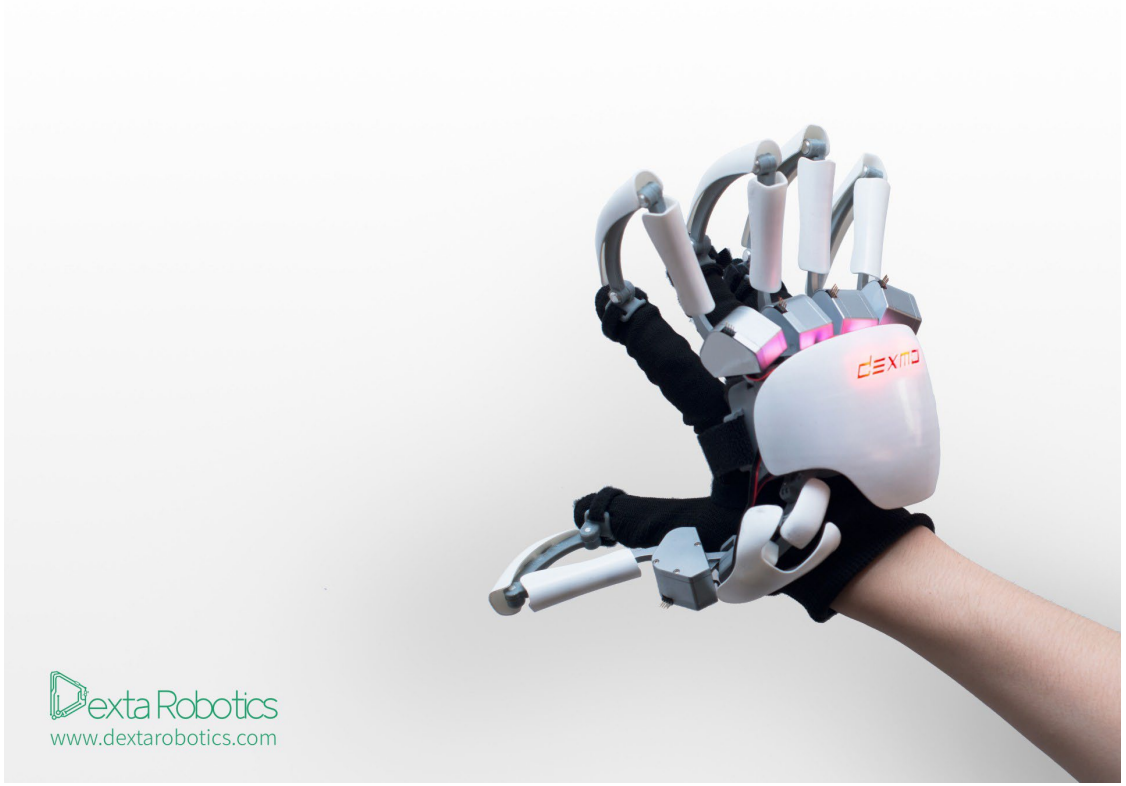
# Kind of Mechanical Tracking


Phantom Omni



# Electromagnetic

Measures a magnetic field

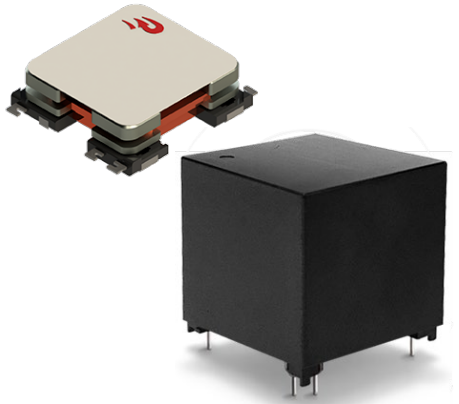
**Problems:**

Interference of metallic materials

**Example:**

- Ascension Flock of Birds
- Magic Leap
- Premo

**Magic Leap 1 6DoF electromagnetic tracking**



**Premo**


**Ascension Flock of Birds**

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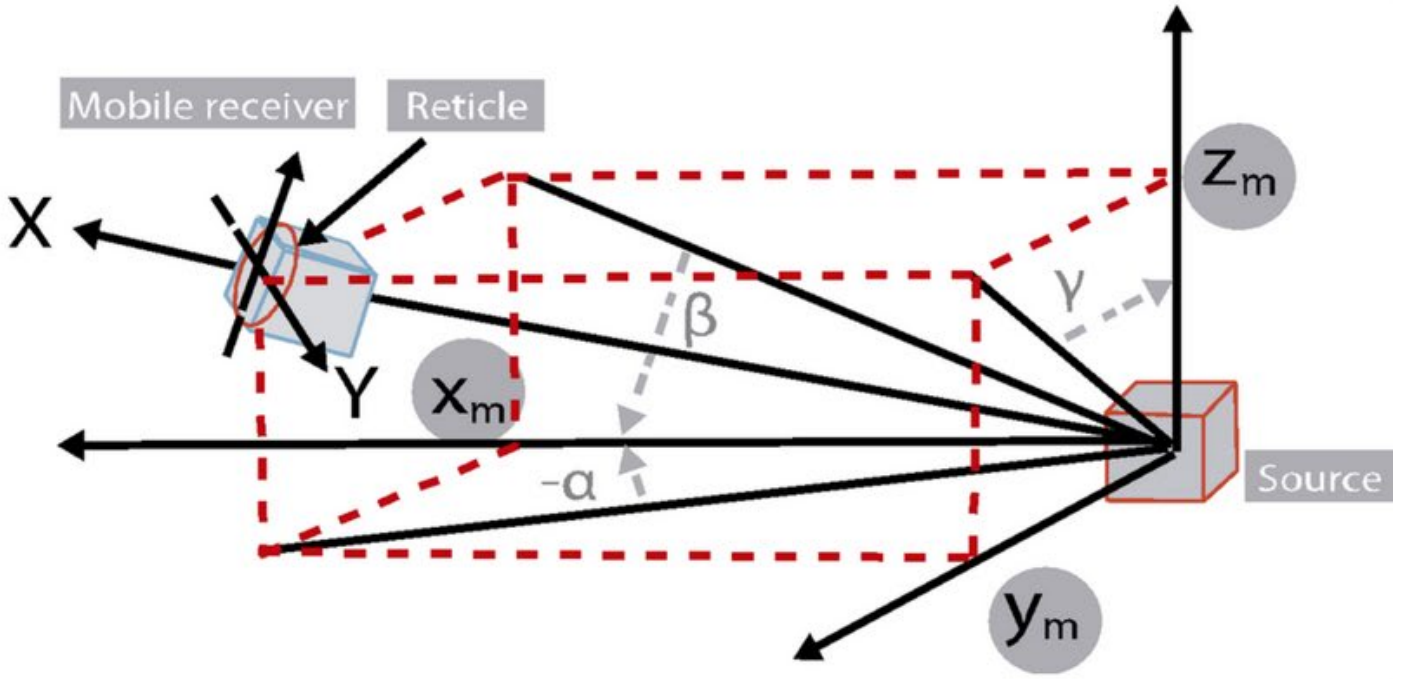
# How Electromagnetic Trackers work




Source: https://3dcoil.grupopremo.com/blog/electromagnetic-tracking-systems-virtual-reality/

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# Acoustic

Time-of-flight or wave coherence

**Problems:**

Accumulation of errors

Low refresh rate and occlusions

**Example:**

TDK SonicTrack Chip CH-101

Intersense I-900


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# Inertial

uses gyroscopes and accelerometers (eventually magnetometers)

**Problems:**

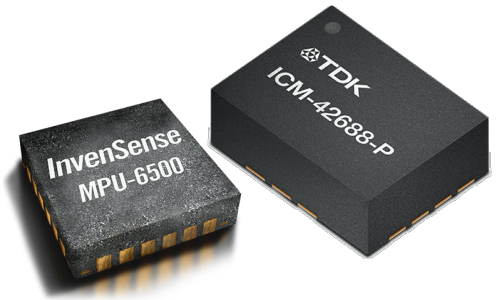
can accumulate errors

**Examples:**

Perception Neuron

MotionNode

Intersense InertiaCube




**Inertial Measurement Units (IMU)**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# Optic (Outside-in)

Currently most used solution

**Problems:**

Line of sight, ambient light and infrared radiation problem

**Example:**

Vicon

ARTrack by A.R.T

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# Motion picture industry application

