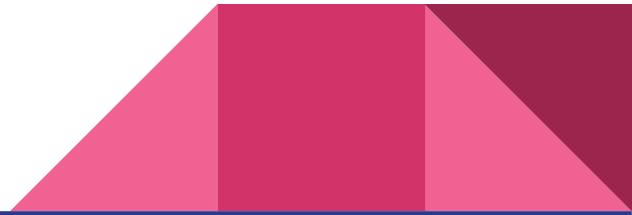
Virtual Reality Basics

-srikrishna s



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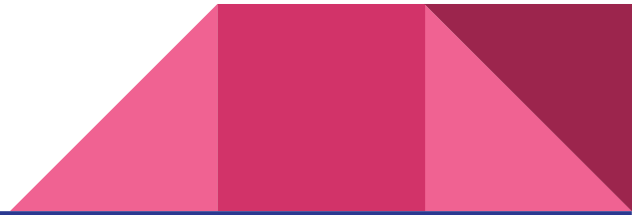
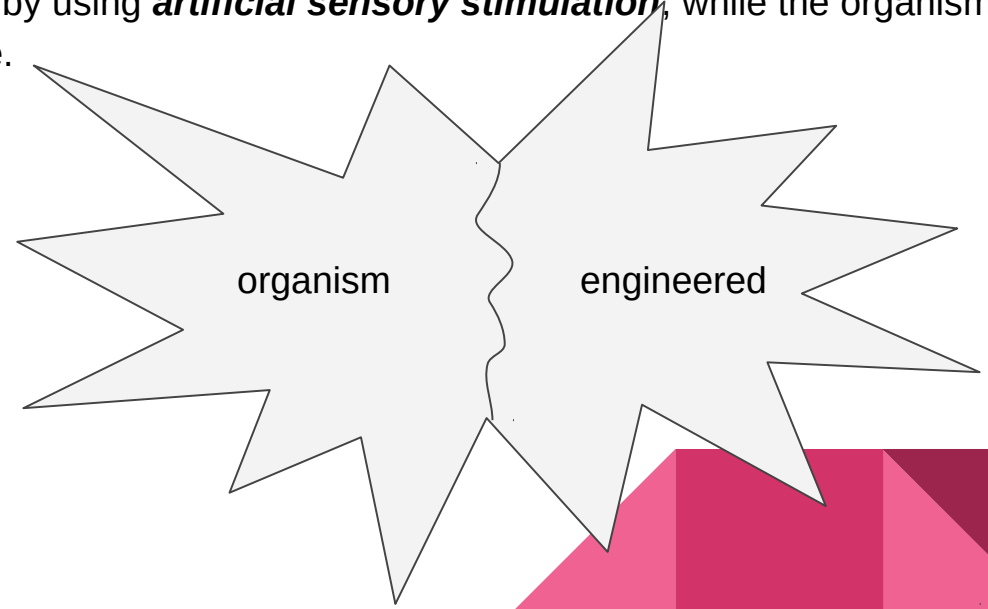


Introduction

What Is Virtual Reality?

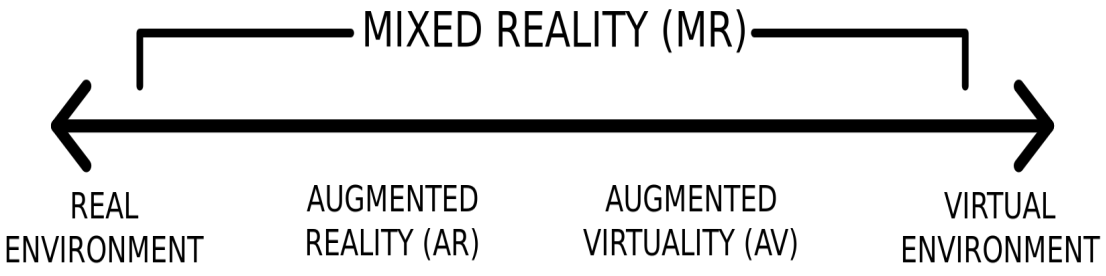
Inducing ***targeted behavior*** in an ***organism*** by using ***artificial sensory stimulation***, while the organism has little or no ***awareness*** of the interference.

- Watching a movie
- Video conference
- Listening to music
- Talking over a phone
- Playing a video game
- First person vs third person
- Notes could be !!
- arrival of a train at ciotat



Modern VR Experiences

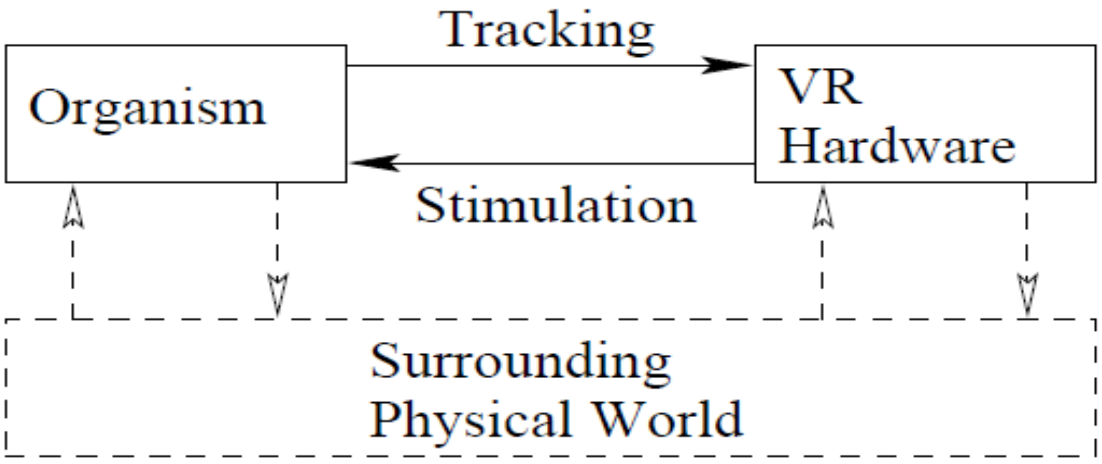
Tele presence { Google's street view, Earth
Virtual Societies { avatars, fb, plus, second
Empathy
Education
Virtual Prototyping
Health Care
Augmented and Mixed Reality
New Human Experiences

