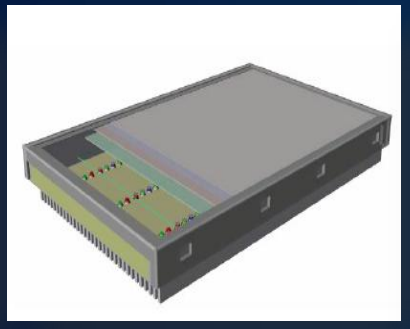
‘3D Display Analysis’

Crosstalk Analysis for Parallax Barrier type by using Optical Simulation

2011.10.13

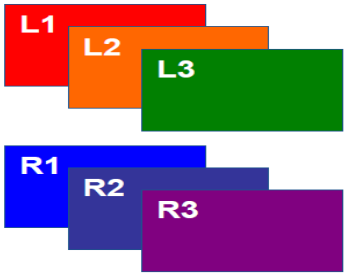
Chungnam Displaycenter

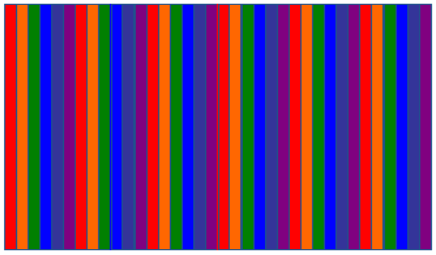
Contents

Introduction of 3D Display

Definition and Meaning

- Expanded Meaning : Both H/W & S/W tech. (Image acqusition, Reality, Evaluation etc.)
- General Meaning: Only focuses on H/W technology for 3D reality





<Imaging Equipments>

<A kind of Frame Mixing Process>

<ex: 3D Reality>

Classification of 3D Display

■ Types of 3D Display (Based on development & Marketing)

▶ Usually, classified by the needs of Glasses to see a 3D images.

Wearing Glasses (Stereoscopic)	Anaglyph type
	Polarization type
	Time Sequence type
	Head Mount Display
Glassless type (Autostereoscopic)	Parallax Barrier
	Lenticular
	Integral Imaging

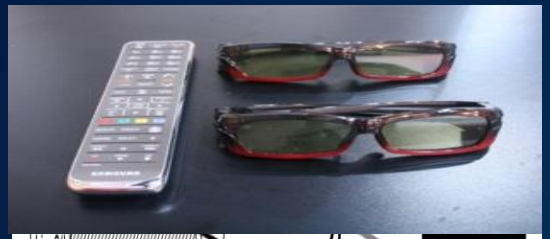
Stereoscopic type

■ Needs a Glass to make a 3D image at the brain

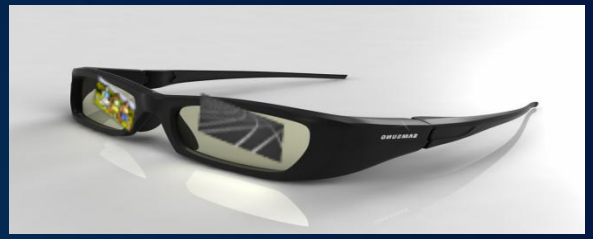
▶ Severe fighting for image quality between Polarization and Time sequence type.

