Workshop on
Coding Technologies for Immersive Audio/Visual Experiences

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Immersive Experiences

- **Immersion** can be
  - defined as the **state of consciousness** where a *visitor* or *immersant*'s awareness of physical self is **transformed** by being surrounded in an artificial **environment**.

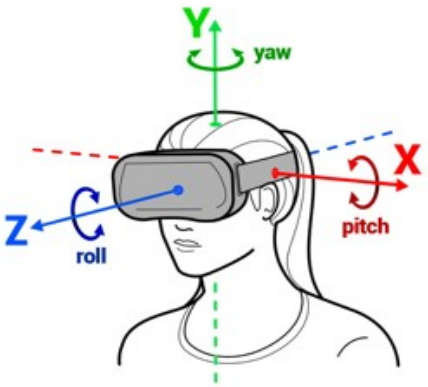
- An **immersive digital environment**
  - artificial, interactive, computer-created scene or "world" within which users can immerse themselves.

Immersive Experiences

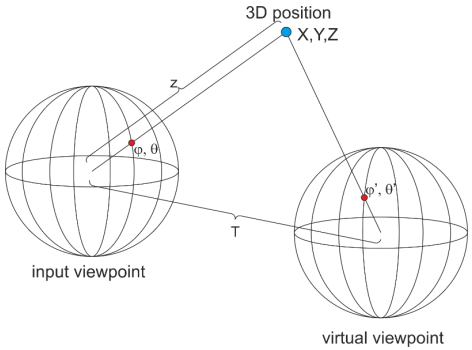
- **Immersion** can also be
  - used for describing partial or complete **suspension of disbelief** by enabling action or reaction to stimulations encountered in a virtual or artistic environment.
  - The greater the suspension of disbelief, the greater the degree of presence achieved.

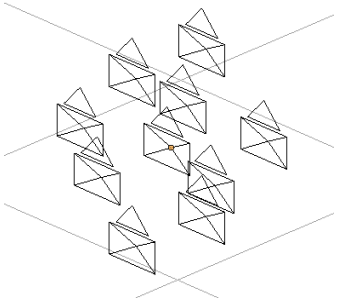
Immersive Experiences

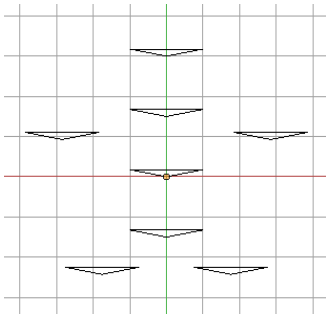
- To create a sense of **full immersion**, the 5 senses (sight, sound, touch, smell, taste) must perceive the digital environment to be physically real.
- **Immersive technology** can **perceptually fool** the senses through:
  - **Panoramic 3D displays (visual)**
  - **Surround sound acoustics (auditory)**
  - Haptics and force feedback (tactile)
  - Smell replication (olfactory)
  - Taste replication (gustation)

