



**ITU-T Workshop on ILE
Macao, China**



FTV (Free viewpoint Television) and Its Standardization in MPEG

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FTV Video Produced by IEEE Signal Processing Society

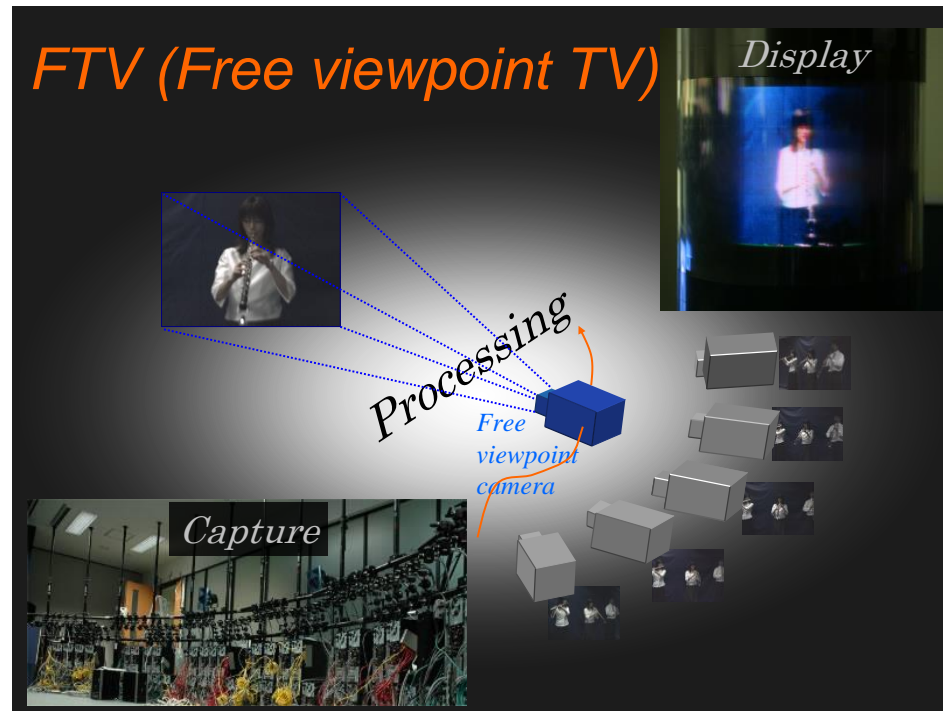


“Signal Processing in Free Viewpoint Television”
<https://www.youtube.com/watch?v=T0VPjHwrc-o>

Outline

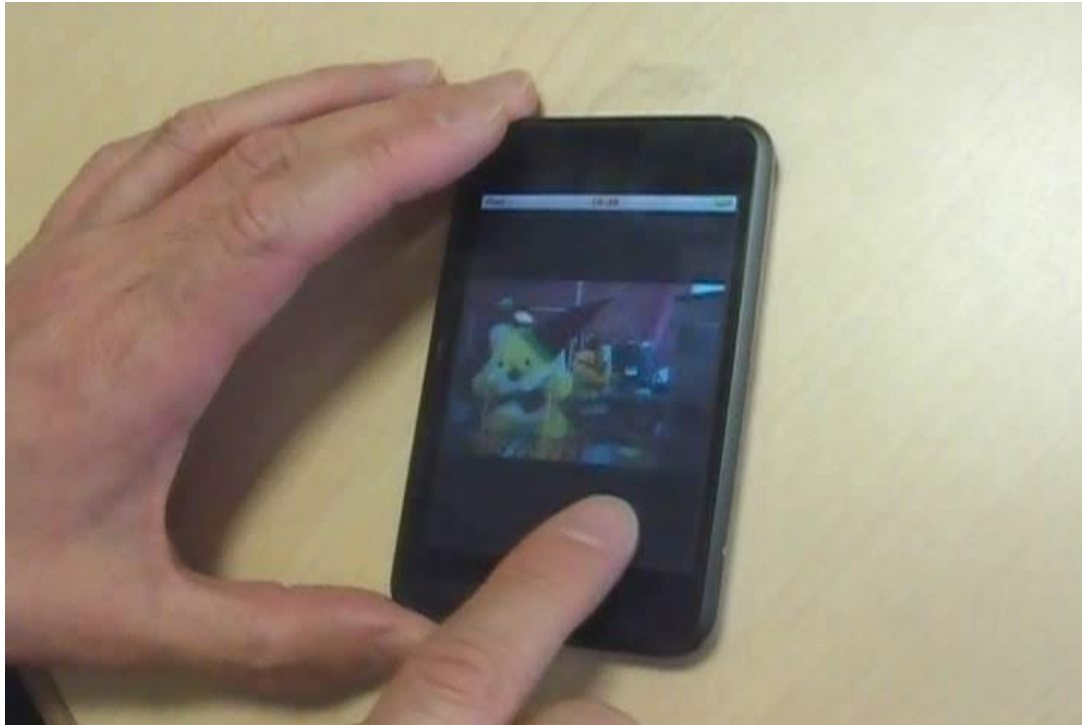
1. Introduction of FTV
2. Principle of FTV
3. FTV Technologies and Demo
4. FTV Standardization in MPEG
5. Conclusions

1. Introduction of FTV



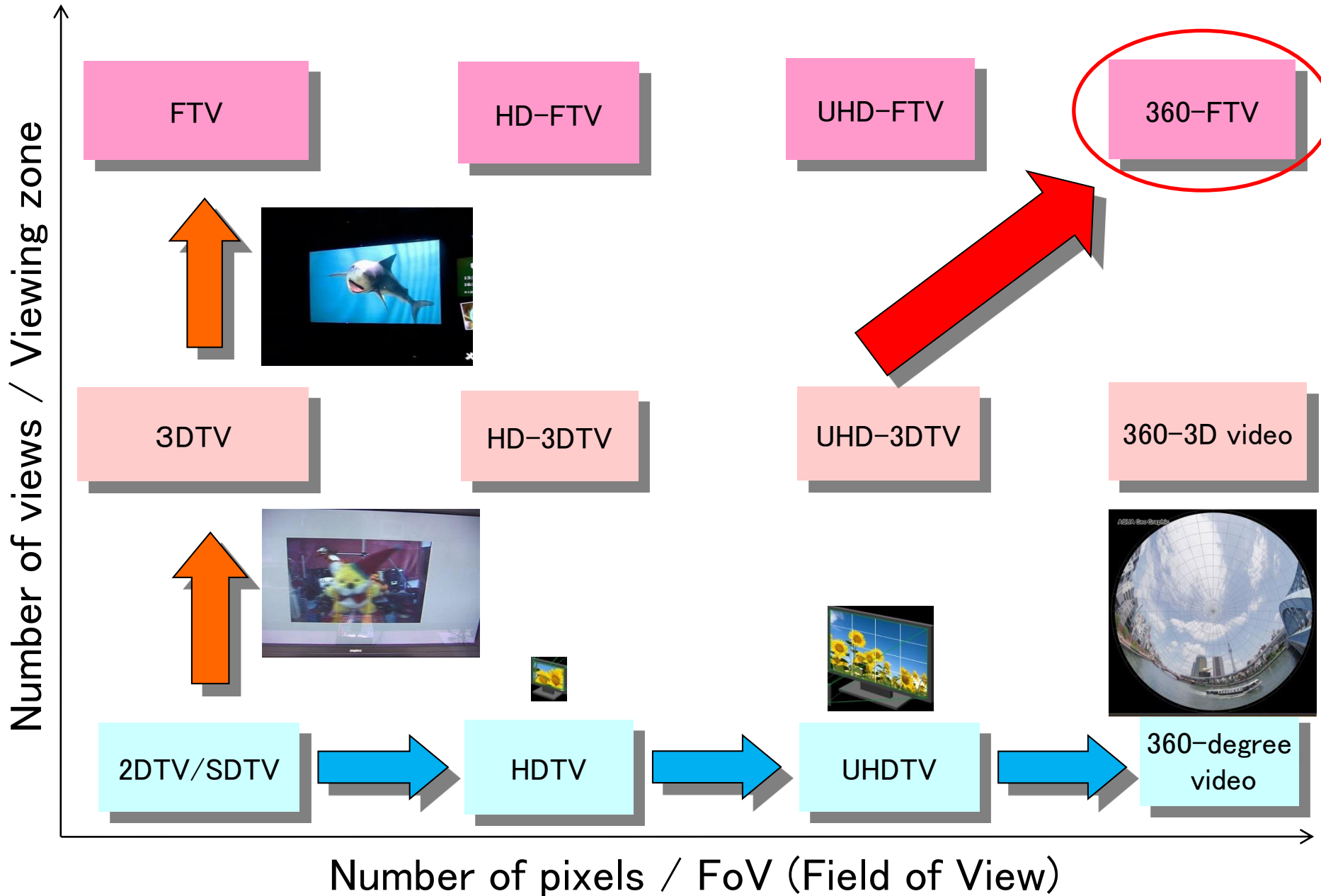
FTV (Free-viewpoint TV)