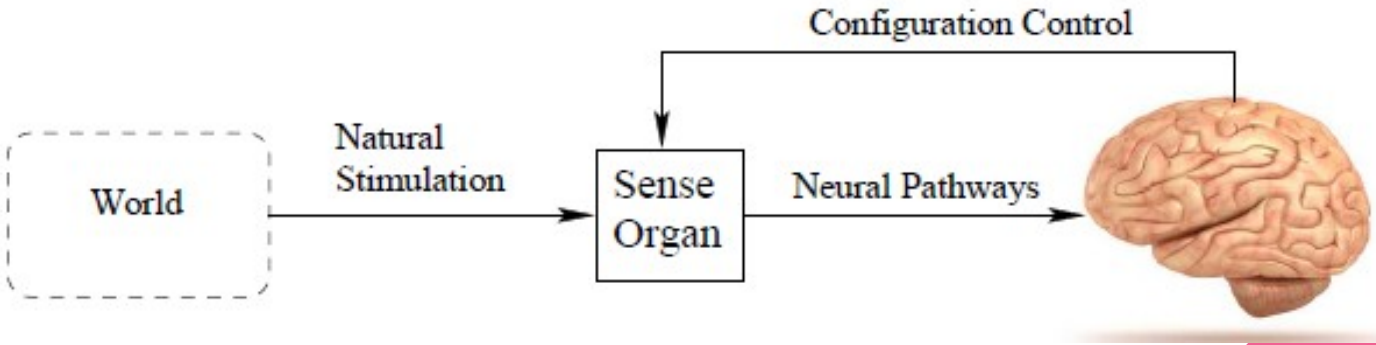


Components

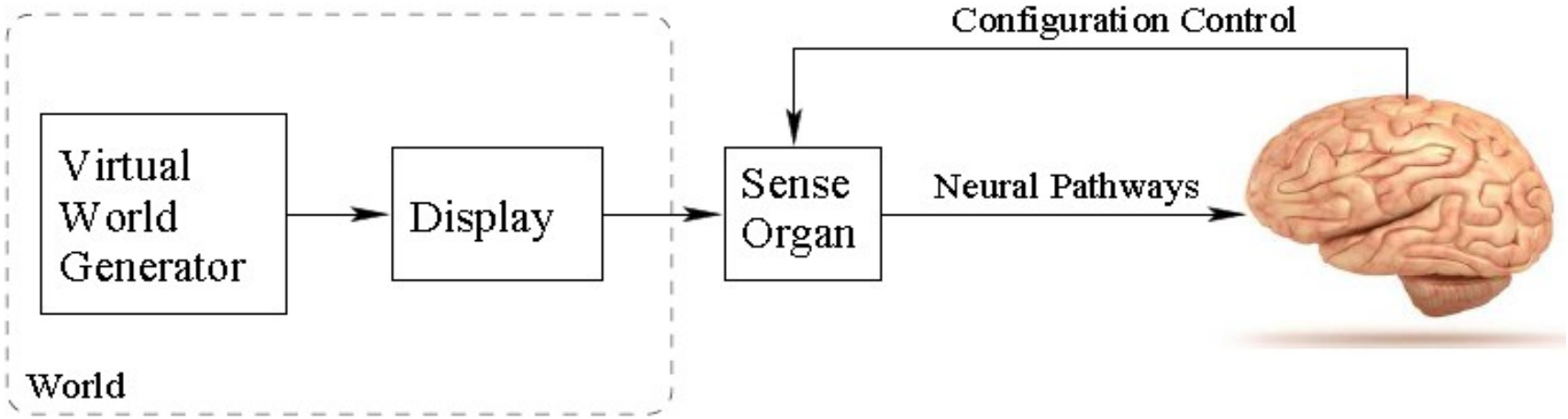
Pick a sensor

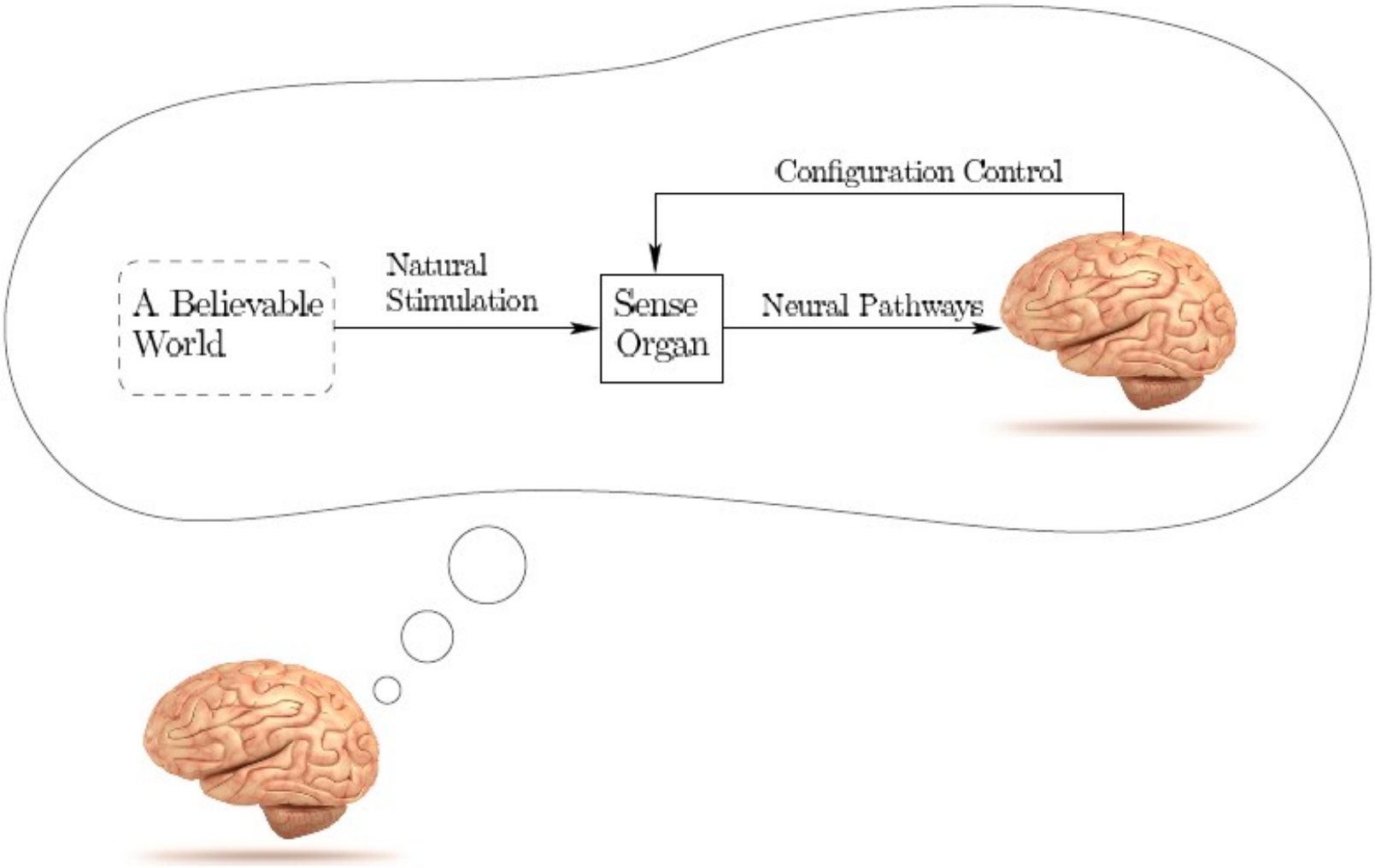
{eye,ear,finger,tongue,nos





Evolution

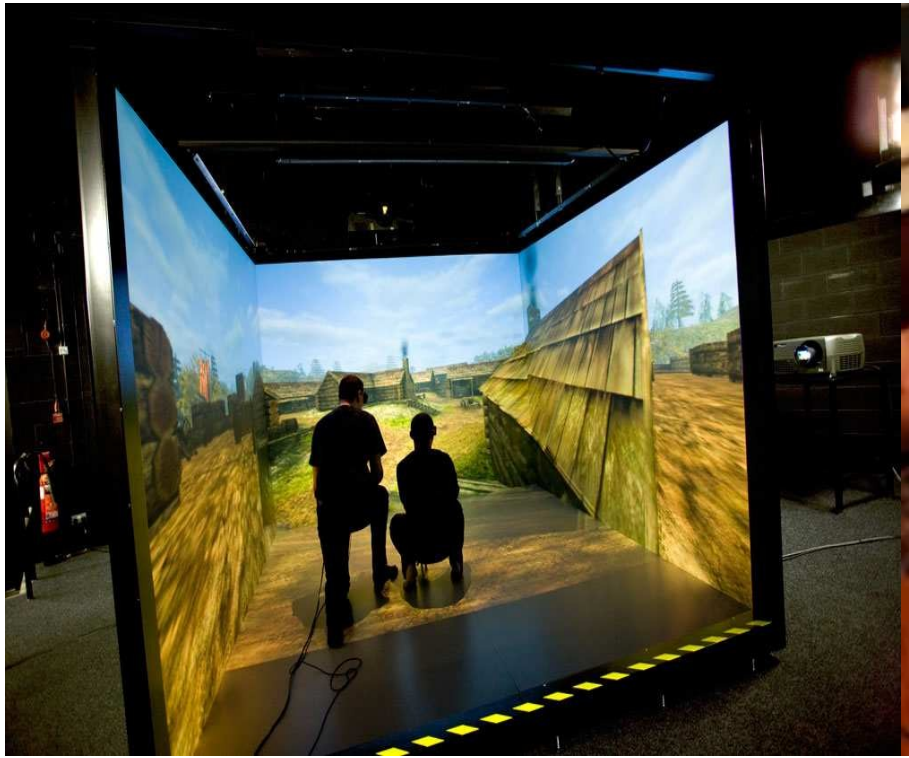

Configuration Control
Virtual World Generator
Display
Sense Organ
Neural Pathways
World


Configuration Control
A Believable World
Natural Stimulation
Sense Organ
Neural Pathways