<Anaglyph type>

<Polarization type>



<Time Sequence type>

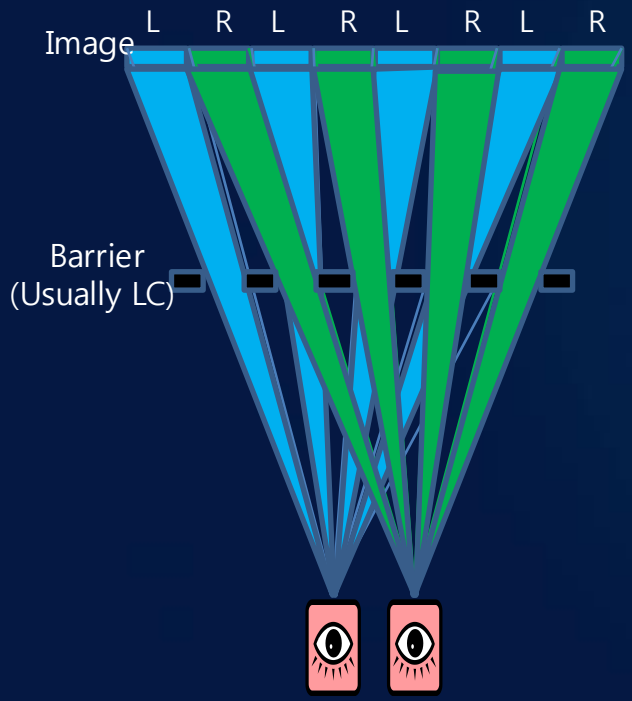


Auto-stereoscopic type

■ No Need to wear a Glass to feel a 3D image

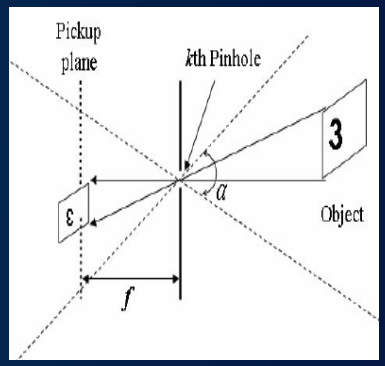
- ▶ Expected to be a main display in near future.
- ▶ Image separation by additional optical components such as Barriers, Lens arrays.