Visual media that enable users to view a 3D scene by freely changing the viewpoint as if they were actually there.

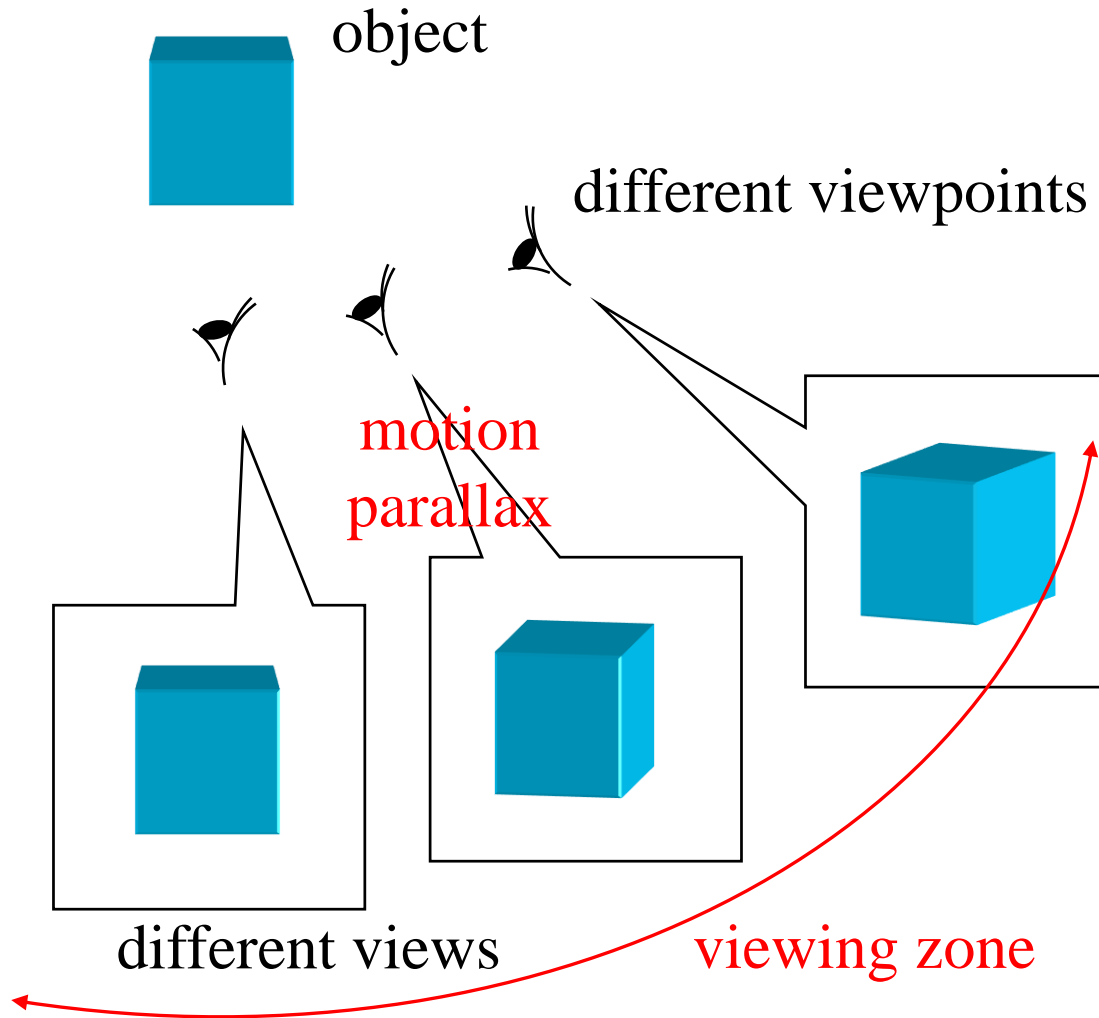


FTV on a
Mobile Player

Progress of Visual Media



Many and Dense Views Needed for Viewing with Motion Parallax and without Eye Fatigue



Significances of FTV

- Ultimate 3DTV that transmits an infinite number of views and ranks as the top of visual media
- Natural interface between human and environment
- Immersive media that provide very realistic VR experiences

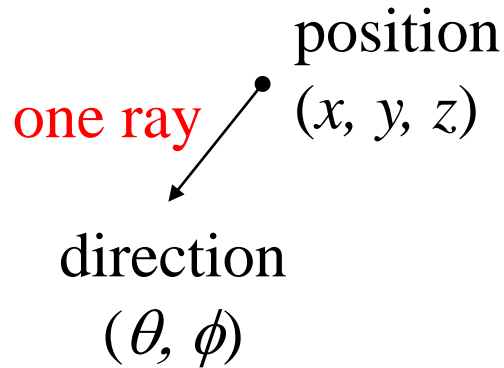
2. Principle of FTV



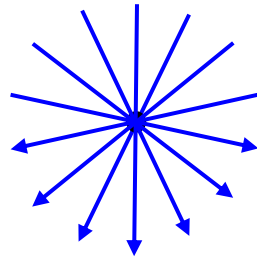
“Multiview Imaging and 3DTV,” IEEE Signal Processing Magazine, Vol.24, No.6, pp.10-21 (November 2007)

Ray-Space Representation

Ray-space is a parameter space where one ray is expressed by one point.