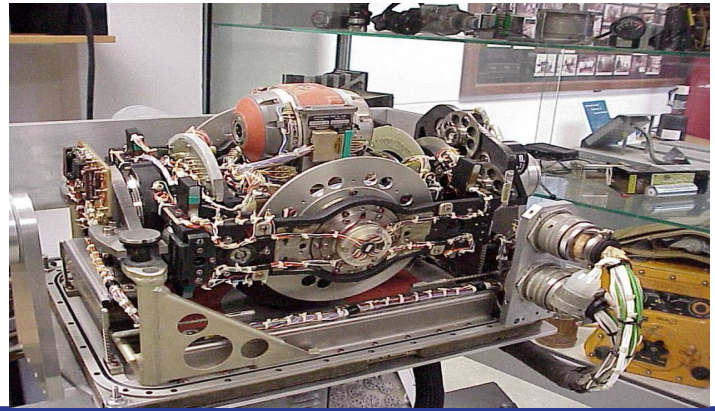
Sensory Organs

Sense	Stimulus	Receptor	Sense Organ
Vision	Electromagnetic energy	Photoreceptors	Eye
Auditory	Air pressure waves	Mechanoreceptors	Ear
Touch	Tissue distortion	Mechanoreceptors	Skin, muscles
		Thermoreceptors	Skin
Balance	Gravity, acceleration	Mechanoreceptors	Vestibular organs
Taste/smell	Chemical composition	Chemoreceptors	Mouth, nose

Hardware (Cave vs HMD)



Hardware contd..