Pirates of the Caribbean: Dead Man's Chest

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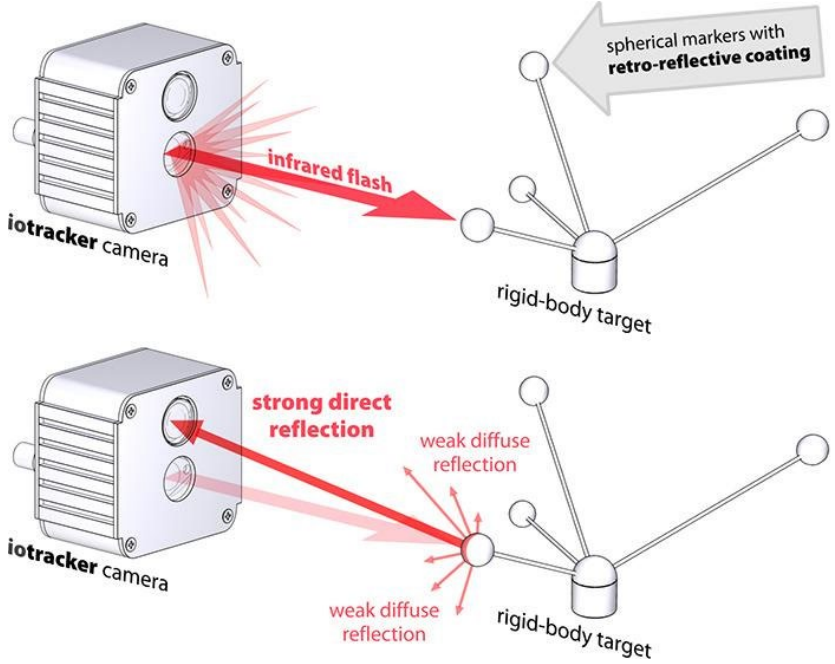
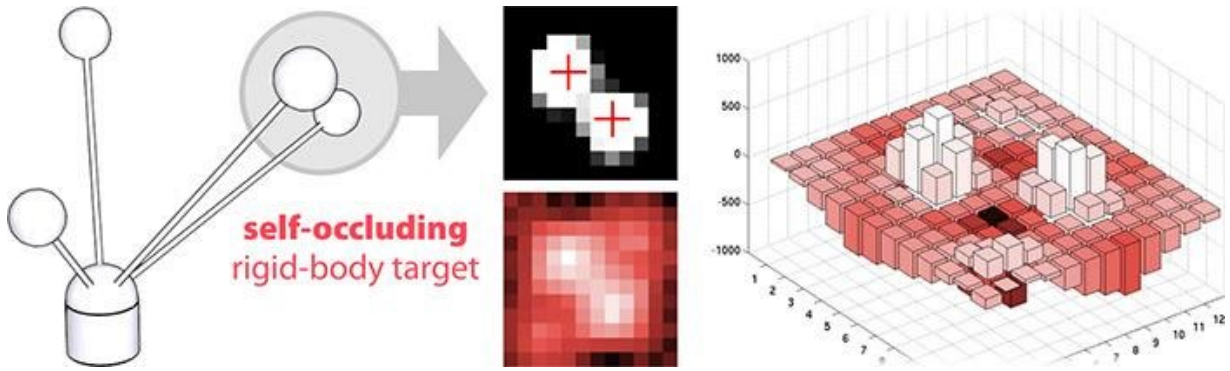
# Optical tracking