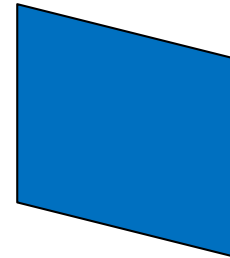


group of rays through one point



[Real Space]

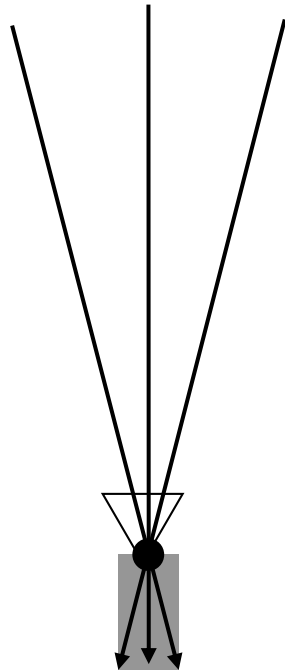
plane



[Ray-Space]

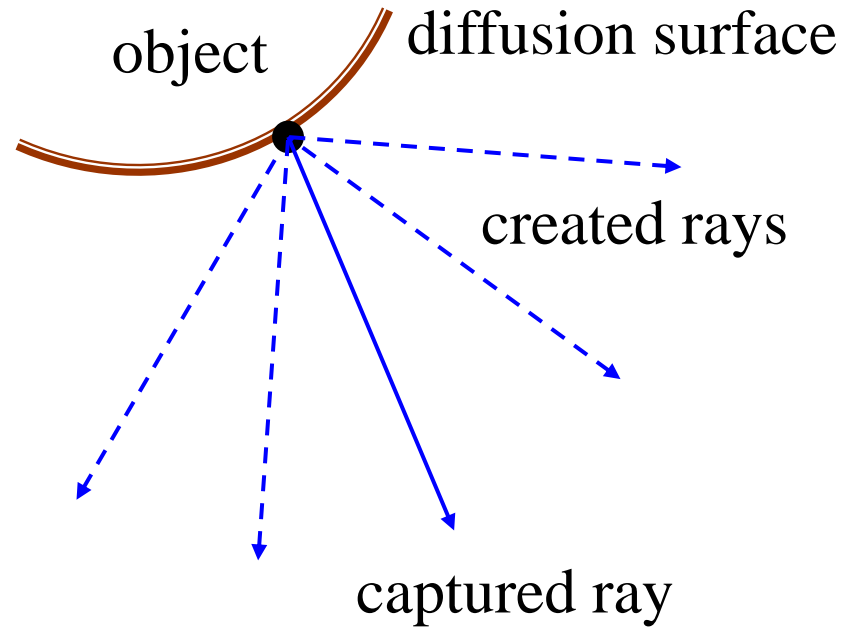
Concept of “Group of Rays through One Point”