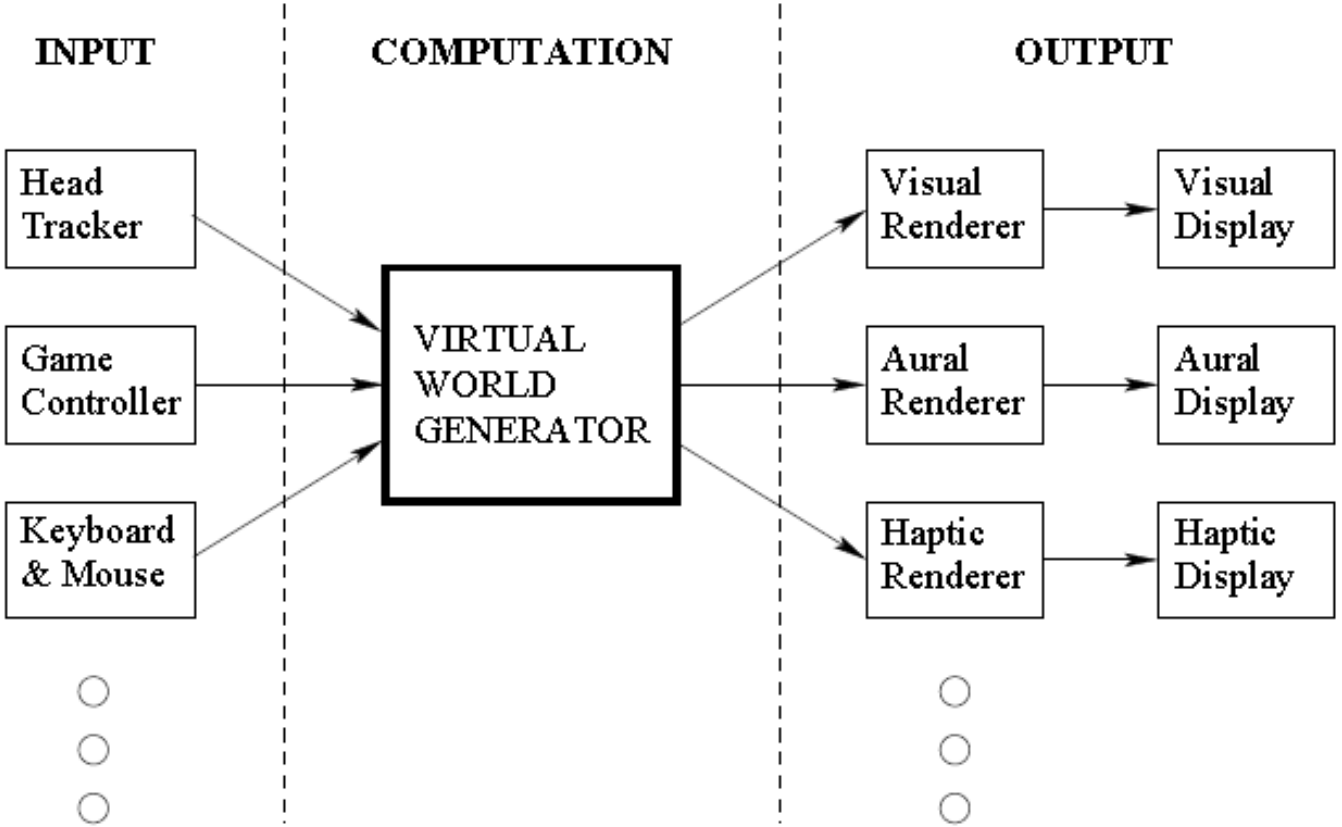
hardware(contd..) Oculus Rift DK2

software

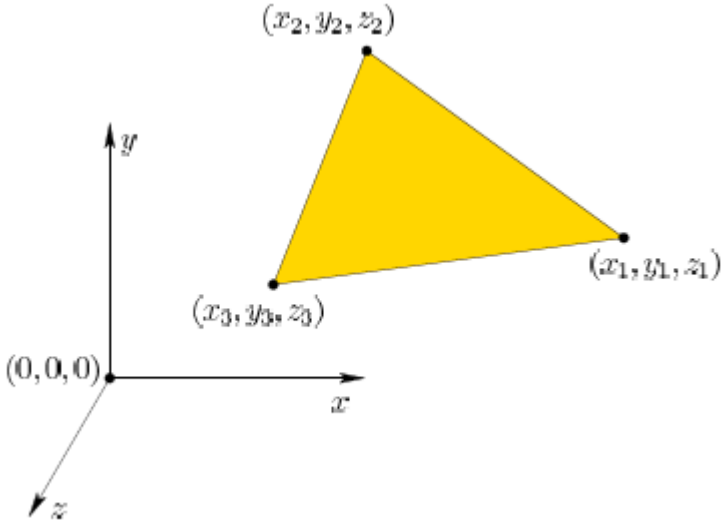
- SDK
- Drivers

Available Tools

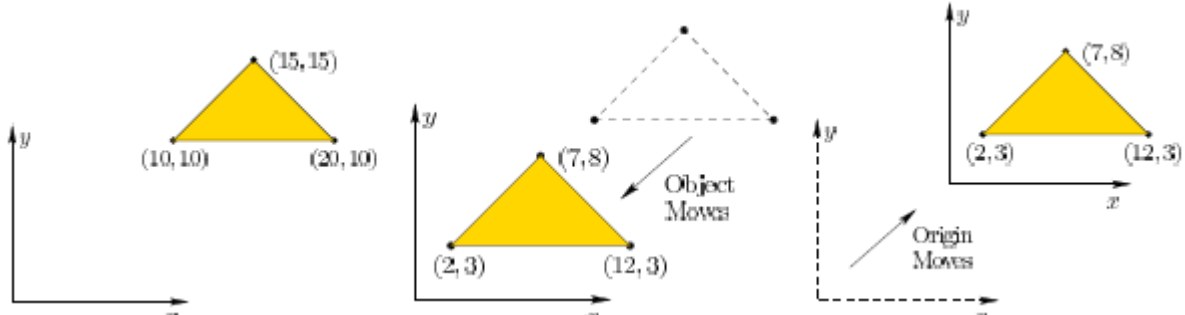
- Opencv & open
- Unity
- Unreal
- Blender
- Maya....