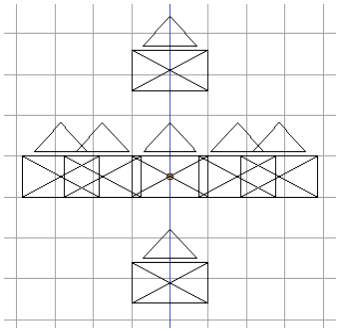


Multi-Sphere for Parallax



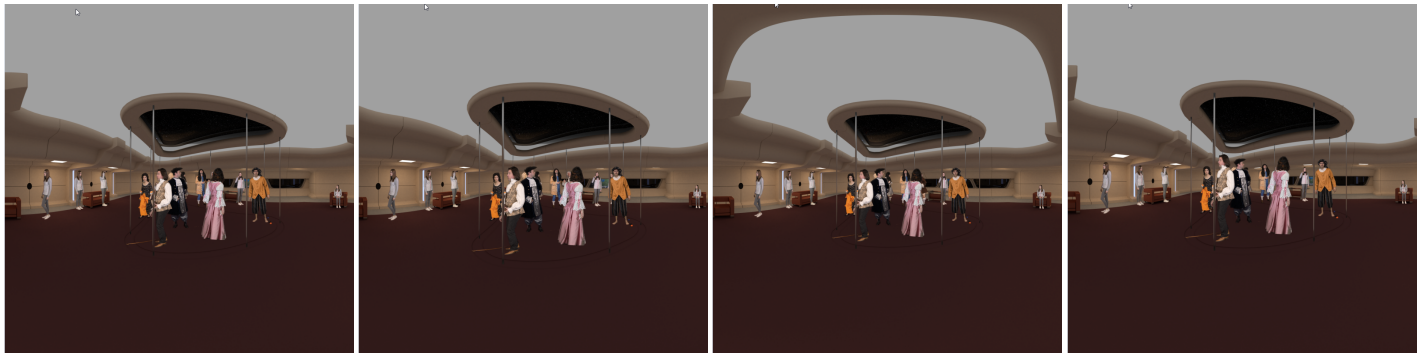






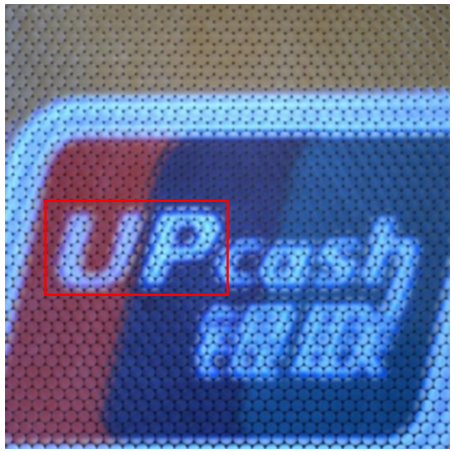
30cm radius

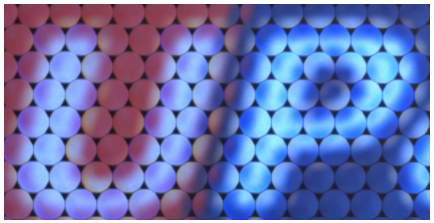
TechnicolorHijack:
10 semi-ERP RGB+D virtual cameras