Vicon Tracking / iotracker



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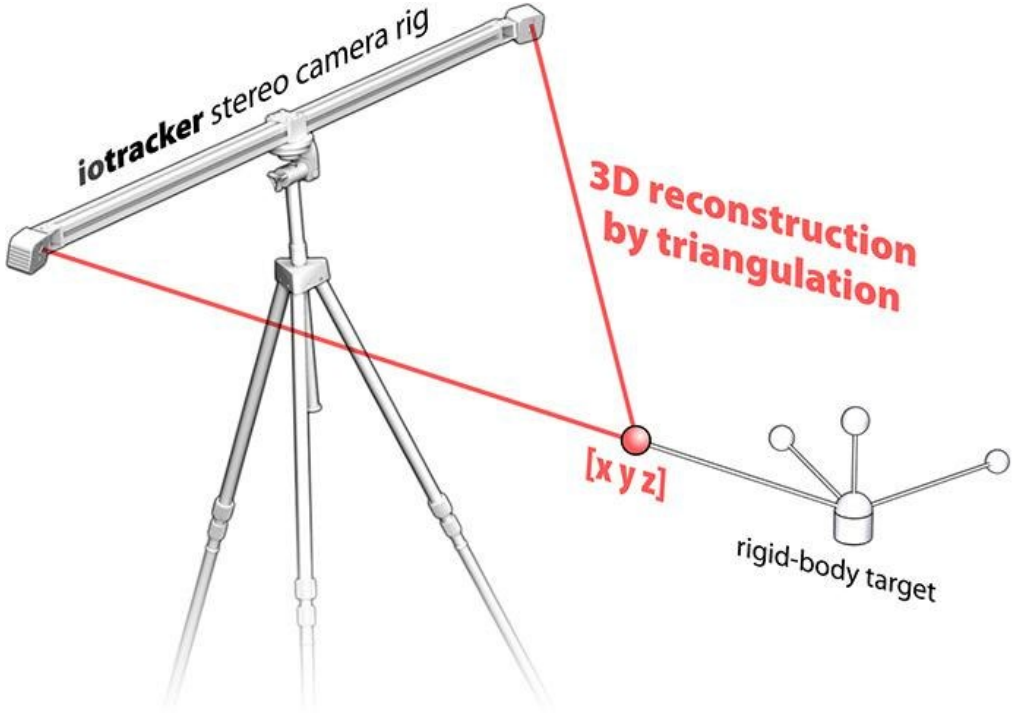
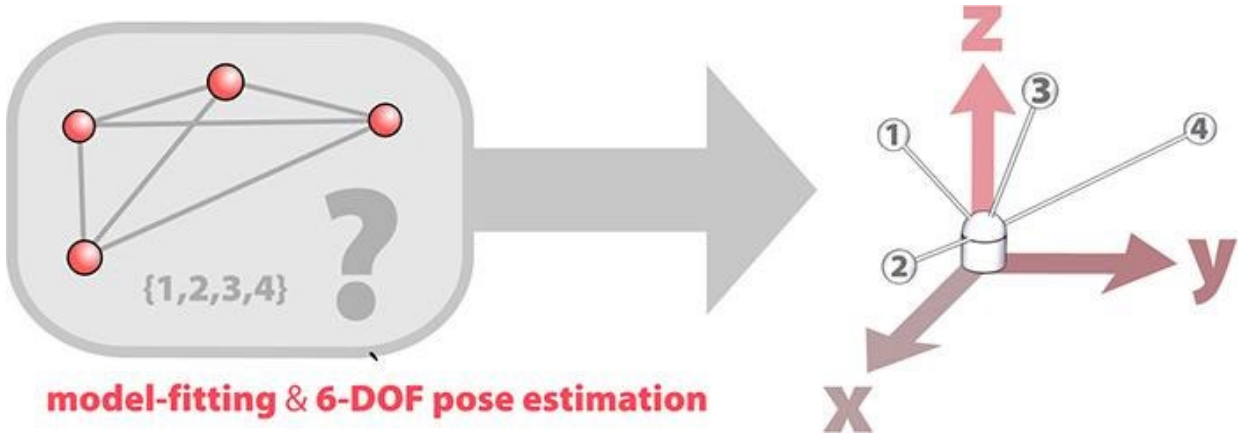
# Needs many cameras and spheres