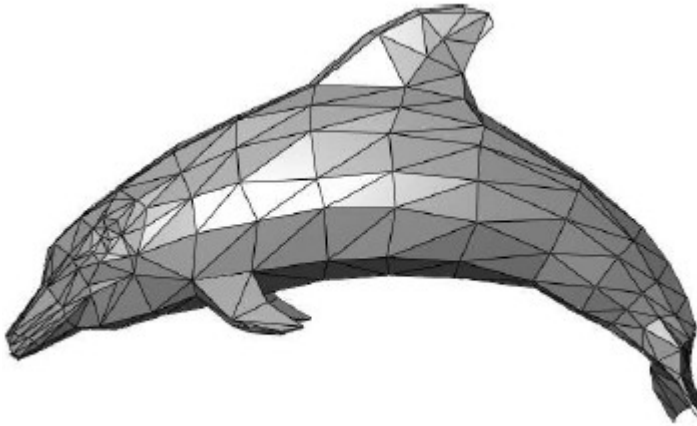


Geometric Models



- Right handed coordinate system
- GPU support for triangles
- Collisons and computation cost
- Stationary vs Movable models
- Choosing coordinate, axis, position n orientation
- Rotations by Identity matrix variations
- Pitch, Yaw, Roll ~ quaternion





Light and Optics

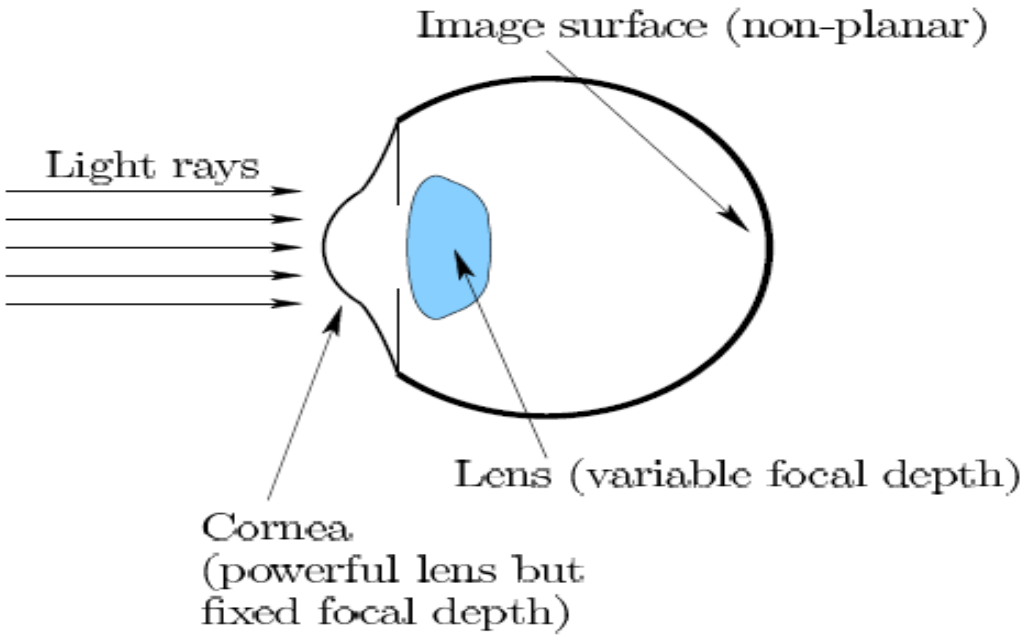
Basic Behavior of Light

Lenses

Optical Aberrations

The Human Eye

Cameras

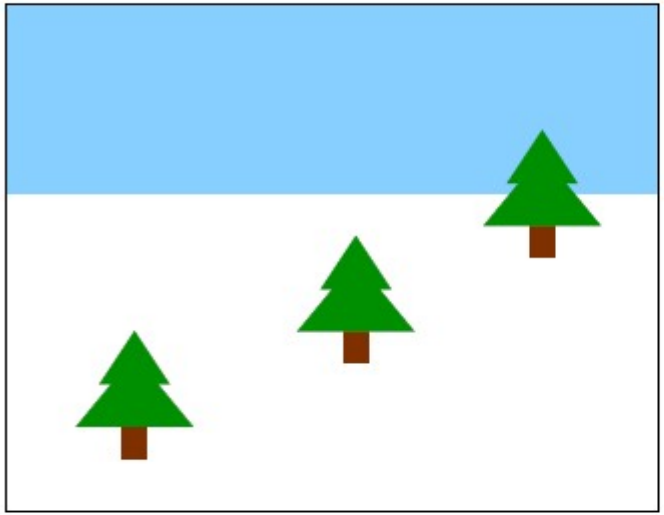


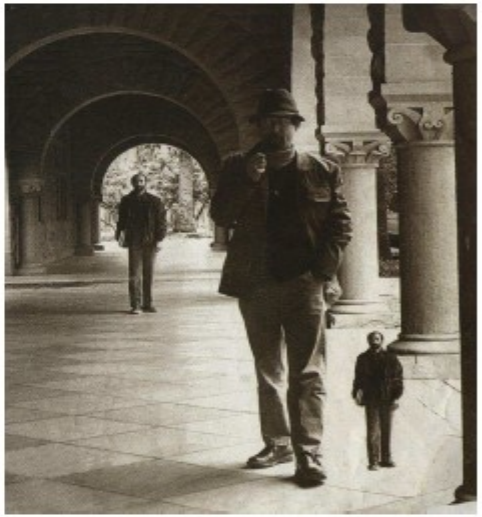
Light source	Luminance (cd/m^2)	Photons per receptor
Paper in starlight	0.0003	0.01
Paper in moonlight	0.2	1
Computer monitor	63	100
Room light	316	1000
Blue sky	2500	10,000
Paper in sunlight	40,000	100,000