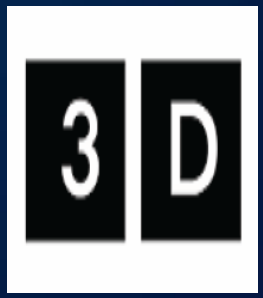
<Parallax Barrier>

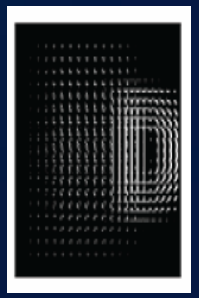


<Lenticular lens>

<Integral Imaging>





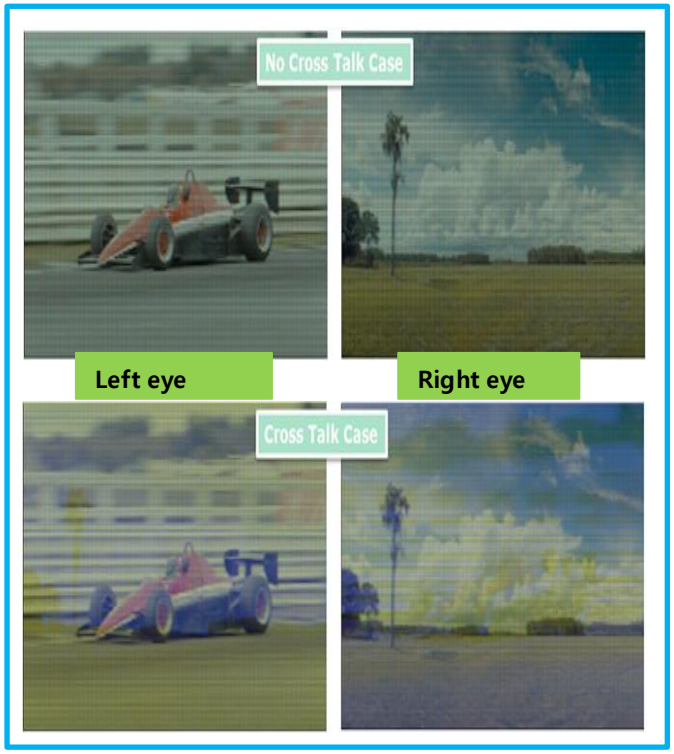


Factors for Visual Fatigue

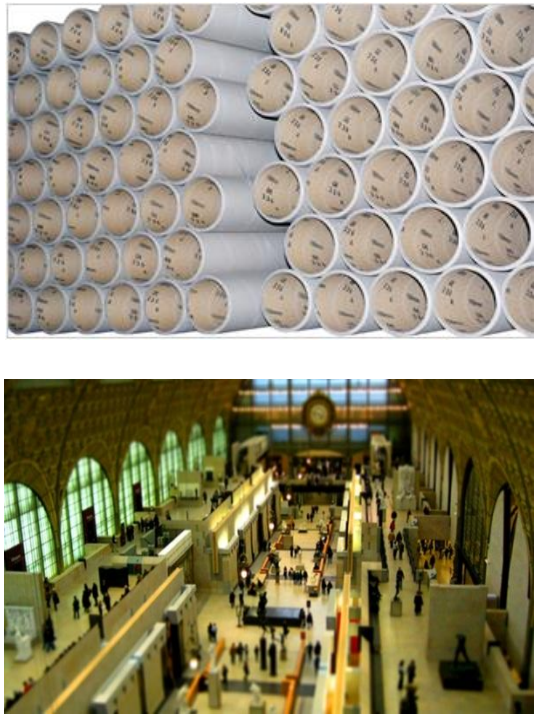
- **Nowadays, 3D displays mainly use Convergence and Binocular Disparity.**
  - ▶ These cause imperfect 3D images and finally result in some physical symtoms.
    (Eyestrain, Heavy Eyes, Double Vision, Dry Eyes, Dizziness etc.)

