



# 3D4YOU

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## 3D in the Cinema

- Increasing number of 3D productions
- First studios start to release all productions also in 3D
- Technology
  - Stereoscopic 3D
  - Glasses based
- Display sizes
  - Regular size
  - IMAX

## 3D in the Home

- Various displays available
- Various technologies
- Various input formats
- Various sizes



# Content



- Display technologies
- Formats
- Capture technologies
- Conclusions



# 3D Displays – Glasses Based - Anaglyph



# 3D Displays – Glasses Based



Samsung  
active shutter glasses  
stereoscopic 3D input



Panasonic (up to 103" prototype)  
active shutter glasses  
stereoscopic 3D input

# 3D Displays – Glasses Based



Hyundai  
passive polarized glasses  
stereoscopic 3D input



JVC (up to 4k prototype)  
passive polarized glasses  
stereoscopic 3D input

# 3D Displays – Non Glasses Based



Fraunhofer HHI  
Free2C, 2 views, tracked  
stereoscopic 3D input



Philips  
WOWvx, 9 views  
video+depth input  
internal conversion to multiview



# 3D Displays – Non Glasses Based



Alioscopy, 8 views, 42", HD  
Input: native format



Setred, 20", XGA  
Input: 2x Video+Depth



# 3D Displays – Non Glasses Based



Spatial View, 46", HD



# 3D Displays – Non Glasses Based



Tridexterity, 57", HD

**HOLOVIZIO™**



HoloVizio 128WLD (32")



HoloVizio 720RC (72")

# 3D Displays – Non Glasses Based



## ITRI

- > 50 views
- Format unknown

## NHK

- 40x40 views
- Driven by Ultra High Vision projector



side-by-side



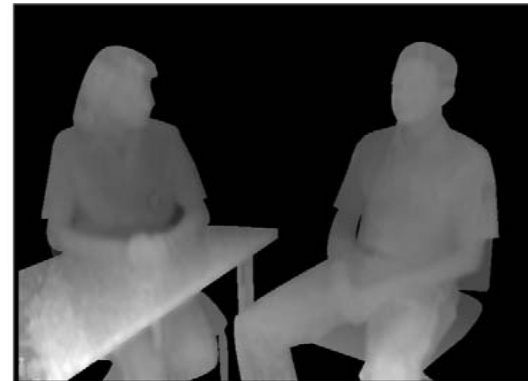
interleaved

- Standard format for 3D Cinema (+)
- Standard format for glasses-based consumer displays (+)
- No support for non-glasses-based multiview displays (-)
- Allows adjustment of zero-parallax (+)
- No scaling of depth (-)
  - No adjustment to display size
  - No personal preferences, kids mode
- No occlusion information
  - No motion parallax

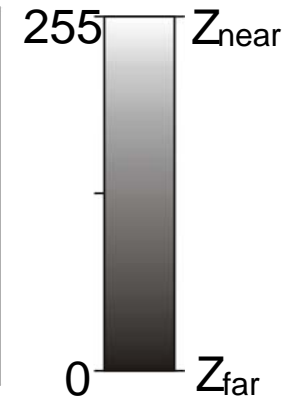


Video

+



Per-Pixel Depth Map



- Successful demonstrated by ATTEST project (2002-2004), MPEG-C Part 3
- Not the standard format for 3D Cinema (-)
- Depth-Image-Based-Rendering
  - Support for stereoscopic glasses-based consumer displays
  - Support for non-glasses-based multiview displays (+)
  - Allows scaling of depth (+)
    - Adjustment to display size
    - Personal preferences, kids mode
  - Views must be extrapolated (-)
- Allows adjustment for zero-parallax (+)
- No occlusion information (-)
  - Reduced quality of depth-image-based-rendering

