

GPU Computing Seminar

3D and Medical Applications on GPU

Dr. Kai-Che Liu

Assistant Manager

3D System Application Division

Electronics and Opto-electronics Research Laboratories

Industrial Technology Research Institute

2010/01/22

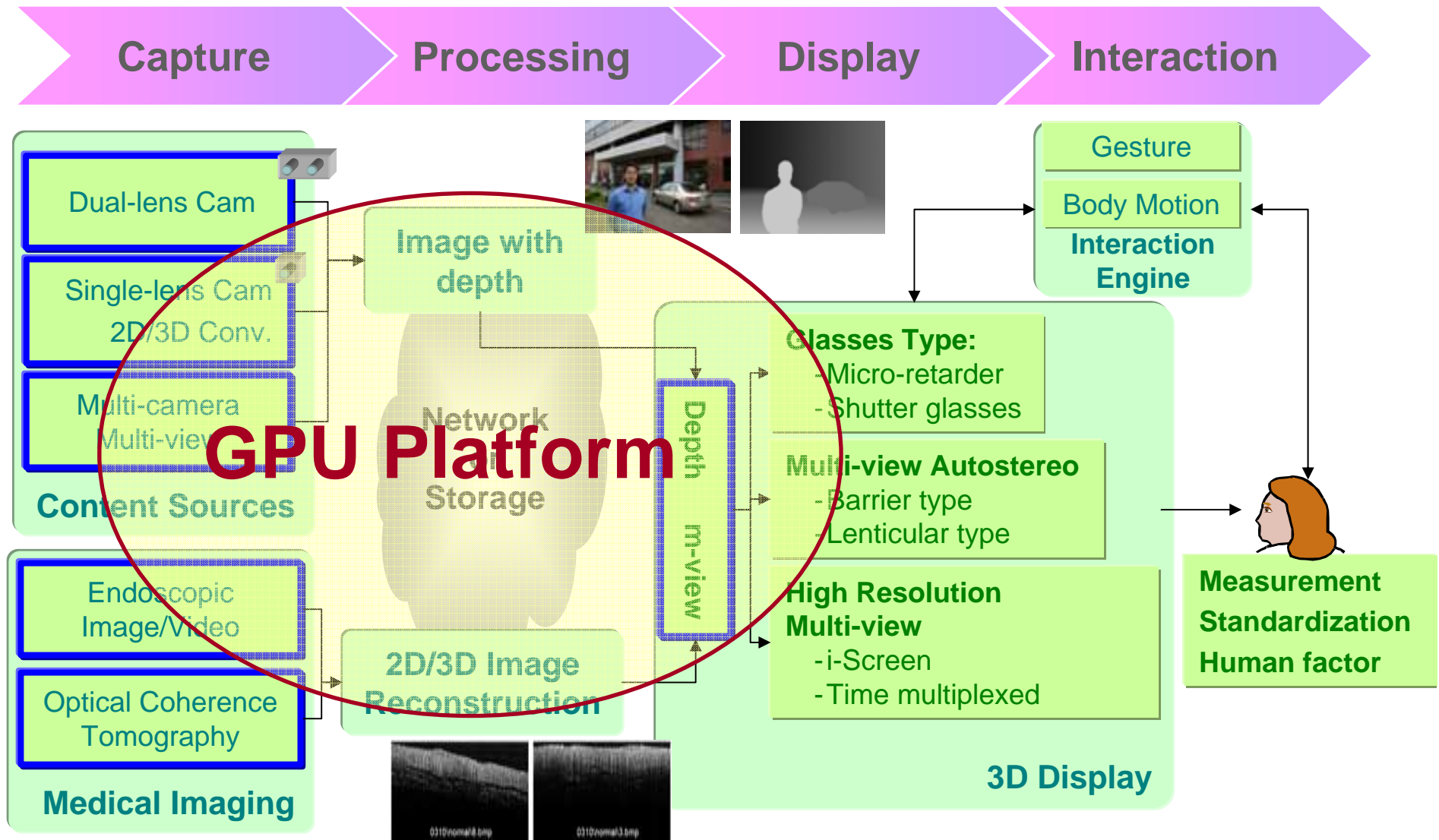