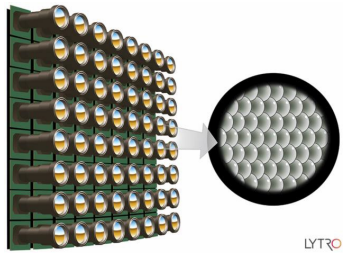
Dense Light Fields

- Lenslet cameras
  - Plenoptic 1.0

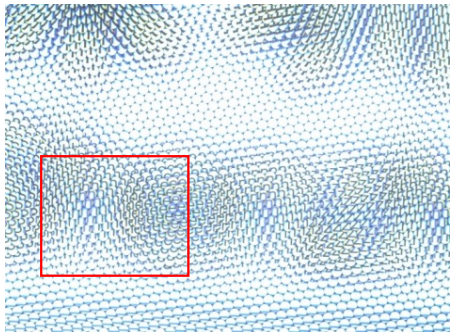


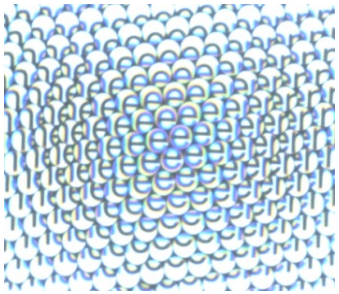


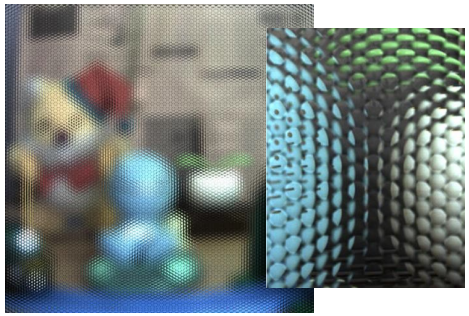
From multi-cams to micro-lenses



  - Plenoptic 2.0

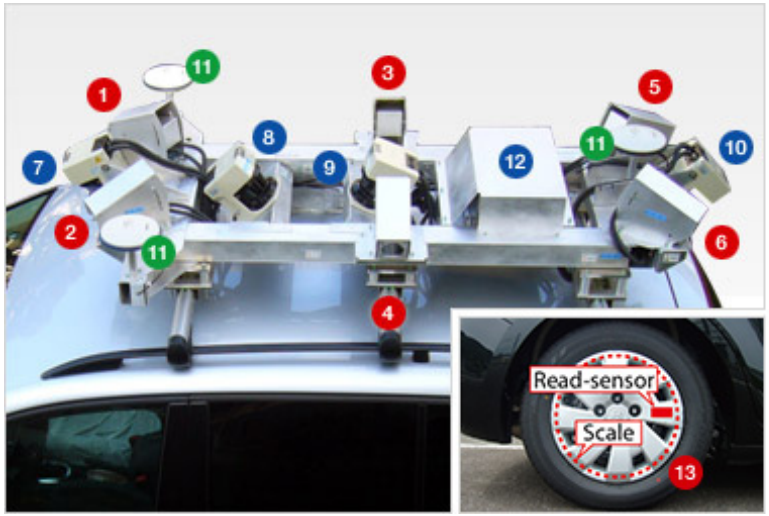






Point Cloud Capturing

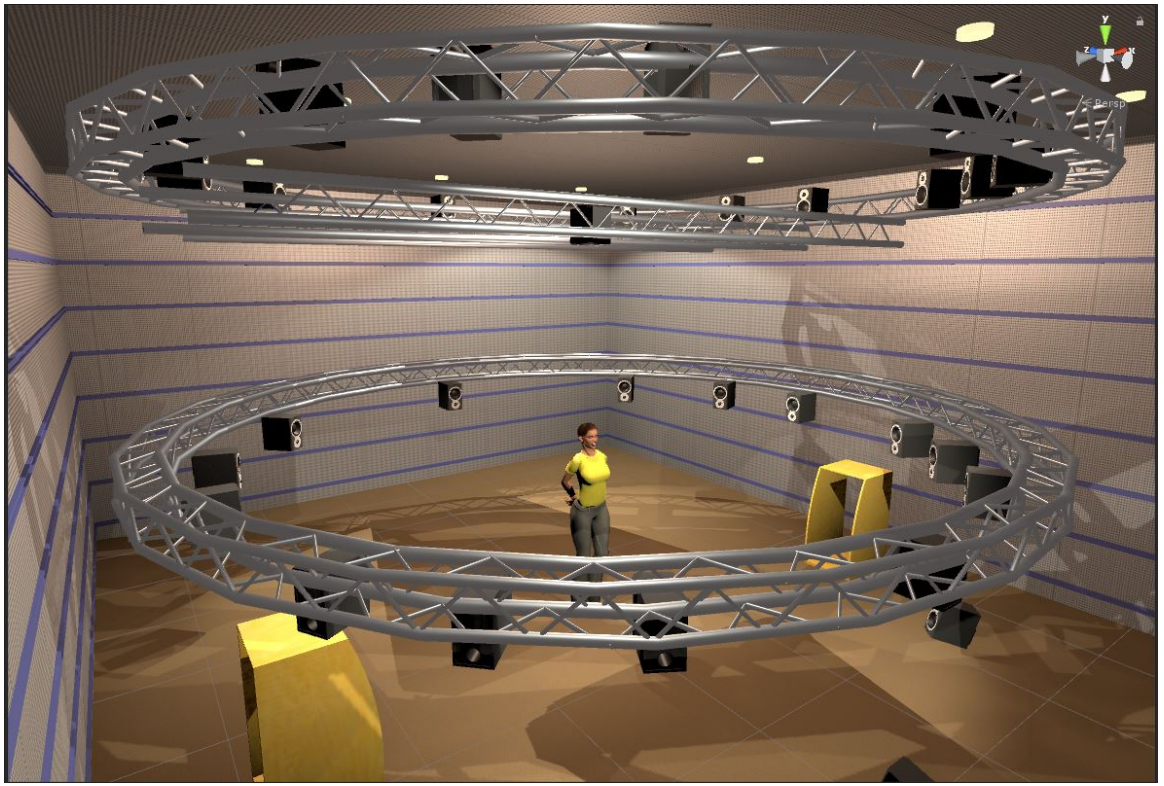
Example studio for capturing dynamic point clouds



1 Camera(front;right)
2 Camera(front;left)
3 Camera(side;right)
4 Camera(side;left)
5 Camera(rear;right)
6 Camera(rear;left)
7 Laser scanner(front;downward)
8 Laser scanner(rear;upward)
9 Laser scanner(front;upward)
10 Laser scanner(rear;downward)
11 GPS antenna
12 IMU
13 In-wheel odometer

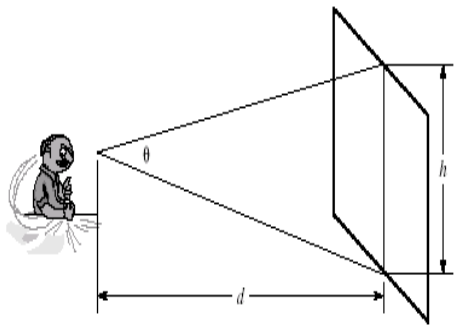
Sensor system for generating mobile mapping point clouds