# Occlusions



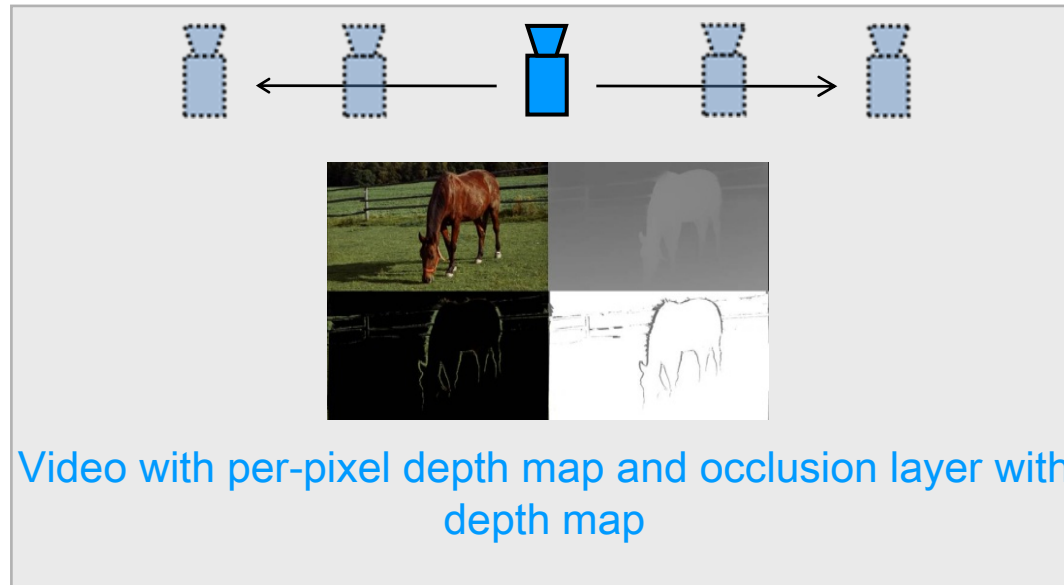
Input: stereo image pair,  
cam 3 and 5



Processing: disparity estimation and  
calculation of depth for  
cam 3 and 5. Generation  
of virtual view for cam 4  
using information from  
cam 3 or cam 5

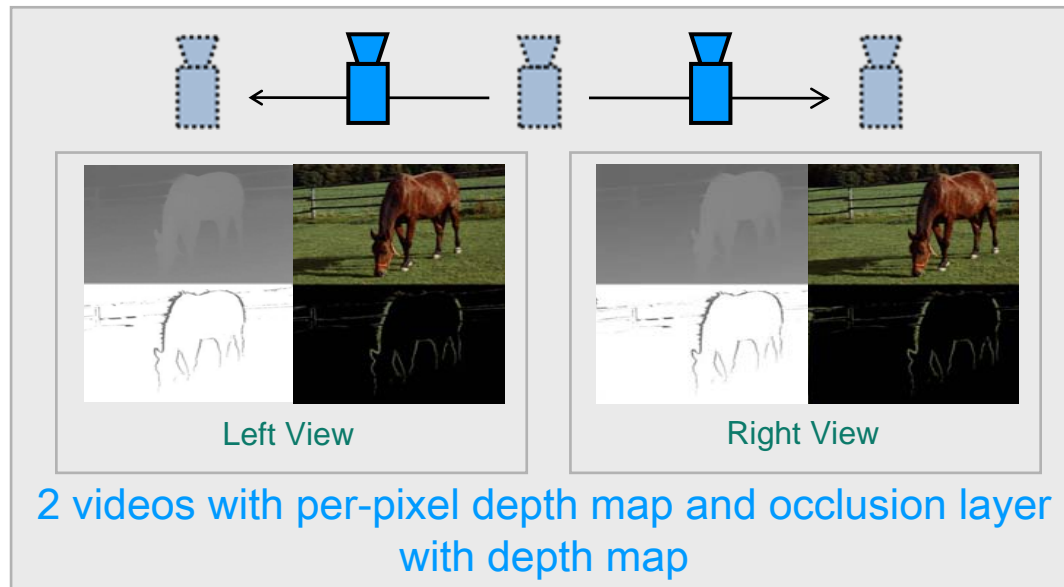


Original image from cam 4



- Not the standard format for 3D Cinema (-)
- Depth-Image-Based-Rendering
  - Support for stereoscopic glasses-based consumer displays
  - Support for non-glasses-based multiview displays (+)
  - Allows scaling of depth (+)
  - Views must be extrapolated (-)
- Allows adjustment for zero-parallax (+)
- Provides occlusion information (+)
  - Better quality of depth-image-based-rendering