Factors

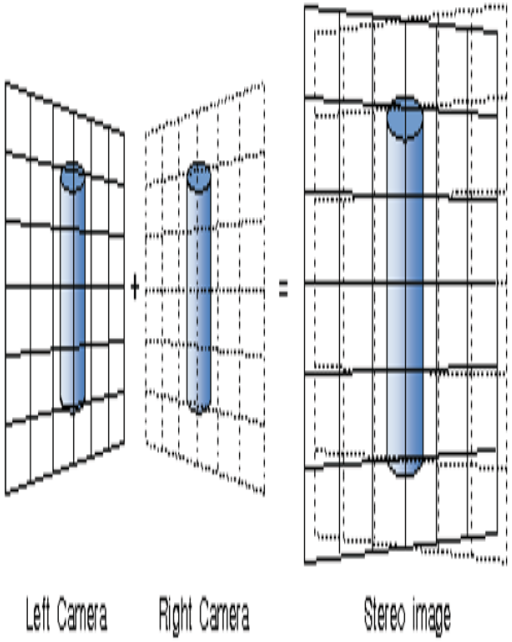
<Crosstalk Effect>



<Cardboard & Puppet theater Effect>



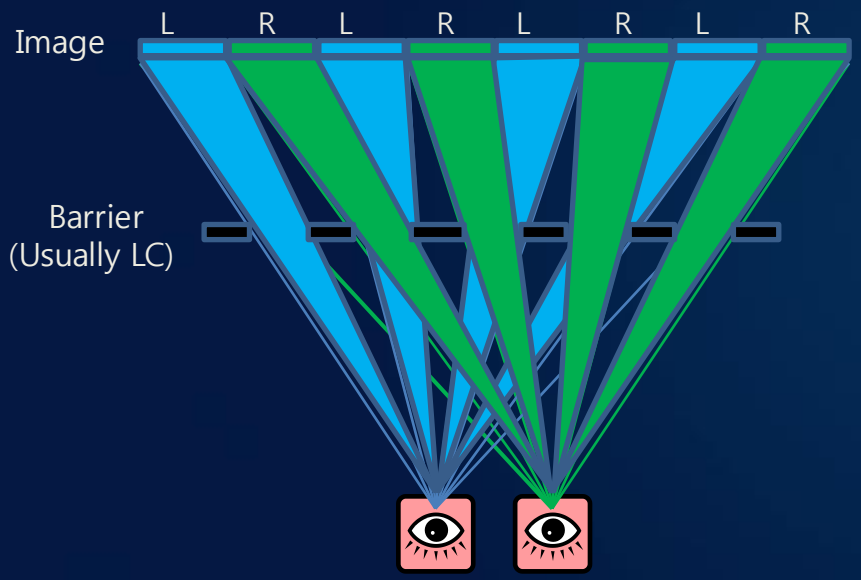
<Keystone distortion>



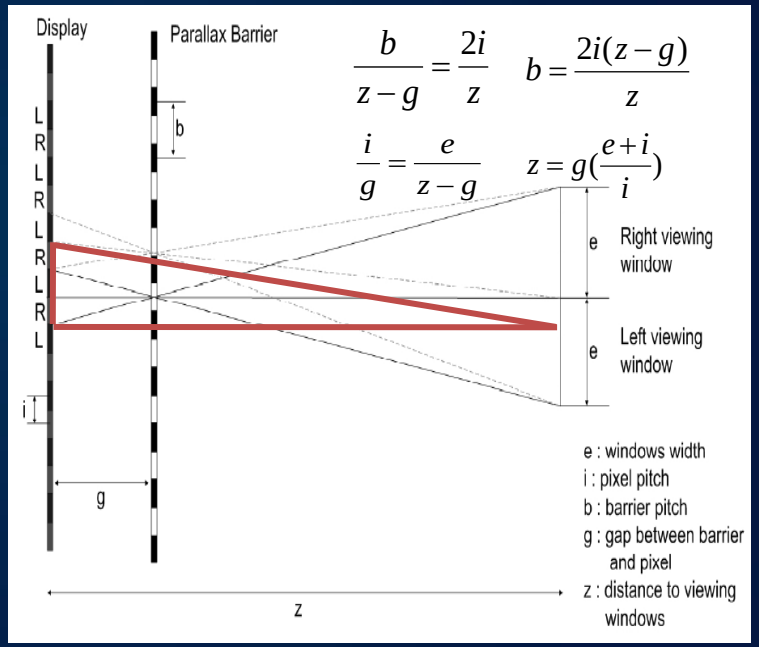
Parallax Barrier type

■ Principle & Design Parameters

▶ By setting a Barriers(usually LC is used) from a proper position, each left and right eye can see a divided image.



<Operating Principle of Parallax Barrier type>



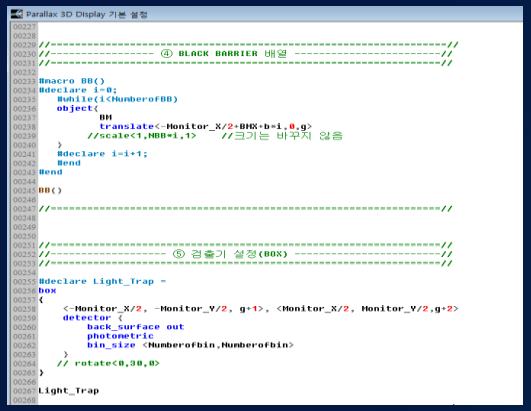
<Design Parameters>

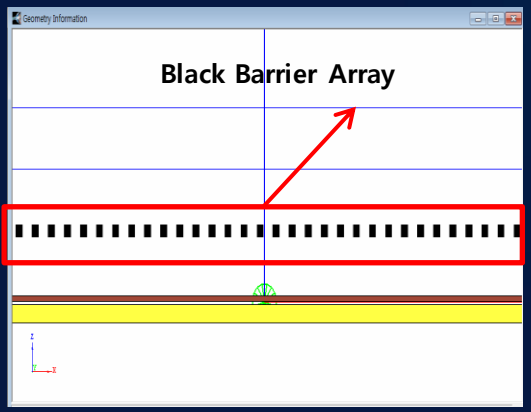
Optical Simulation & Analysis

Design & Simulation Process

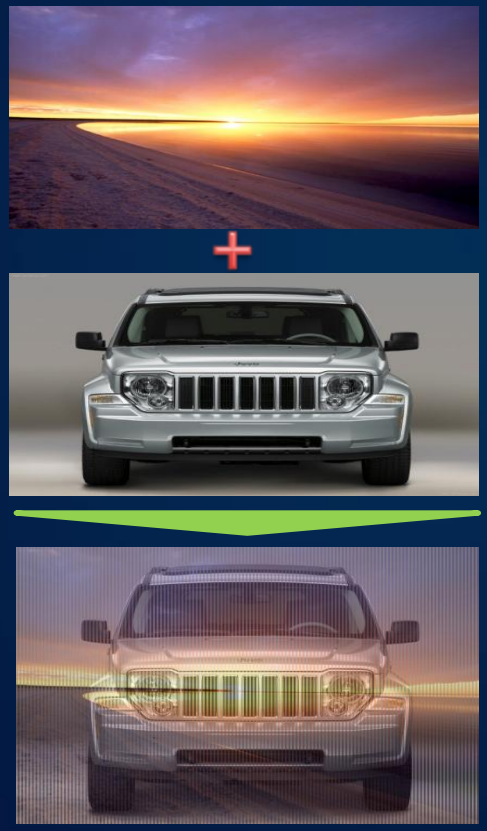
▶ We used commercial optical design s/W, RayWiz, to trace a great # of rays to realize the lower error. (※ Errors are necessarily happened as long as using Monte-Carlo Method.)