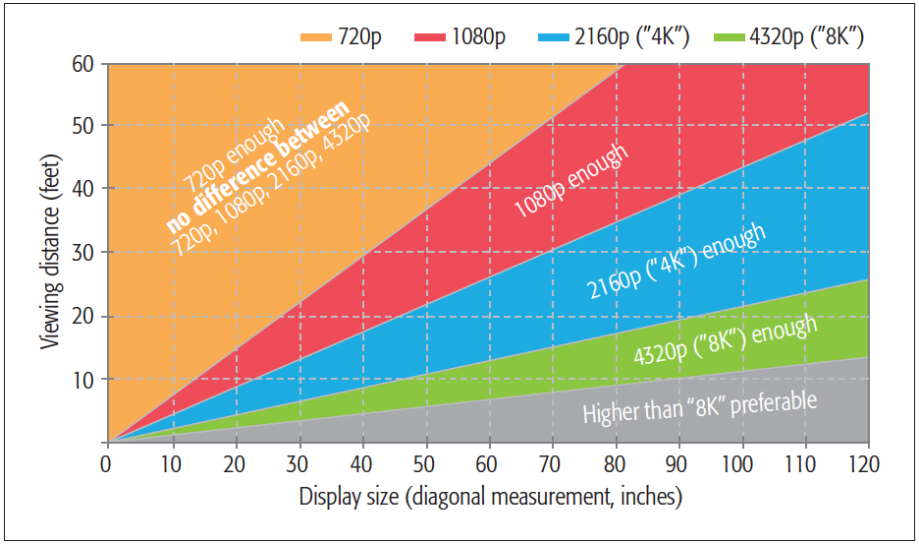
Virtual Acoustic Environment



Big Data – 3 Degree of Freedom

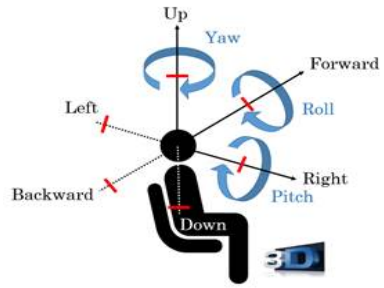
- Retina resolution at fovea: ~200 PPD (pixel per degree)
- 4K UHD, 16:9, 3-times-height-of-picture viewing distance,
  - 36° FoV → ~100 PPD
- 4K UHD, 360 ° omnidirectional video → ~ 11PPD
  - ✓ 200PPD , 360 ° * 180 ° , 72K * 36K → 2.5G pixel → 4,500Gbps

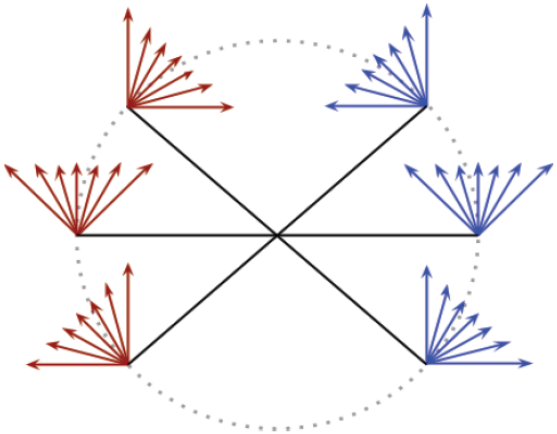




E. Bastug, Toward interconnected Virtual Reality: Opportunities, Challenges, and Enablers, IEEE Communications Magazine, Jun. 2017