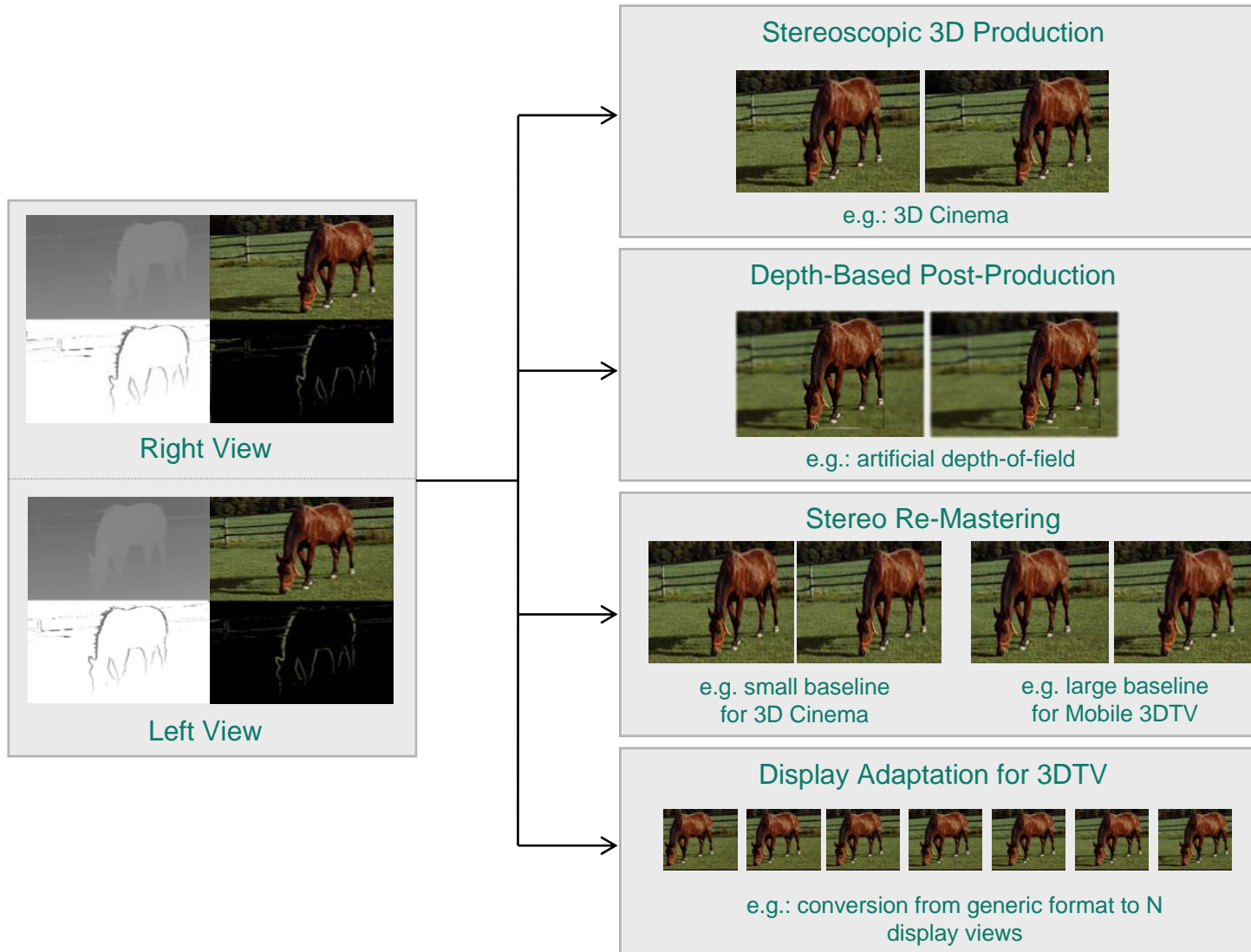
# Depth Enhanced Stereo (DES)



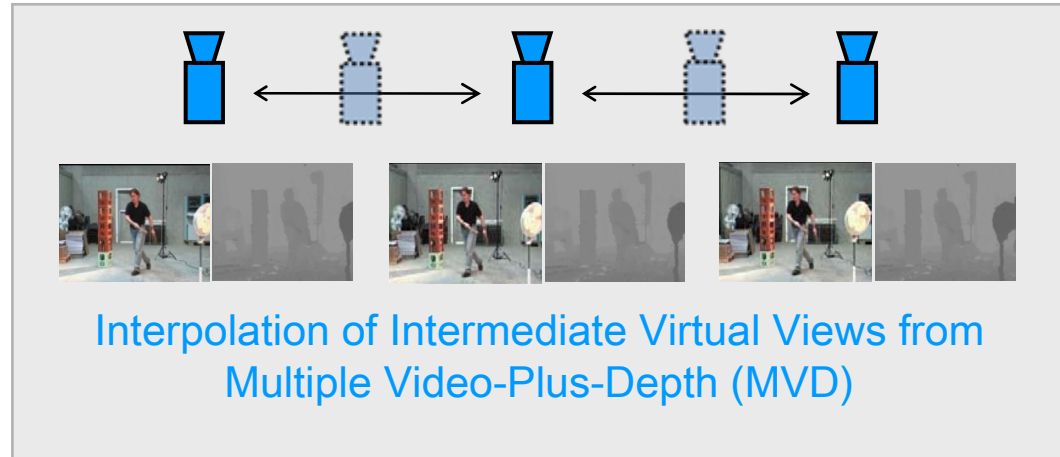
- Not the standard format for 3D Cinema (-)
- Easily usable for stereoscopic glasses-based consumer displays (+)
- Depth-Image-Based-Rendering
  - Support for non-glasses-based multiview displays (+)
  - Allows scaling of depth (+)
  - Views are interpolated or extrapolated
- Allows adjustment for zero-parallax (+)
- Provides excellent occlusion information (++)