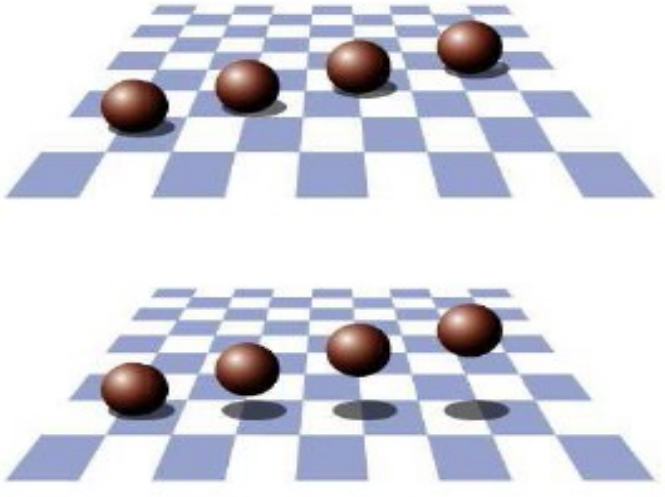
Visual Perception

- Perception of Depth
- Perception of Motion
- Perception of Color
- Combining Sources of Informat

FPS	Occurrence
2	Stroboscopic apparent motion starts
10	Ability to distinguish individual frames is lost
16	Old home movies; early silent films
24	Hollywood classic standard
25	PAL television before interlacing
30	NTSC television before interlacing
48	Two-blade shutter; proposed new Hollywood standard
50	Interlaced PAL television
60	Interlaced NTSC television; perceived flicker in some displays
72	Three-blade shutter; minimum CRT refresh rate for comfort
90	Modern VR headsets; no more discomfort from flicker
1000	Ability to see zipper effect for fast, blinking LED
5000	Cannot perceive zipper effect







Visual Rendering

Correcting Optical Distortions

Improving Latency and Frame Rates

Immersive Photos and Videos

Image Order Rendering	**Object Order Rendering**
Pixel by Pixel	Triangle by Triangle
Ray Tracing	Rasterization
Easier to implement	Harder to implement
Slower	Faster
Academic & Research	Industrial (GPU support)

Motion in Real and Virtual Worlds

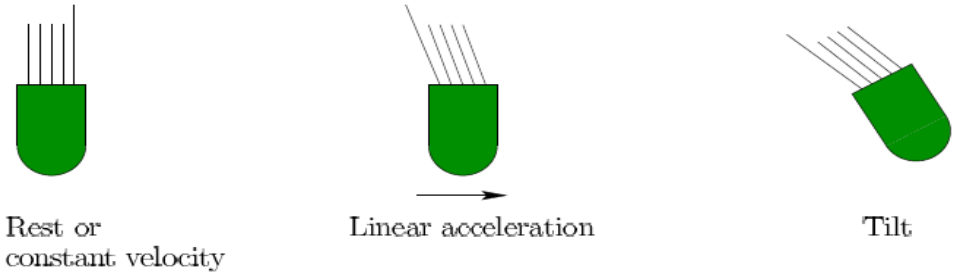
Velocities and Accelerations{v=dy(t)/dt, a=dv(t)/dt, w=d(@(t))/dt, 3d, rigid}

linear, angular,3d linear, 3d angular, rigid bodies their respective velocities and acc