<Coding the parameters>

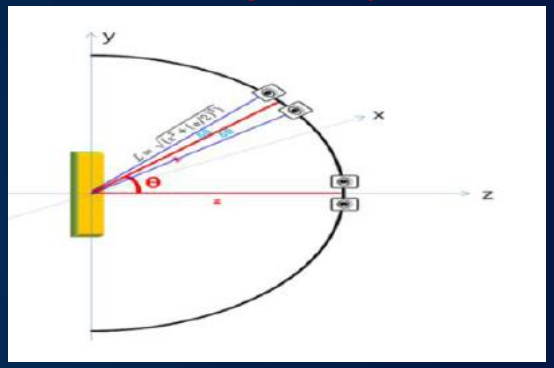


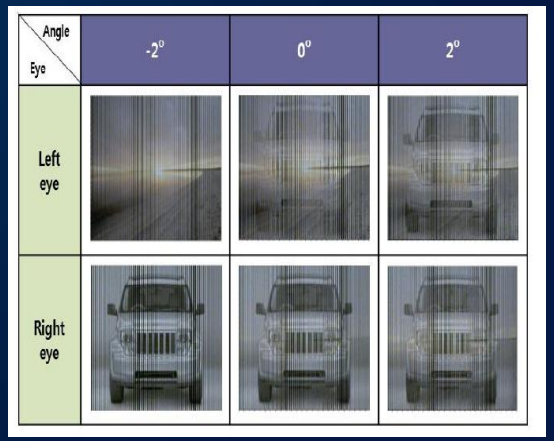


<Image synthesis>



<Positioning & Analysis>

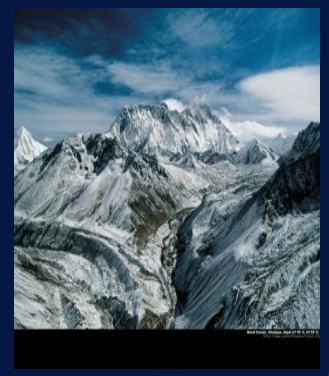




Test Result

Pictures by a general digital camera in exact front of display

- We control the barriers on and off by clicking the switch to make 2D/3D convert.
- At 2D mode, no changes are arised, but at 3D mode only flower is seen without mountain.



Test Result

Test Result (image change by camera rotation)

2D Mode

Angle / Direction of rotation	Normal	1°	2°	3°	4°	5°
Left						
Right						

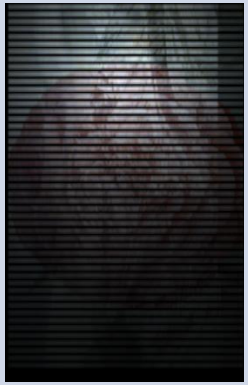
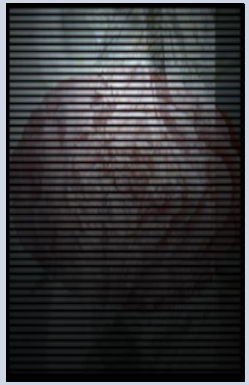
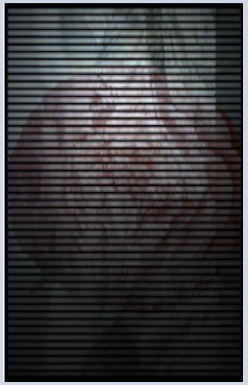
Test Result (image change by camera rotation)

3D Mode

Angle / Direction of rotation	Normal	1°	2°	3°	4°	5°
Left						
Right						

Simulation Result

3D Mode

Angle / eye	Normal	-25°	-20°	-15°	-10°	-5°
Left Eye						
		5°	10°	15°	20°	25°
						

Future Work

■ Matching and Fitting the result between test and simulation

▶ Need to input exact configuration for development.

(Resolution, Material indices, Reflectance & Transmittance, Barrier Pitch etc.)

■ System Optimization

▶ By changing some parameters to get a least crosstalk data

- It's very tedious work !

■ Expand the designing to Lenticular and Integral Imaging type

▶ Putting Lenticular and Lens array in front of the image plane

▶ Same process will be applied

Thank you !