Vicon Tracking / iotracker

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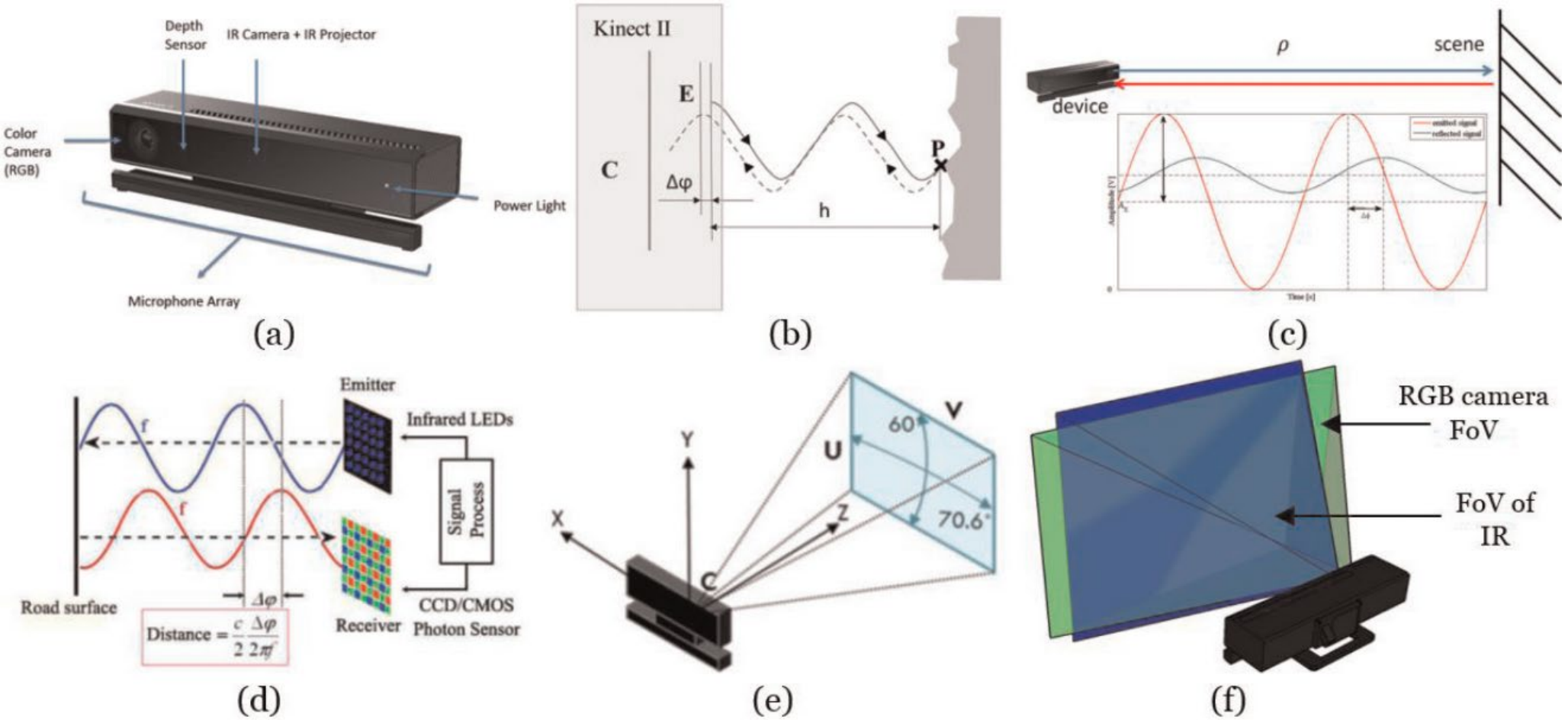
# Kinect v2




Ouma, Yashon. (2019). On the Use of Low-Cost RGB-D Sensors for Autonomous Pothole Detection with Spatial Fuzzy c-Means Segmentation. 10.5772/intechopen.88877.

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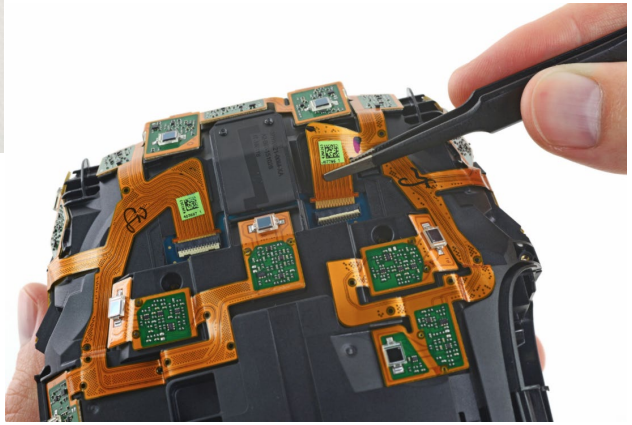
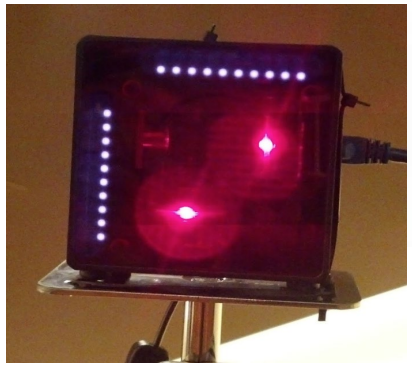
# Vive Tracking Sensors