Big Data – 3 Degree of Freedom +





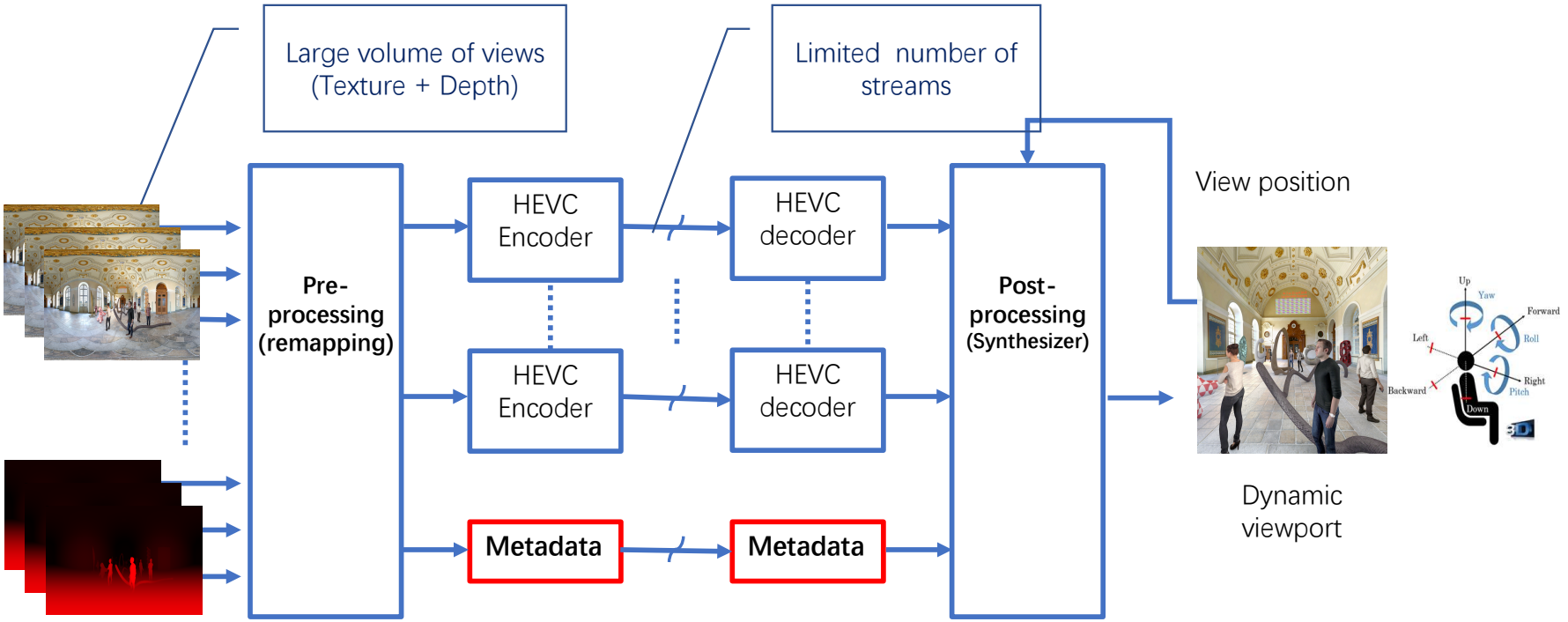
Synthesis Results

Synthesis from 24 views

Synthesis from 8 views

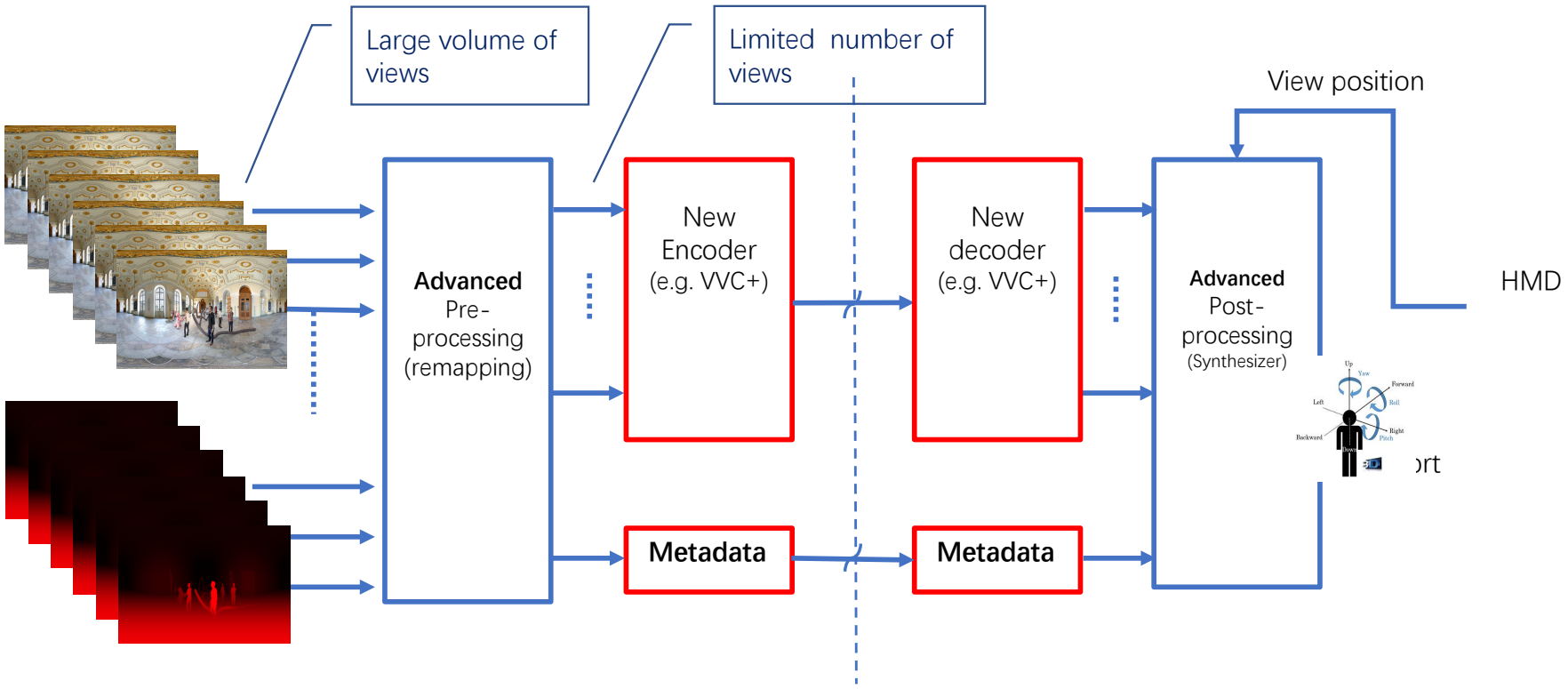
Synthesis from 2 views

MPEG-I Visual 3DoF+ Activities



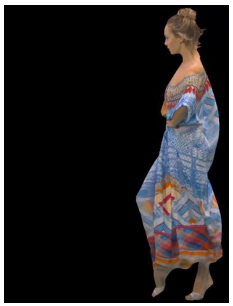
3DoF+: 3DoF with additional limited translational movements (typically, head movements)