The Vestibular System

Physics in the Virtual World

Mismatched Motion and Vection



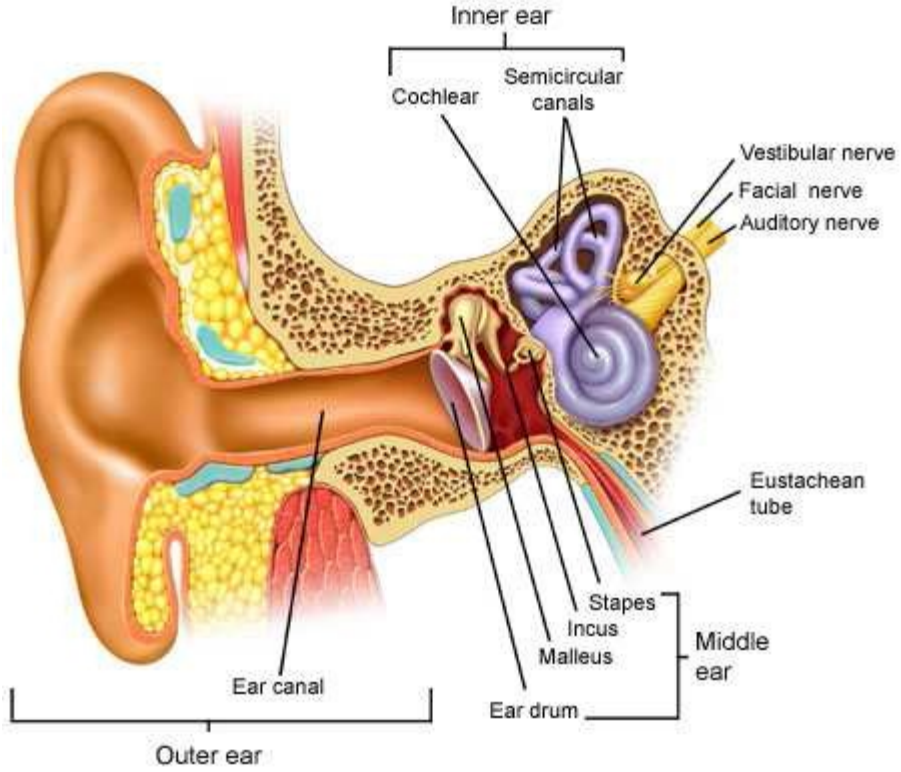
Audio

The Physics of Sound

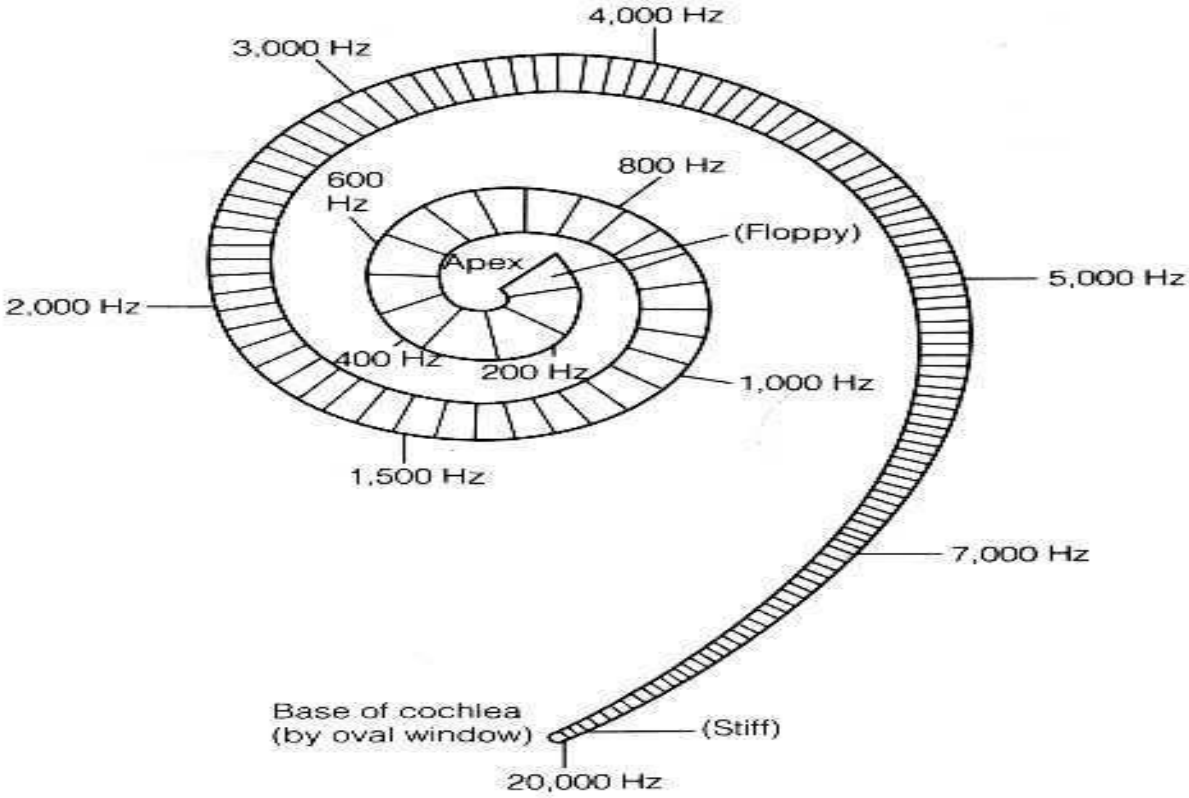
The Physiology of Human Hearing

Auditory Perception

Auditory Rendering



Audio(contd..)


4,000 Hz
3,000 Hz
800 Hz
600 Hz
(Floppy)
Apex
5,000 Hz
2,000 Hz
400 Hz
200 Hz
1,000 Hz
1,500 Hz
7,000 Hz
Base of cochlea
(by oval window)
(Stiff)
20,000 Hz