- Position and Orientation
- Good precision
- Depends on Base Stations



https://www.thevrist.com/steamvr-tracking

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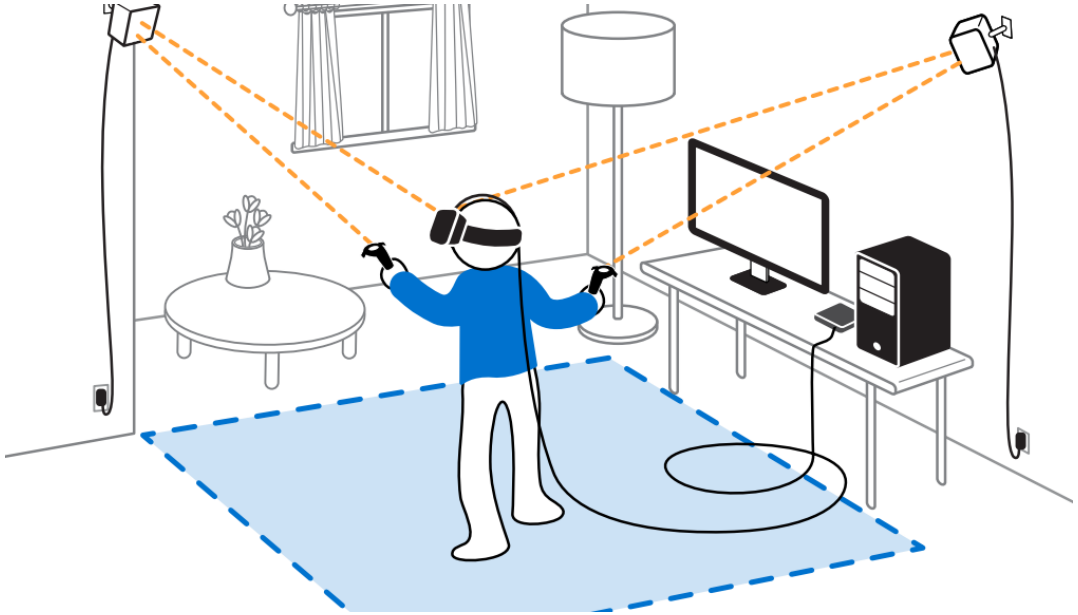
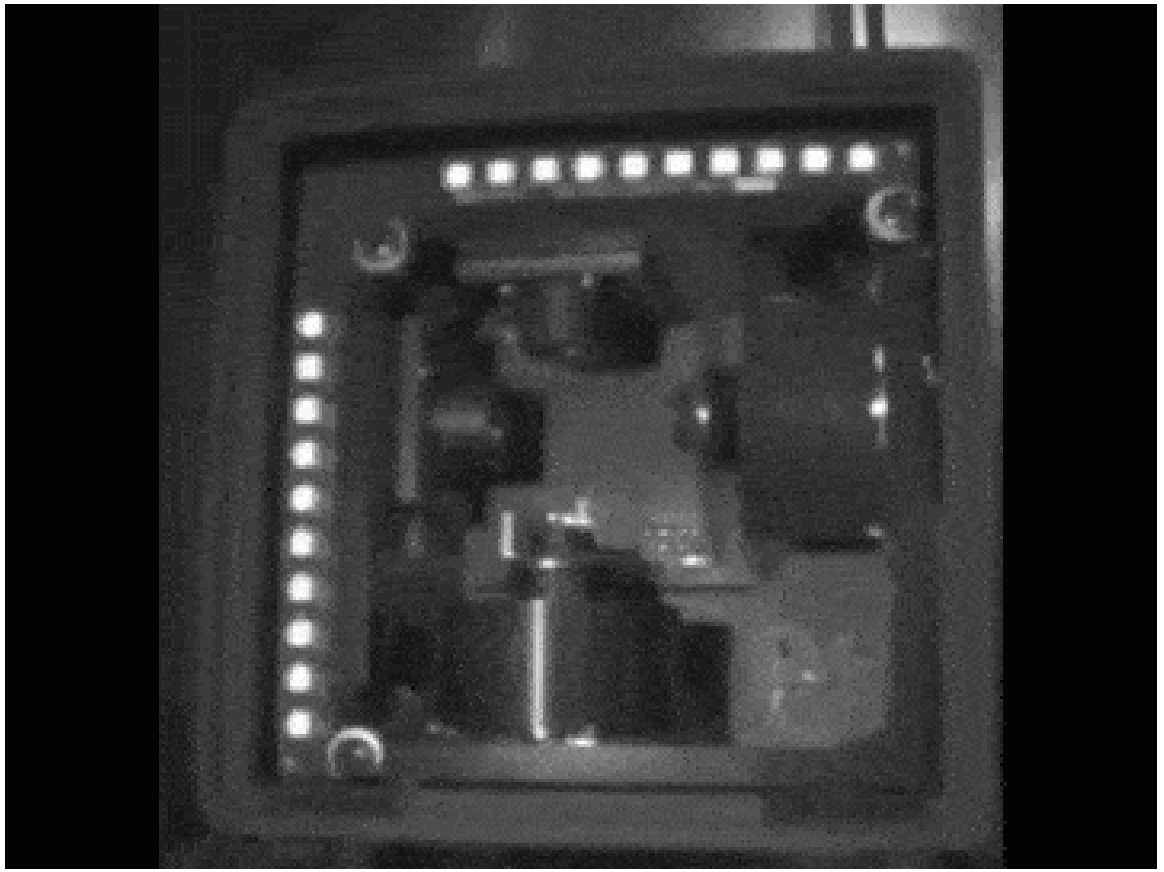
# Lighthouse in Slowmotion