MPEG-I Visual 6DoF Activities

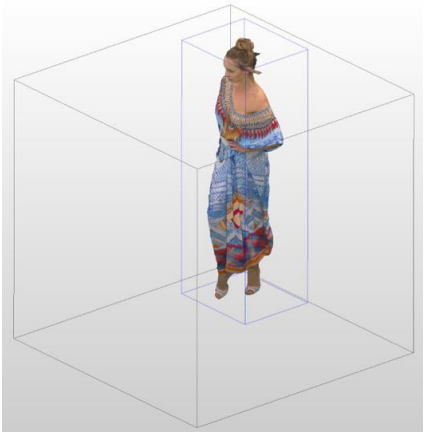


6DoF: 3DoF with full translational movements along X, Y and Z axes. A typical use case is a user freely walking through 3D 360 VR content

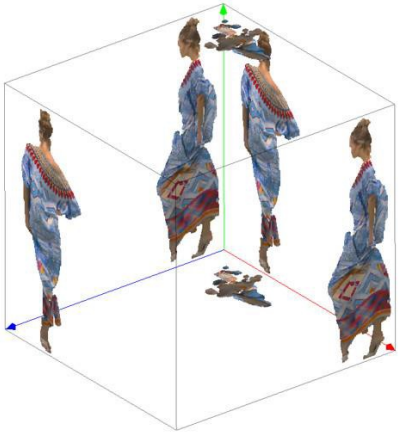
Point Cloud Compression



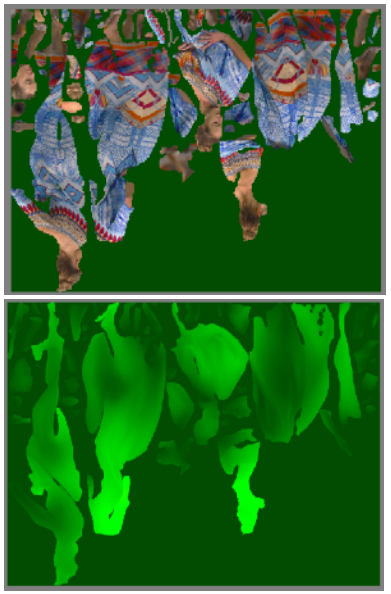
Animated
Point Cloud
(voxels)