1. View generation

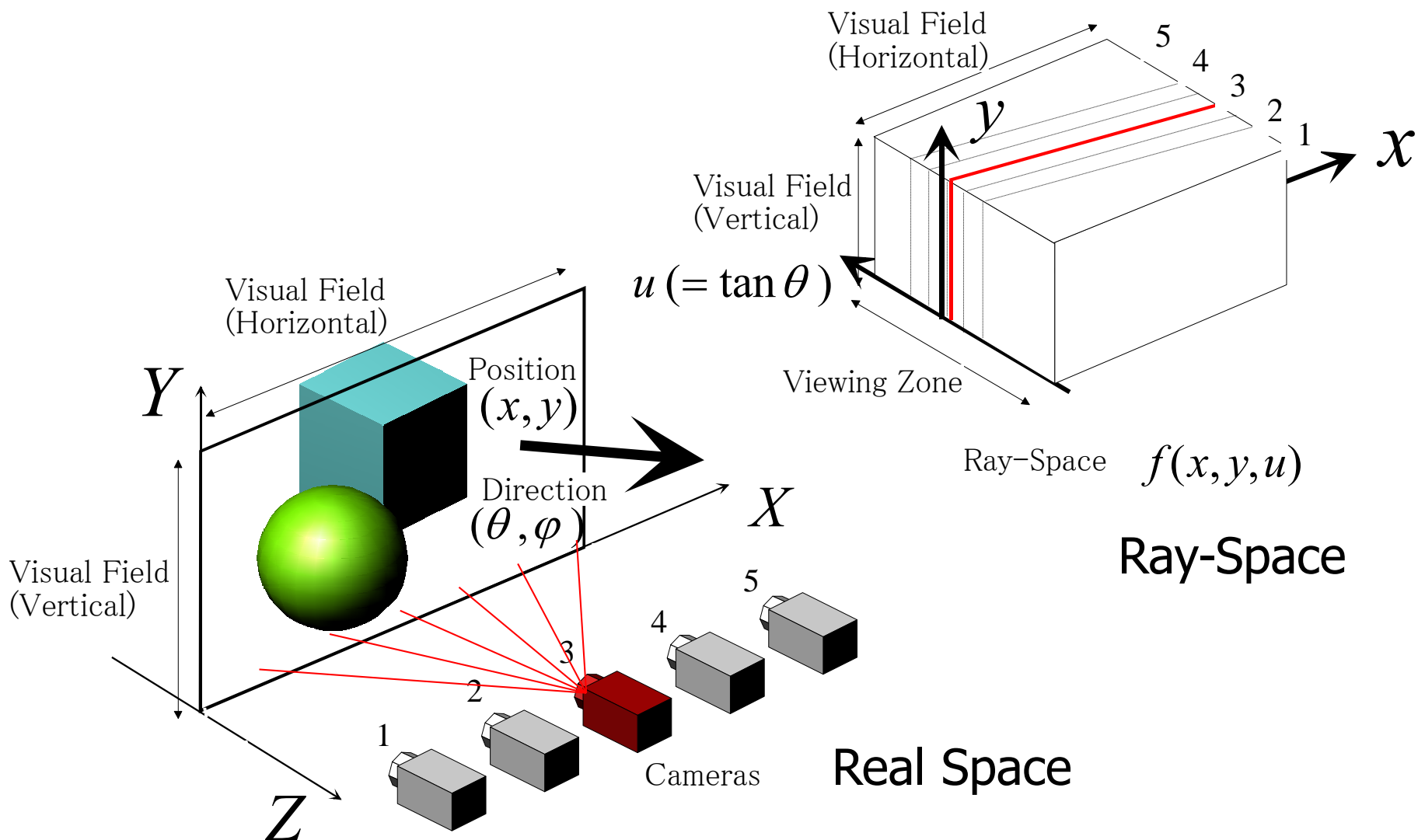


virtual camera

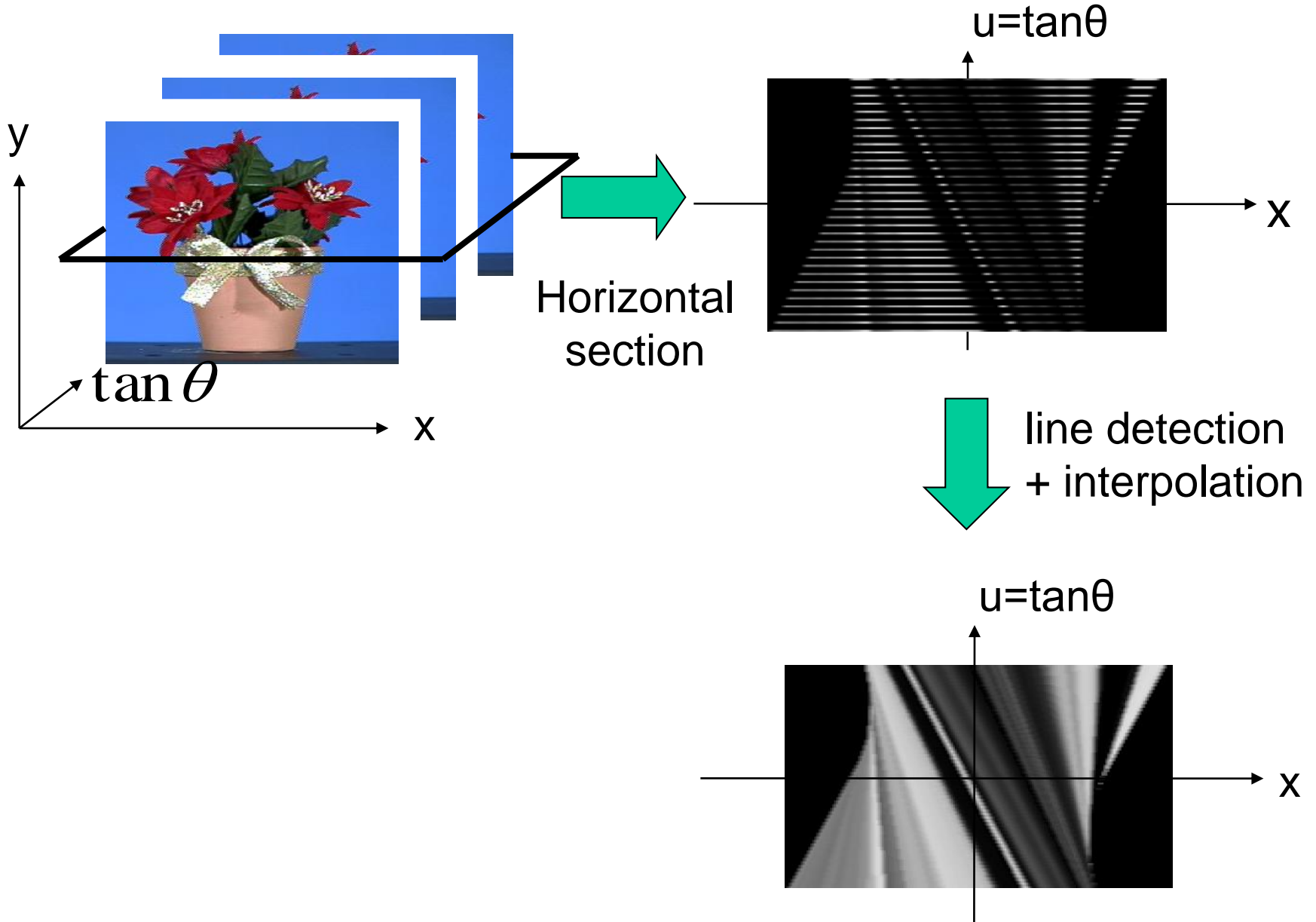
2. Ray interpolation



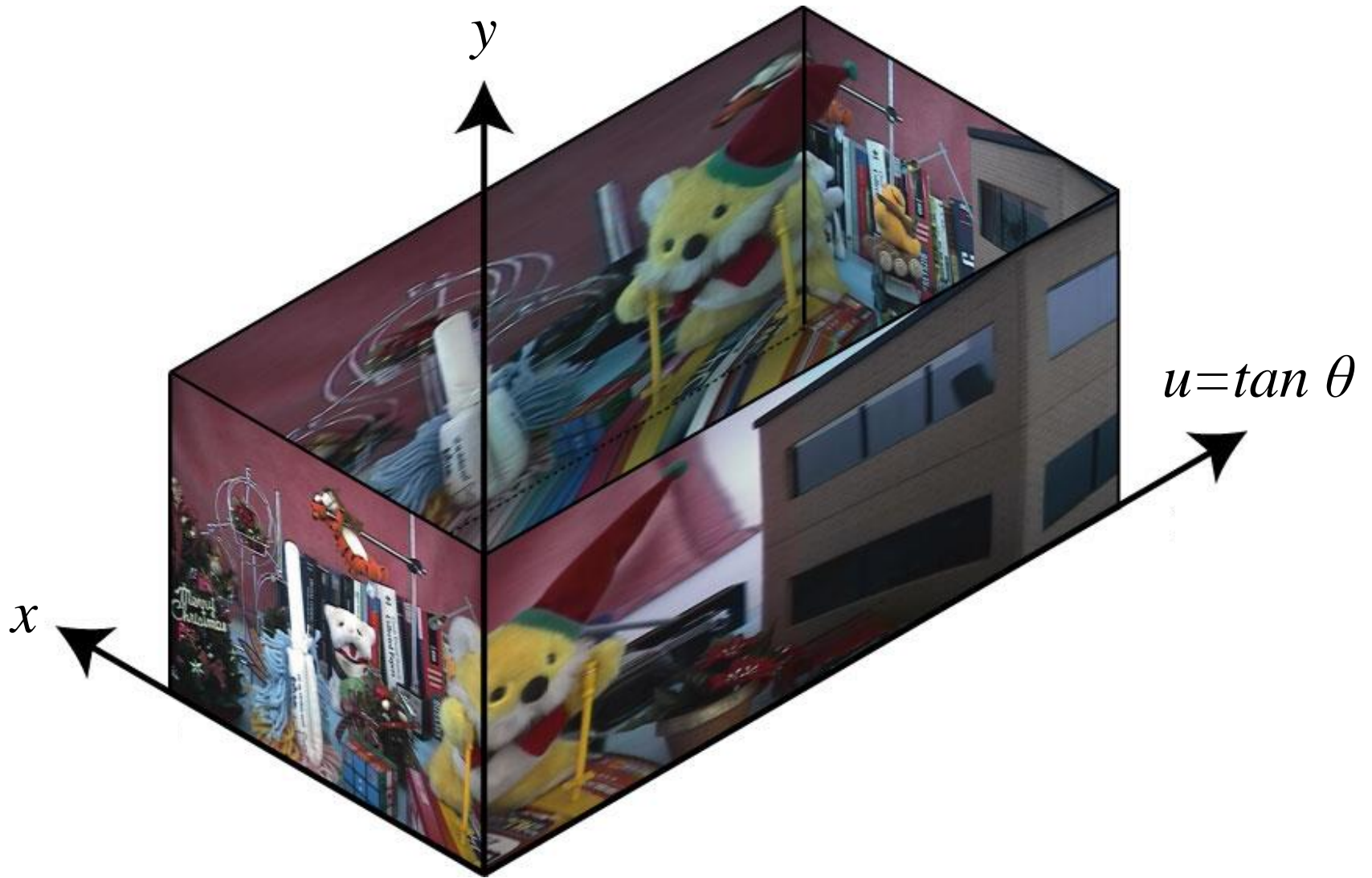
Ray Capture in Linear Camera Arrangement