https://www.youtube.com/watch?v=5yuUZV7cgd8

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# Lighthouse Sweep

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

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# SLAM (Simultaneous Localization and Mapping)


Meta Quest 2

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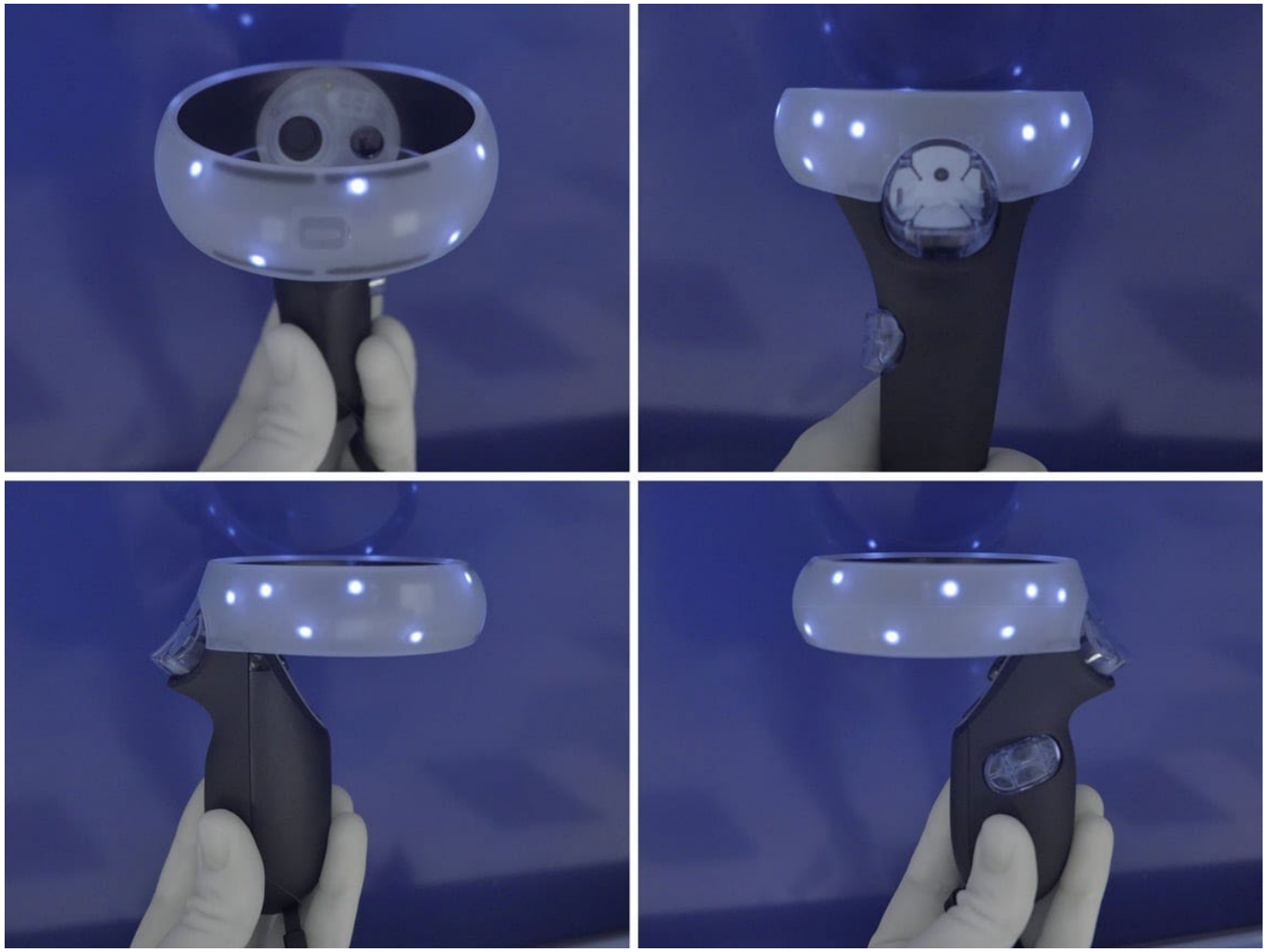
# Quest Touch Controllers



https://www.reddit.com/r/OculusQuest/comments/ca28kn/15_tracking_dots_per_touch_controller_seen/