Content

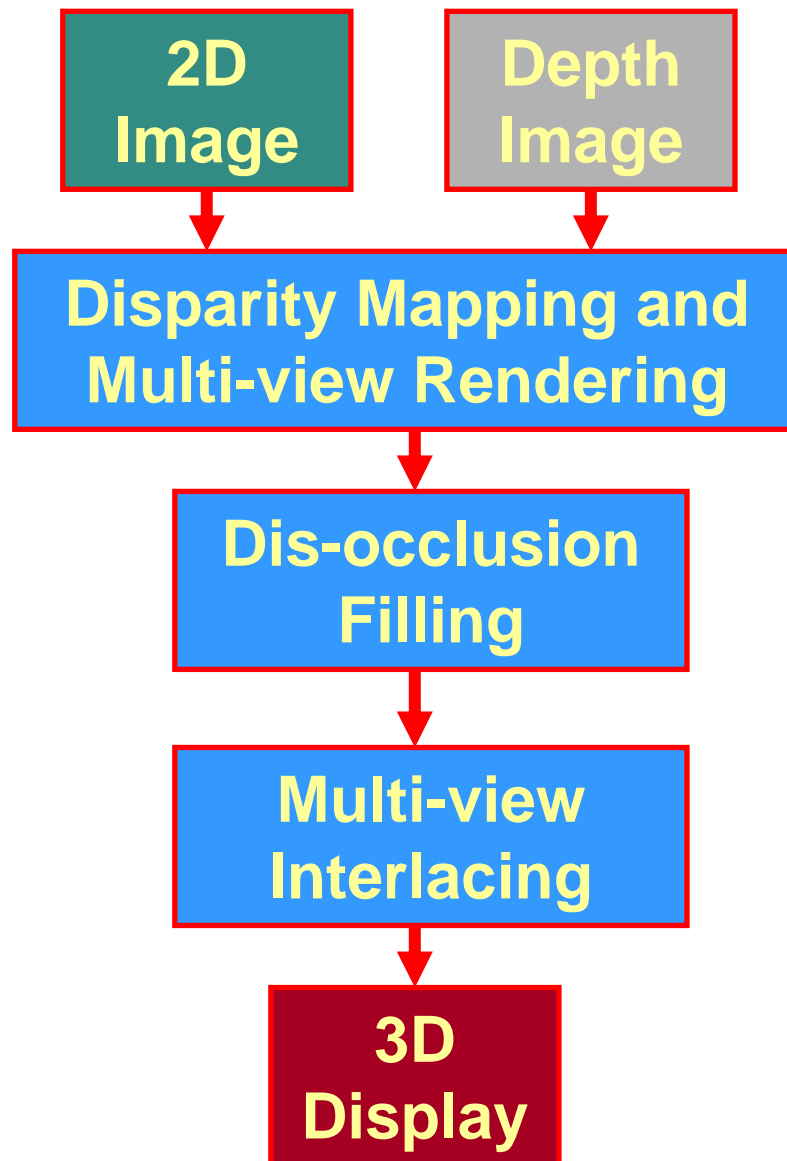
- **Introduction**
 - **End to End Solution**
- **Applications on GPU Platform**
 - **DIBR Rendering**
 - **Multi-view Synthesis**
 - **Optical Coherence Tomography**
- **Other Researches**