Ray Interpolation

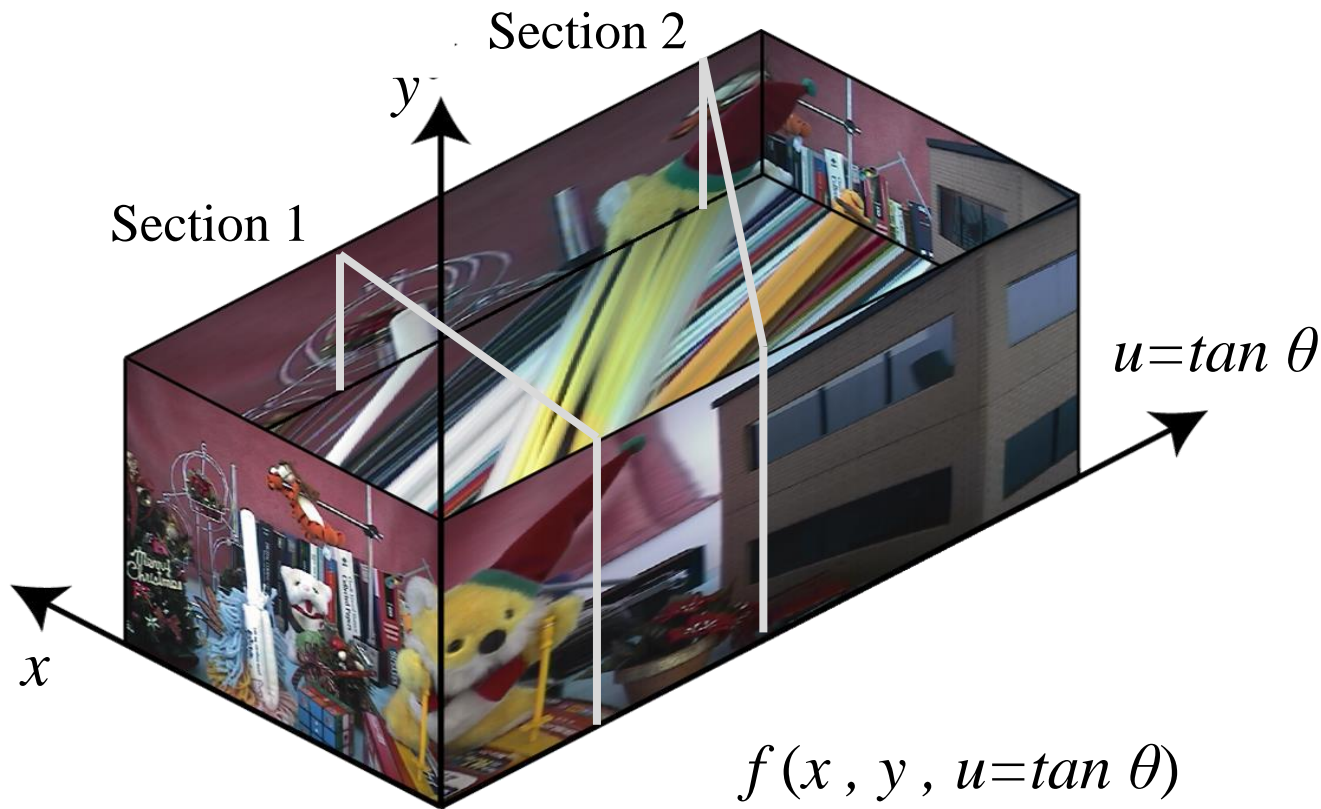


Orthogonal Ray-Space and Horizontal Cross-Section



The horizontal cross-sections of orthogonal ray-space have line structures.