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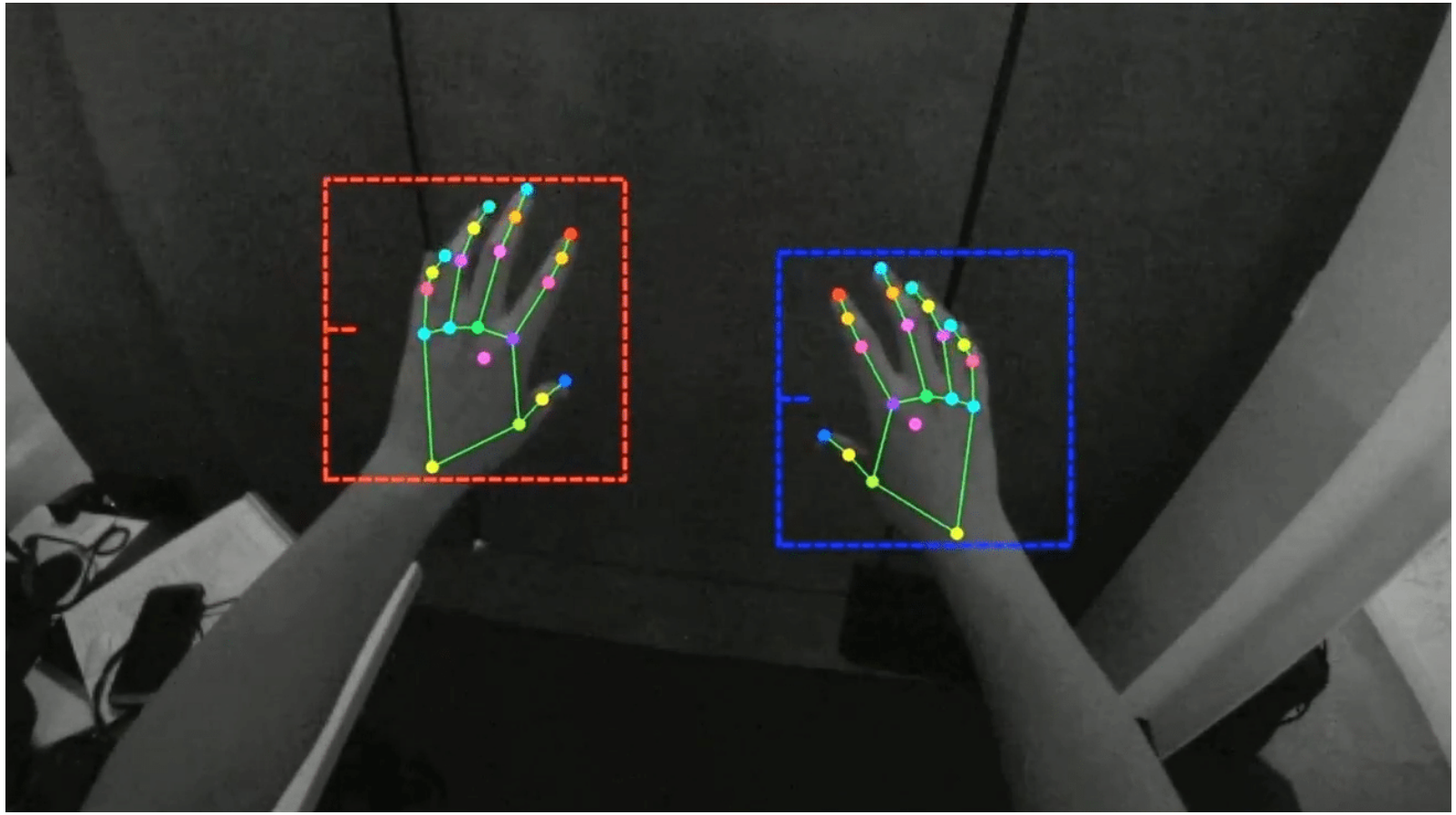
# Hand Tracking



https://www.uploadvr.com/quest-hand-tracking-2-1-fast-movements/

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# Other Tracking Systems

There are several technologies for tracking, let's see some of them here.


KatVR

GPS satellite