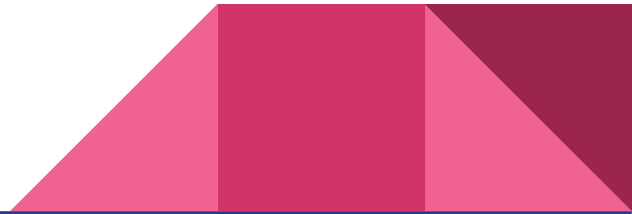
Evaluating VR systems and Experiences

Perceptual Training

Recommendations for Developers

Comfort and VR Sickness

Experiments on Human Subjects



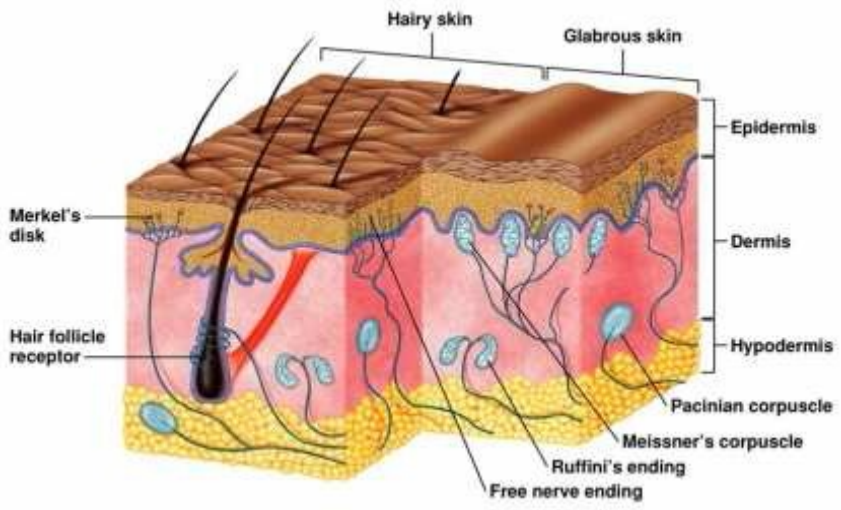
Frontiers

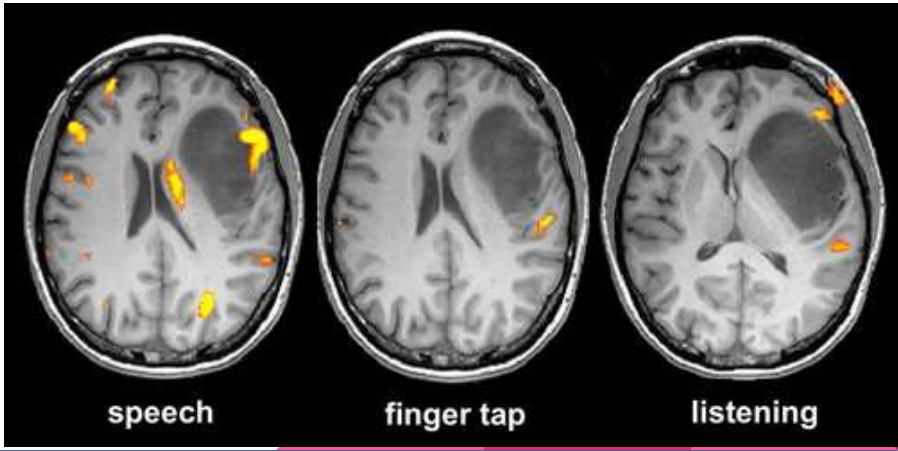
Touch and Proprioception

Smell and Taste

Robotic Interfaces

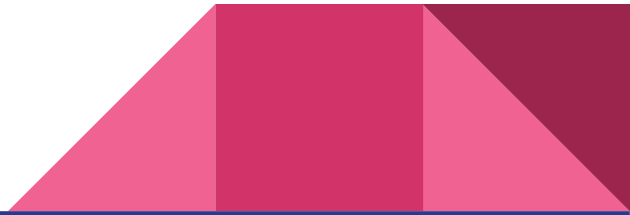
Brain-Machine Interfaces



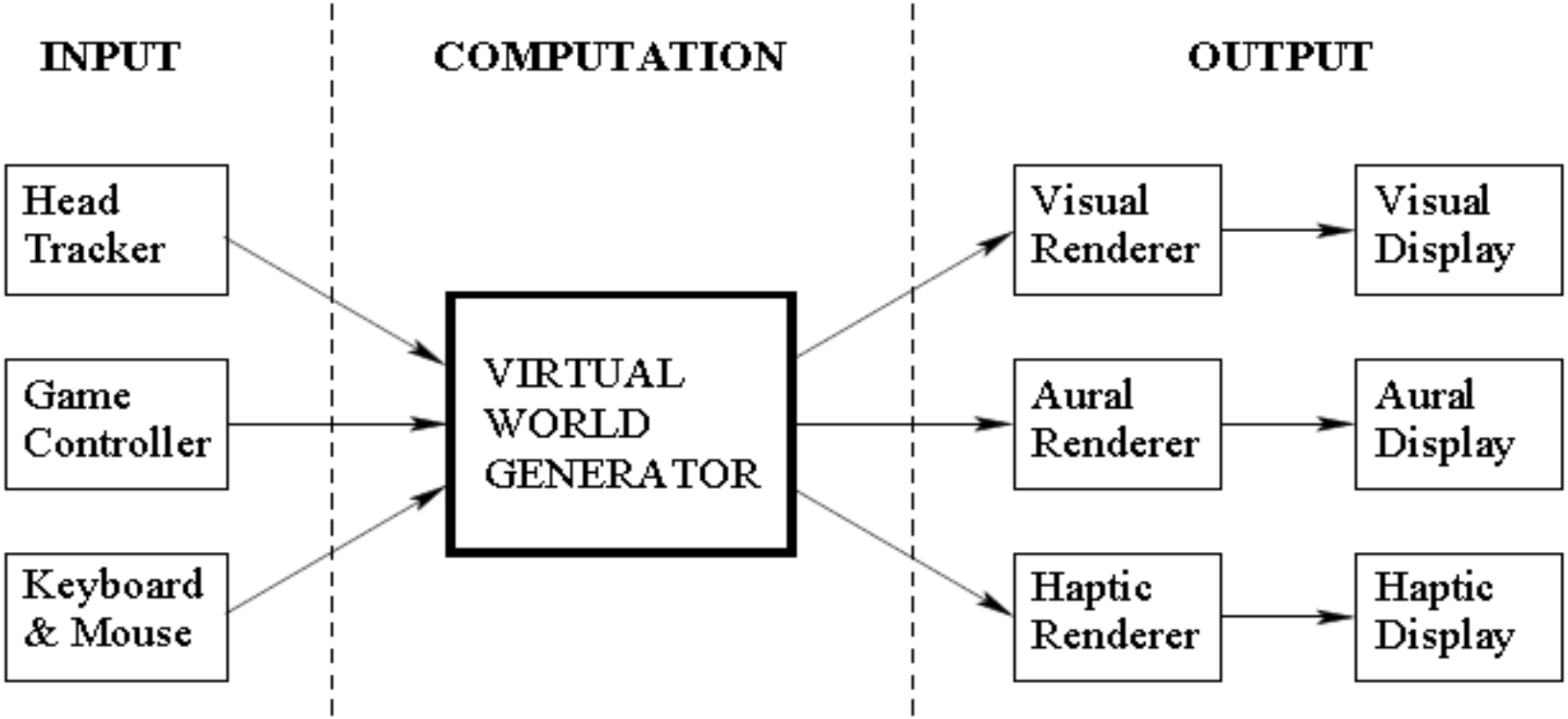


thanks!!

Q&A



Additional slides



Tracking

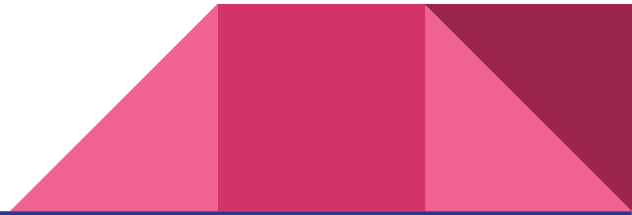
Tracking 2D Orientation

Tracking 3D Orientation

Tracking Position and Orientation

Tracking Attached Bodies

3D Scanning of Environments



Interaction

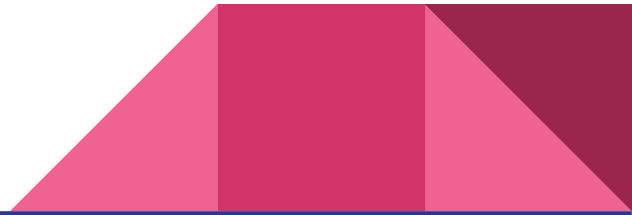
Motor Programs and Remapping

Locomotion

Manipulation

Social Interaction

Additional Interaction Mechanisms



Physiology of Human Vision

From the Cornea to Photoreceptors

From Photoreceptors to the Visual Cortex

Eye Movements

Implications for VR