View Generation in Linear Camera Arrangement



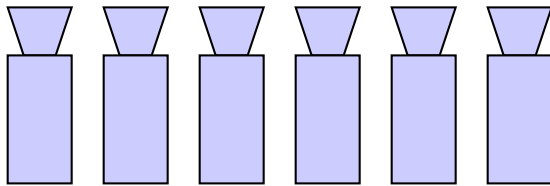
Section Image 1



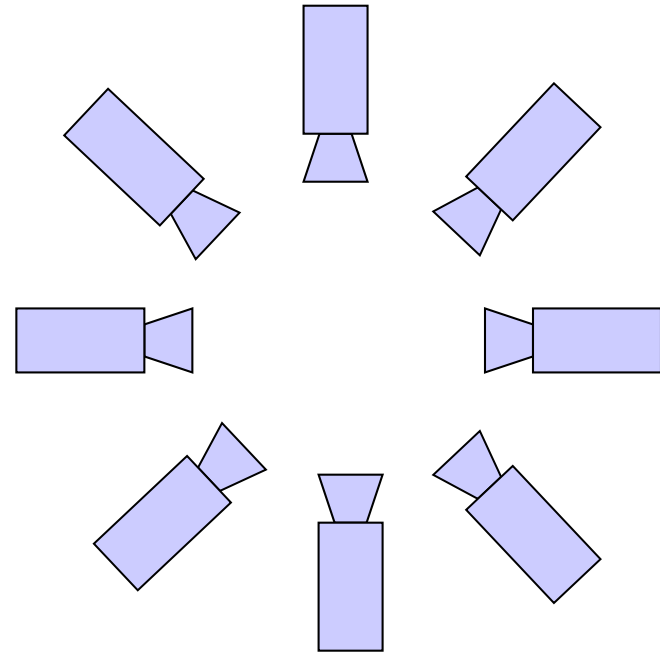
Section Image 2



Camera Arrangements for Capture

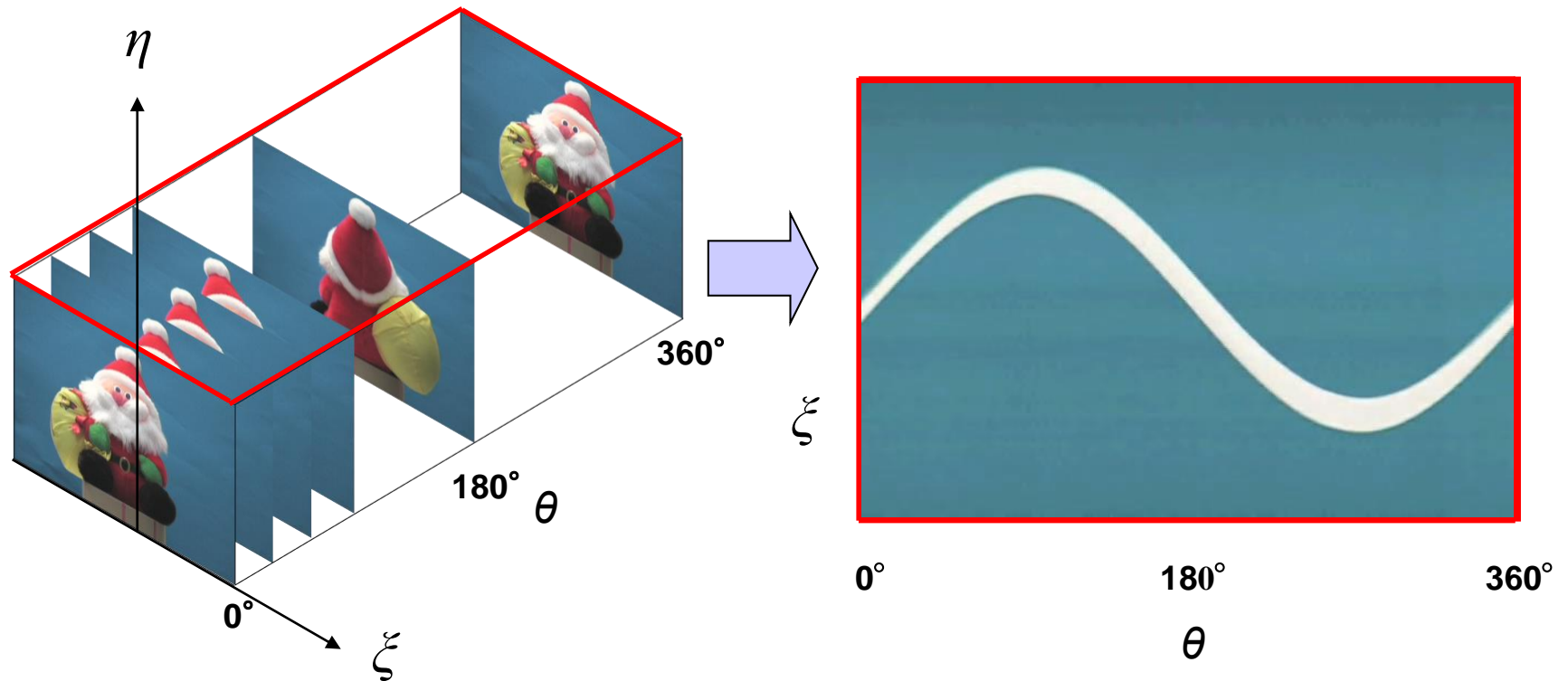


(a) Linear/planar arrangement
for parallel view



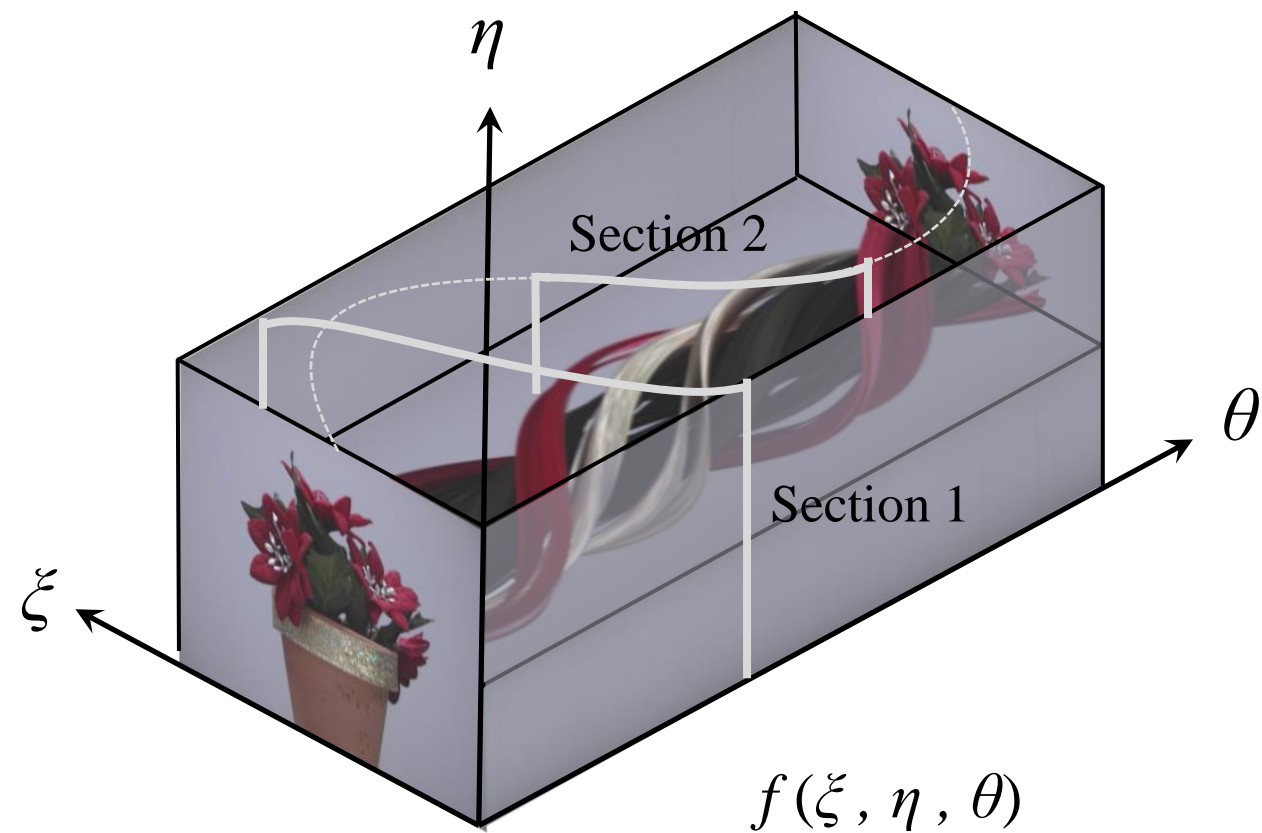
(b) Circular/spherical arrangement
for convergent view

Horizontal Cross-Sections of Spherical Ray-Space



The horizontal cross-sections of spherical ray-space have sinusoidal structures.