# Usage of Depth Enhanced Stereo (DES)

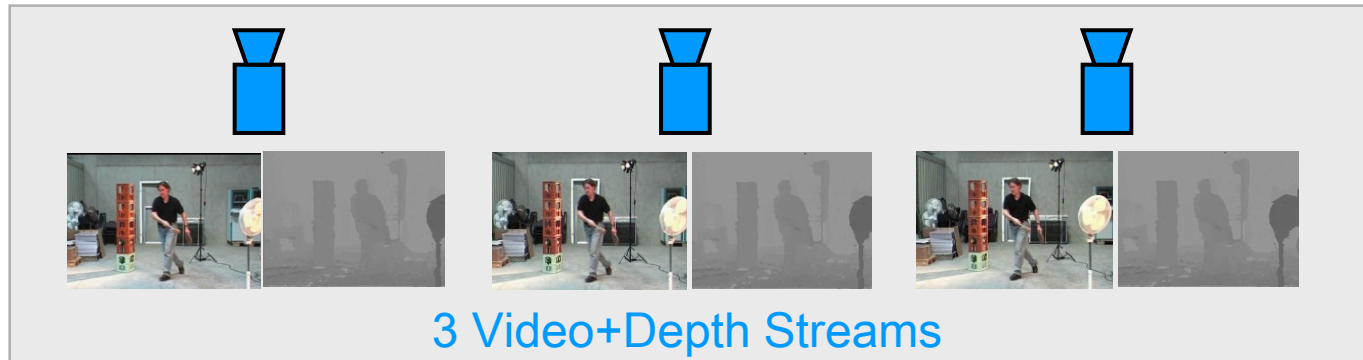


# Multiple Video-Plus-Depth (MVD)

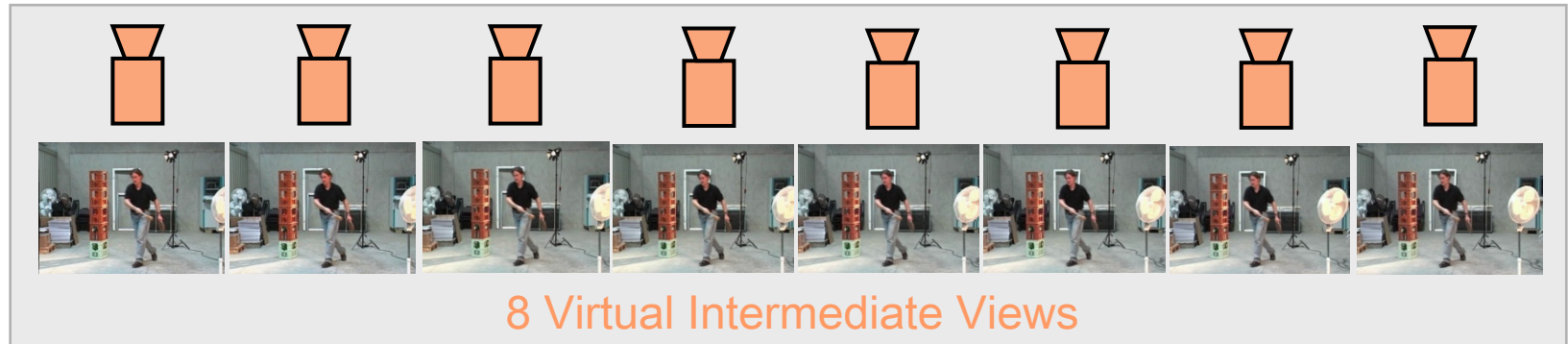


- Not the standard format for 3D Cinema (-)
- Easily usable for stereoscopic glasses-based consumer displays
- Depth-Image-Based-Rendering
  - Support for non-glasses-based multiview displays (+)
  - Allows scaling of depth (+)
  - Views are interpolated (+)
- Allows adjustment for zero-parallax (+)
- Provides good occlusion handling due to redundant information (+)