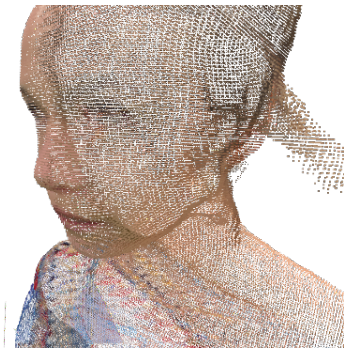


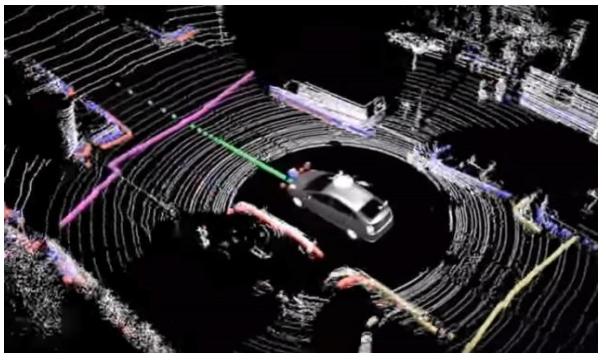
Bounding volume



Orthographic projection



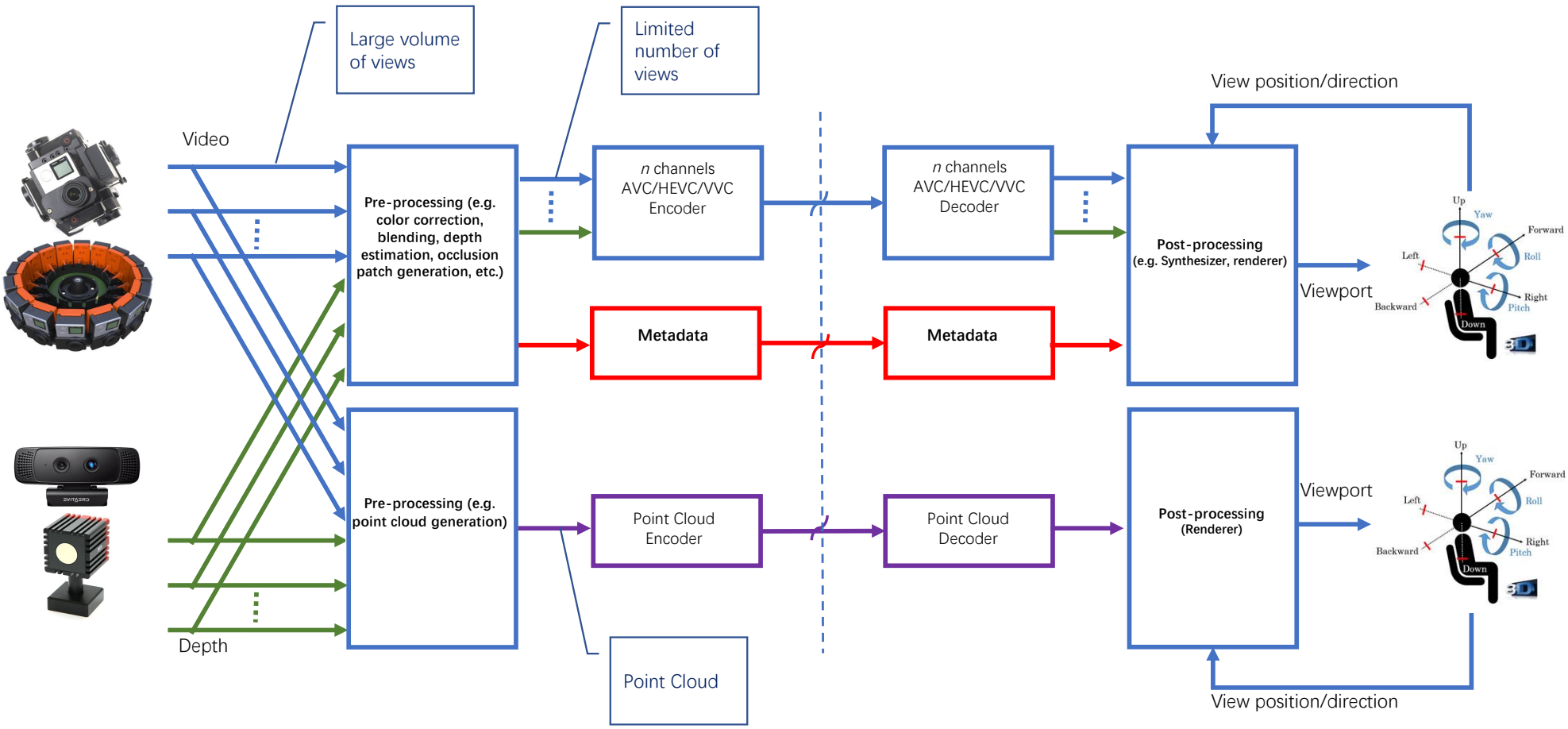


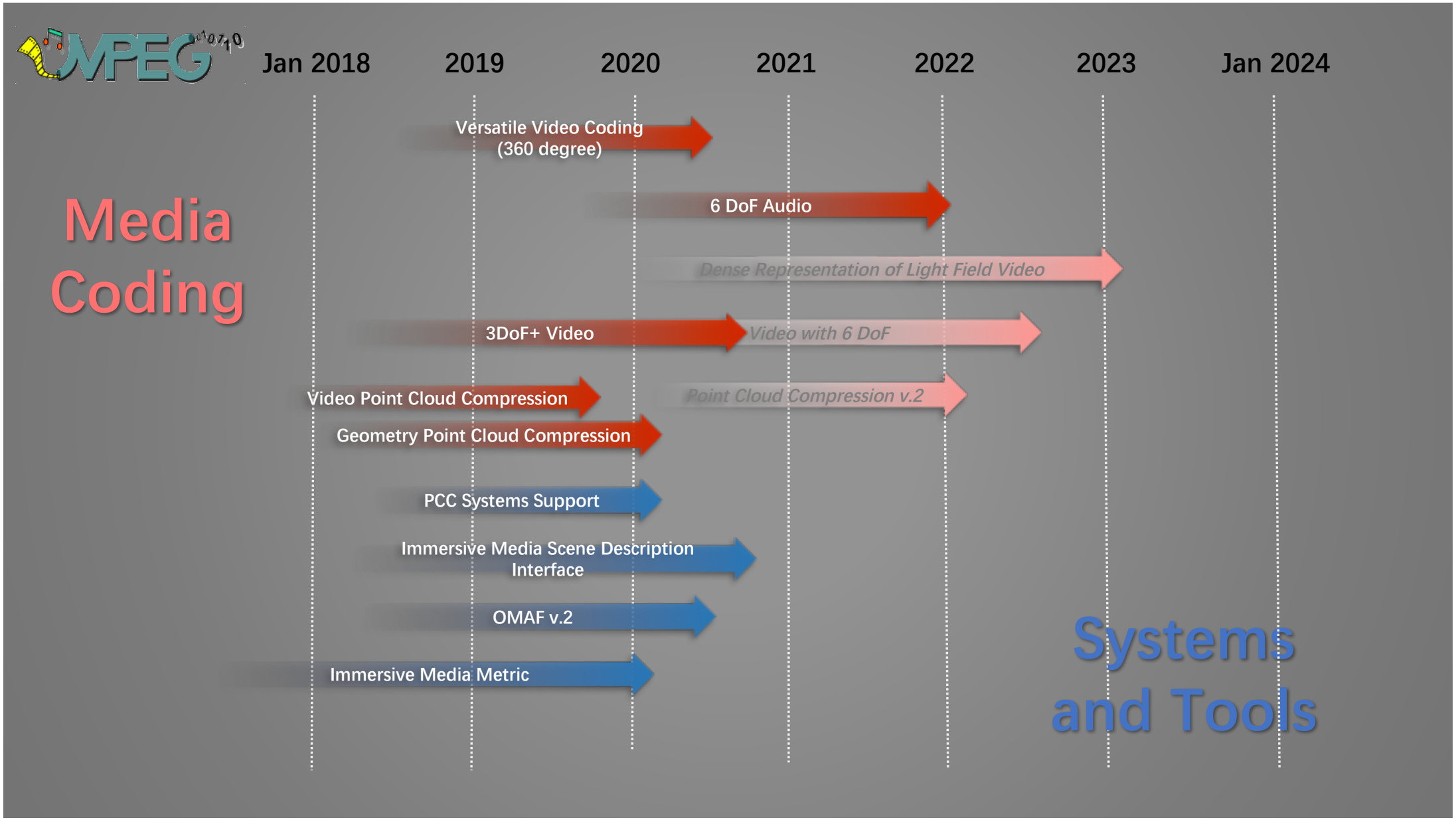


of Points

sequence	Frames	fps	# Pts	Geometry Precision
Queen	250	50	~1,000,000/fr	10 bit
8i VFB – Loot	300	30	~780,000/fr	10 bit
8i VFB – Red_and_Black	300	30	~700,000/fr	10 bit
8i VFB – Soldier	300	30	~1,500,000/fr	10 bit
8i VFB – Long_dress	300	30	~800,000/fr	10 bit
classroomVideo	**120**	**30**	**~120,000,000/fr**	**float**

Video & Graphics based Workflow of Immersive Visual Content




Jan 2018
2019
2020
2021
2022
2023
Jan 2024
Media Coding
Versatile Video Coding (360 degree)
6 DoF Audio
Dense Representation of Light Field Video
3DoF+ Video
Video with 6 DoF
Video Point Cloud Compression
Point Cloud Compression v.2
Geometry Point Cloud Compression
PCC Systems Support
Immersive Media Scene Description Interface
OMAF v.2
Immersive Media Metric
Systems and Tools

Time slot	Topic	Speaker
1300-1315	Introduction	Lu Yu, Zhejiang University
1315-1345	Usecases and challenges about user immersive experiences	Valerie Allie, InterDigital
1345-1415	Overview of technologies for immersive visual experiences	Marek Domanski, Poznan University of Technology
1415-1445	MPEG-I Immersive Audio	Schuyler Quackenbush, Audio Research Labs
1445-1455	Brief introduction about demos: ▪ Integral photography display ▪ Realtime interactive demo with 3DoF+ content ▪ Plenoptic 2.0 video camera ▪ A simple free-viewpoint television system	▪ NHK ▪ InterDigital ▪ Tsinghua University ▪ Poznan University of Technology
1455-1530	Demos Coffee break	
1530-1600	360° and 3DoF+ video	Bart Kroon, Philips
1600-1630	Point cloud compression	Marius Preda, Telecom SudParis, CNRS Samovar
1630-1700	How can we achieve 6DoF video compression?	Joel Jung, Orange
1700-1730	How can we achieve lenslet video compression?	Xin Jin, Tsinghua University, Mehrdad Teratani, Nagoya University