View Generation in Circular Camera Arrangement



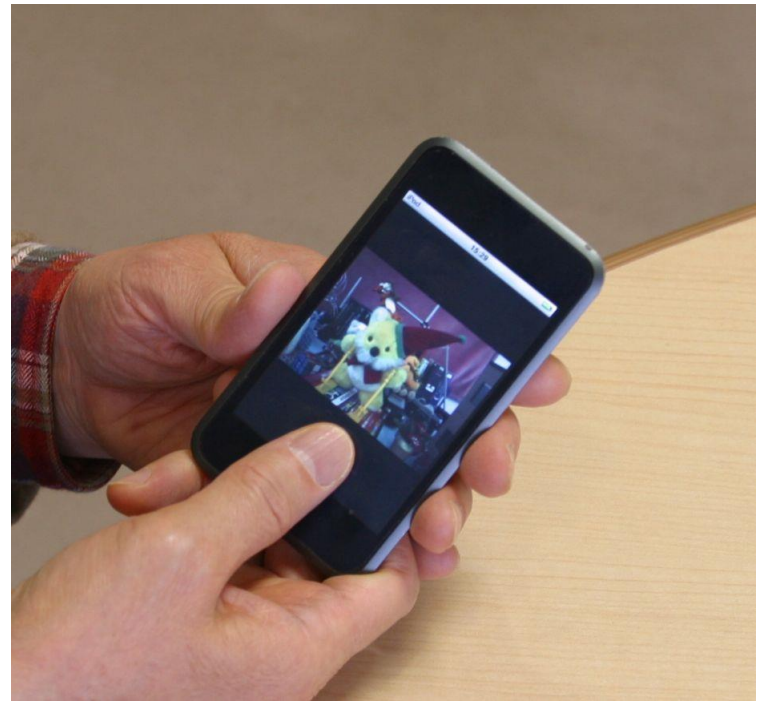
Section Image 1



Section Image 2



3. FTV Technologies and Demo



100-Camera System

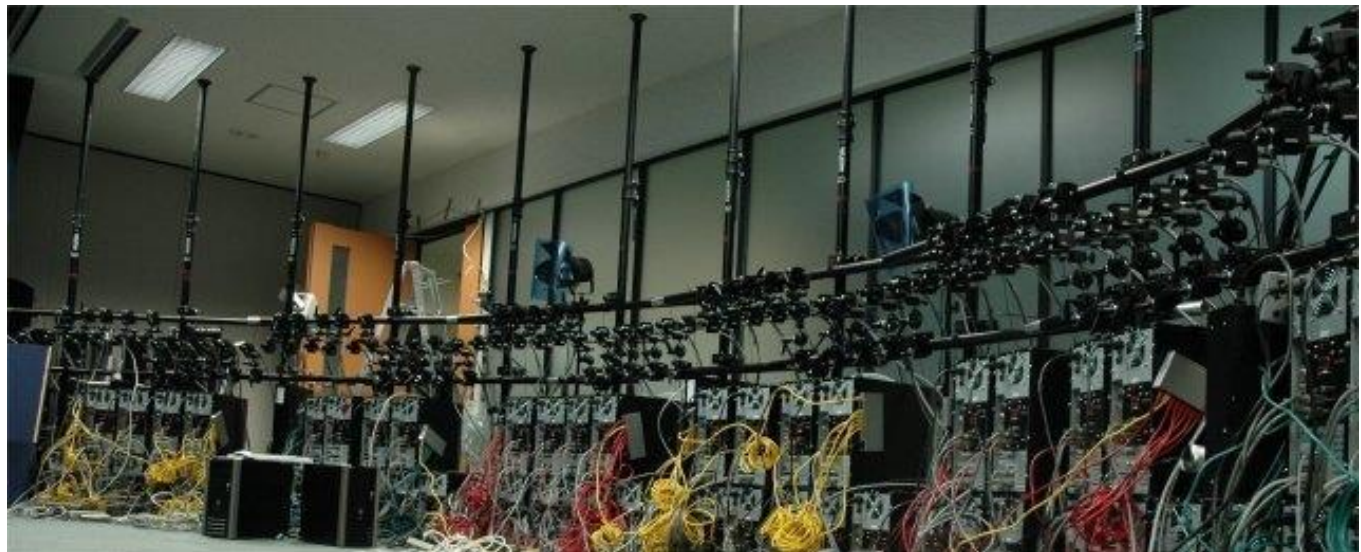
Linear



Planar



Circular



FTV Demo: Aquarium

Original Camera Views (15 Cameras)



FTV Demo: Aquarium Generated Free Views



Original Views



Generated Views - Interpolated -



Generated Views - Forward and Backward -



Interface of FTV

FTV on a laptop PC
with mouse control



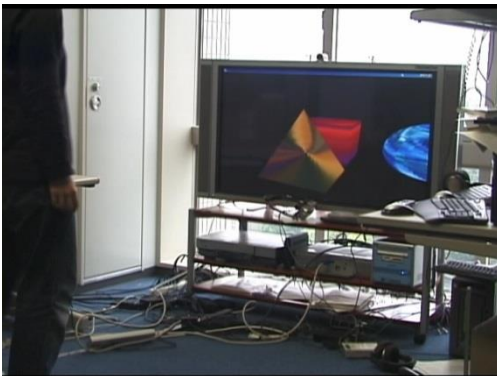
FTV on a mobile player
with touch panel control



FTV on an all-around
3D display (Seelinder)



FTV on a 2D display
with head tracking



FTV on a multi-view 3D display
without head tracking



FTV on a multi-view 3D display
with head tracking



Super-Multiview 3D Display: The SeeLinder



4. FTV Standardization in MPEG



MPEG has been developing FTV standards since 2001.

- **FTV first phase** (2004/03-2009/05)

MVC (Multi-view Video Coding) standard to compress multiple video

- **FTV second phase** (2007/04-2015)

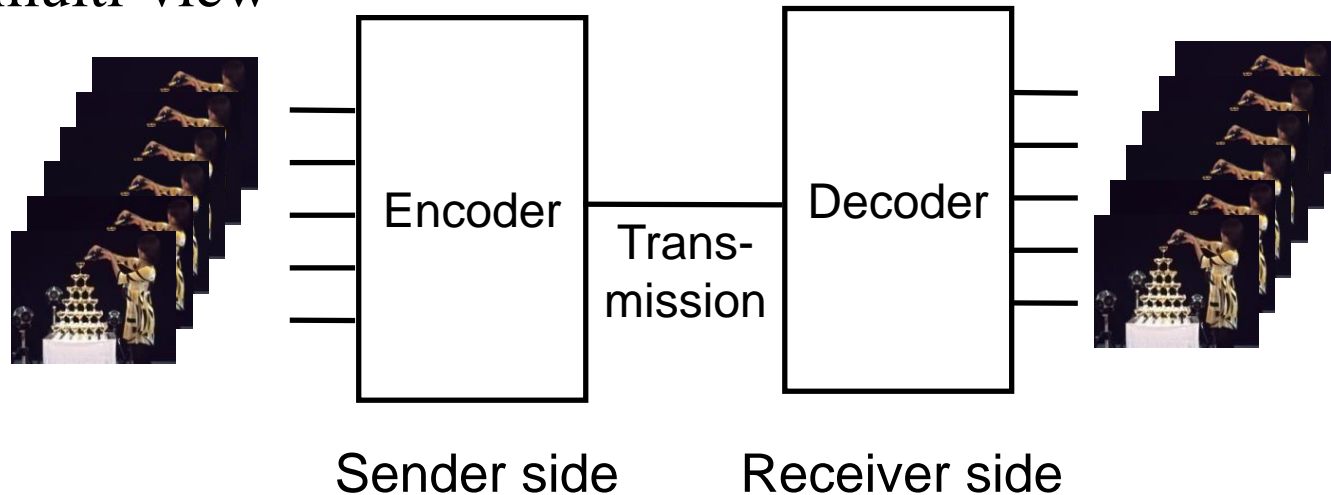
3DV (3D Video) standards for multiview display application

- **FTV third phase** (2013/08-)

FTV standards for Super-Multiview, Free Navigation and 360 3D Video applications

First Phase of FTV (MVC)

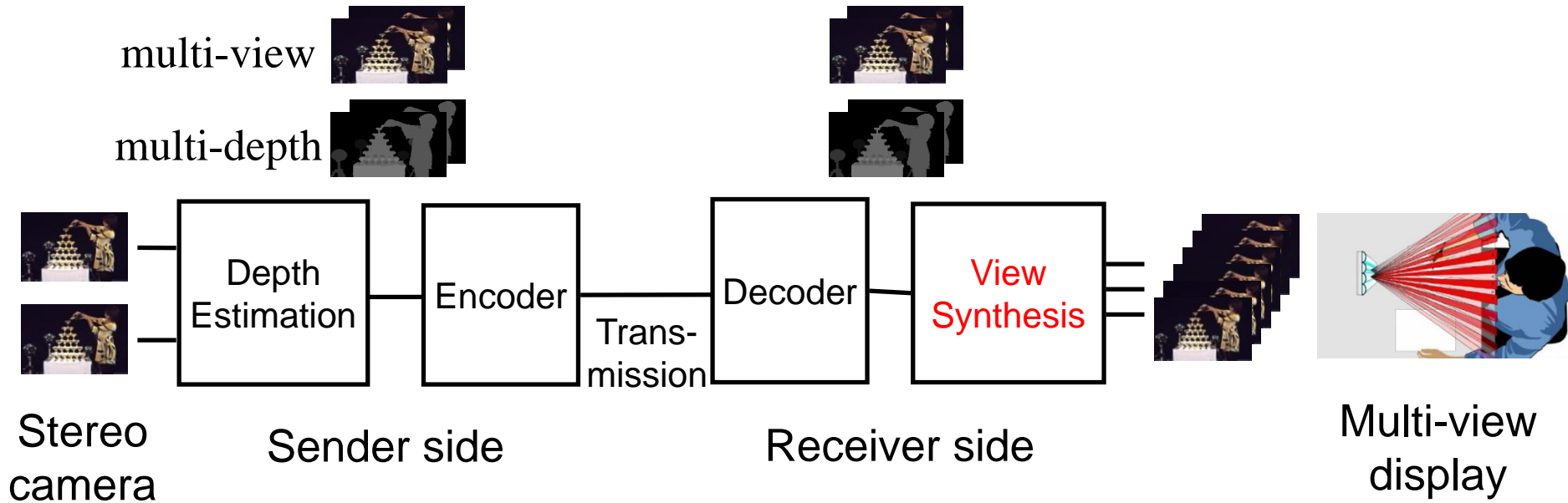
multi-view



- Coding of multiview video
- MVC (Multi-view Video Coding)