## Distribution Format



## View Conversion by Image Based Rendering



## 3D-Display



## Video plus Depth

- 1 video stream with associated depth map

## Layered Depth Video (LDV)

- Video plus depth enhanced with additional occlusion layer with depth information

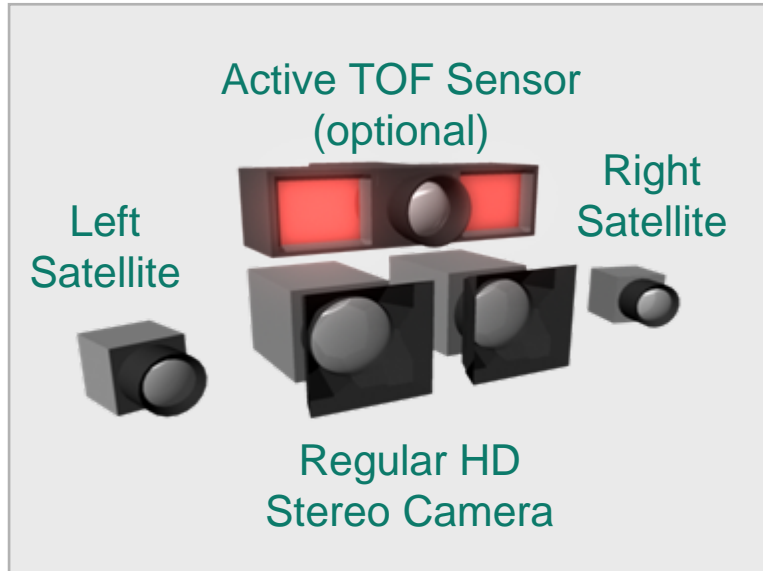
## Depth Enhanced Stereo (DES)

- 2 video streams with depth map and additional occlusion layer with depth information

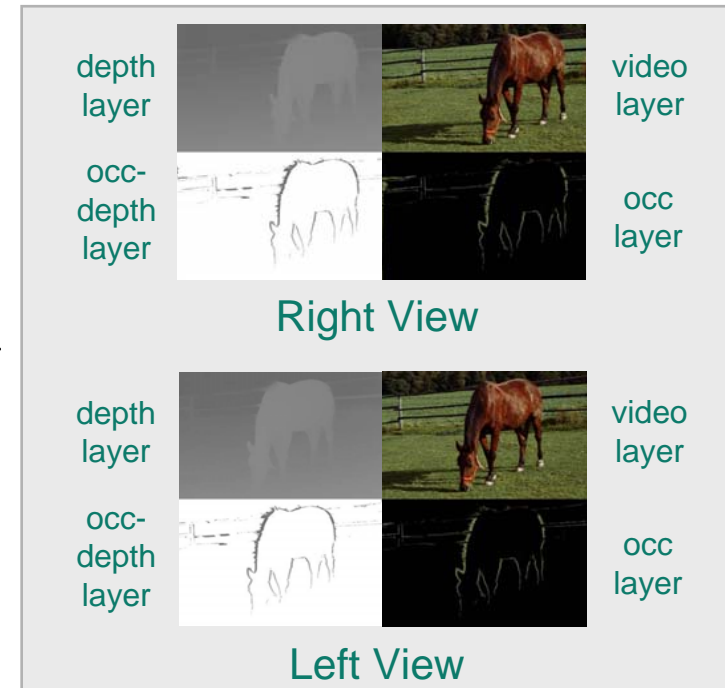
## Multiple Video plus Depth (MVD)

- 2 or more video streams with depth

# Capturing of Generic 3D Format



Conversion  
to Production  
Format



- Original stereoscopic footage keeps untouched
- Satellite cameras for robust disparity estimation
- Active TOF Sensor can help in un-textured areas



- Stereoscopic 3D is the de-facto standard from 3D-Cinema
  - Directly usable for glasses-based displays, but no scaling of depth
  - Not usable for non-glasses-based displays
- A 3D distribution format must be generic for all display types
  - Support for stereoscopic displays
  - Support for multi-view displays
- The complete production chain is involved
  - Cameras
  - Recording technology
  - Post-production
  - Delivery
- Computer vision solutions can be used for formats conversion
  - Estimation of depth maps
  - Generation of virtual views for multi-view and for adjustment of baseline