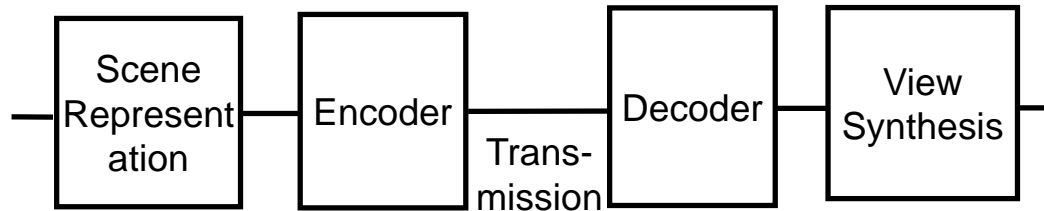
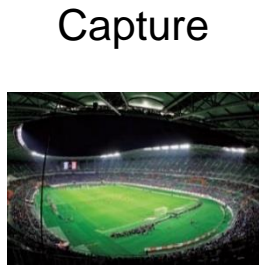
Second Phase of FTV (3DV)

MVD (multi-view + depth)



- Joint coding of multi-view and depth
- 3D-AVC, 3D-HEVC

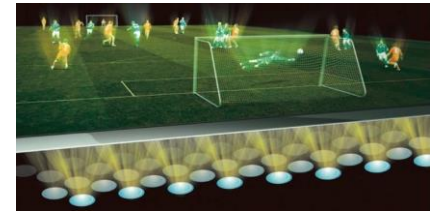
Third Phase of FTV (FTV)



Sender side

Receiver side

Display



Super-Multiview



Free Navigation



360 3D

FTV targets immersive 3D viewing by super-multiview, free navigation and 360 3D.

2022 FIFA World Cup Japan Bid Committee Planned to Deliver the Excitement on Soccer Stadium to the World by FTV



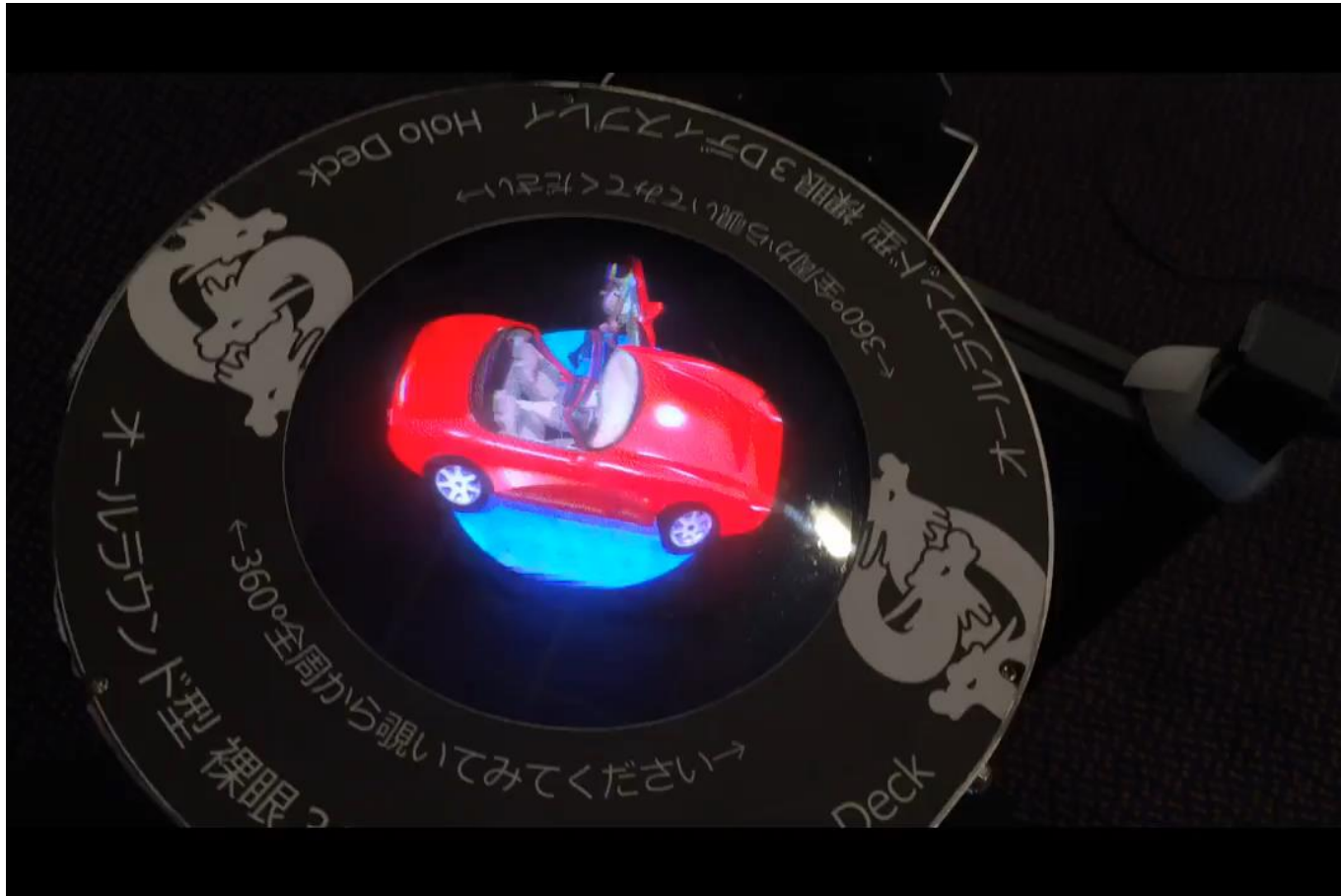
“Revolutionizing Football”

produced by 2022 FIFA World Cup Japan Bid Committee in 2010

1D Super-Multiview Display (Only Horizontal Parallax) 80 directions (Holografika)



All-Around Super-Multiview Display (360 views) Holo-Table (3Dragons LLC)



2D-SMV Display (Full Parallax) Integral 3DTV (400x250 views) (NHK)



Free Navigation for Soccer (KDDI)



- Exploration Experiments and Call for Evidence were conducted.
- Test material, reference software and evaluation methods were developed.
- After the success of Call for Evidence, FTV activity moved to MPEG-I in January 2017 and has been in charge of its video part.

5. Conclusions

- FTV is immersive media that transmit all ray information of a 3D scene and enable very realistic 3D viewing.
- FTV was developed based on the ray-space representation.
- MPEG has been creating various FTV standards.
- FTV activity moved to MPEG-I for further standardization.