End-to-End Solution

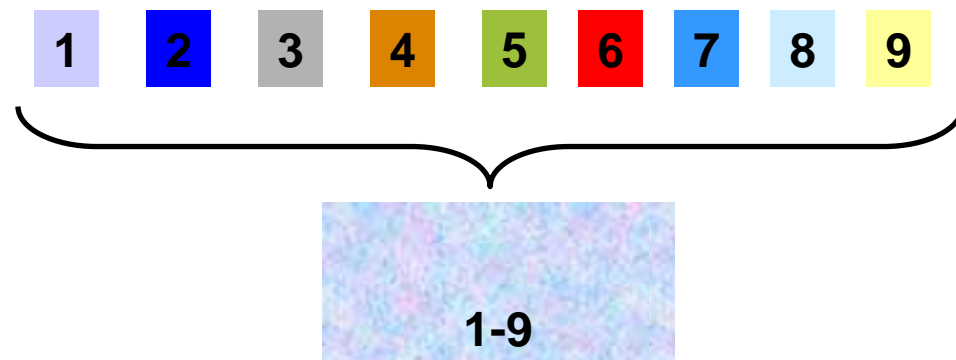
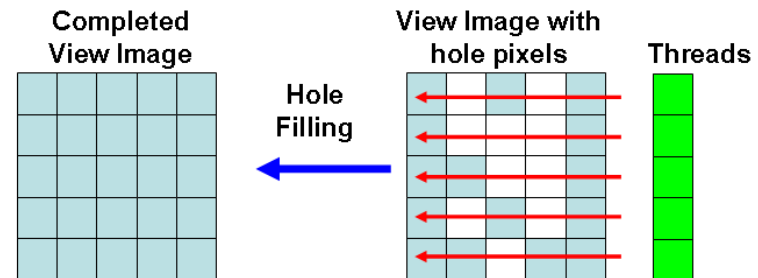
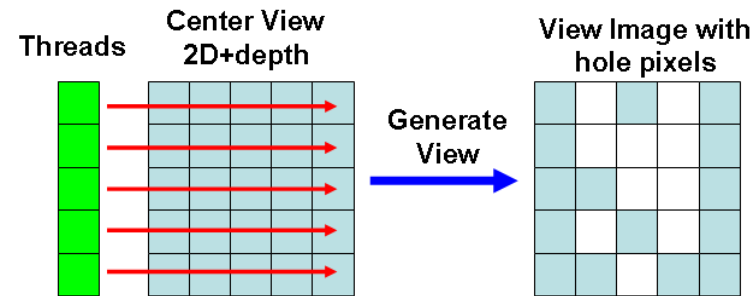
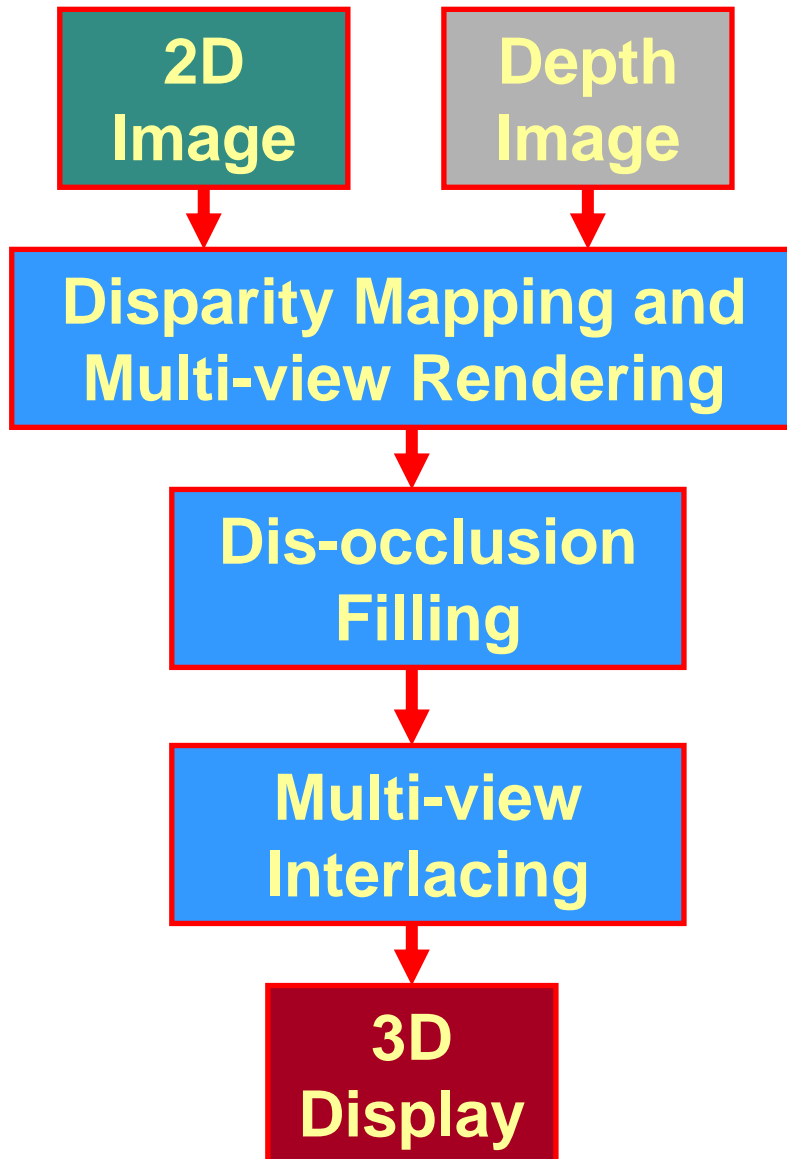
Content Generation , Processing, Display and 3D Interaction



Depth Image Based Rendering and Multi-view Interlacing



Parallel Design



Result

Spec. :

GPU	NVIDIA GeForce GTX 280	
processors		30
cores		240
Clock Rate		1296MHz
Memory		1GB
CPU	Intel Core2 duo	
cores		30
Clock rate		3GHz
Memory	DDR2 800	
	total capacity	4GB

Result :

Operation	time (ms)	frame rate (fps)
disparity	6	
hole filling	4.7	
interlace	8.2	
GPU to CPU	2.2	
subtotal	21.1	47
	554.6	1.8

GPU



26x Speed-up

CPU

3D Display in ITRI

- Stereoscopic Display (Glasses Type)
 - Rendering 2-Views + Interlacing/Page-Flipping



- Auto-Stereoscopic Display (Without Glasses)
 - Rendering N-Views + Interlacing



3.5" 5-view



20" 7-view

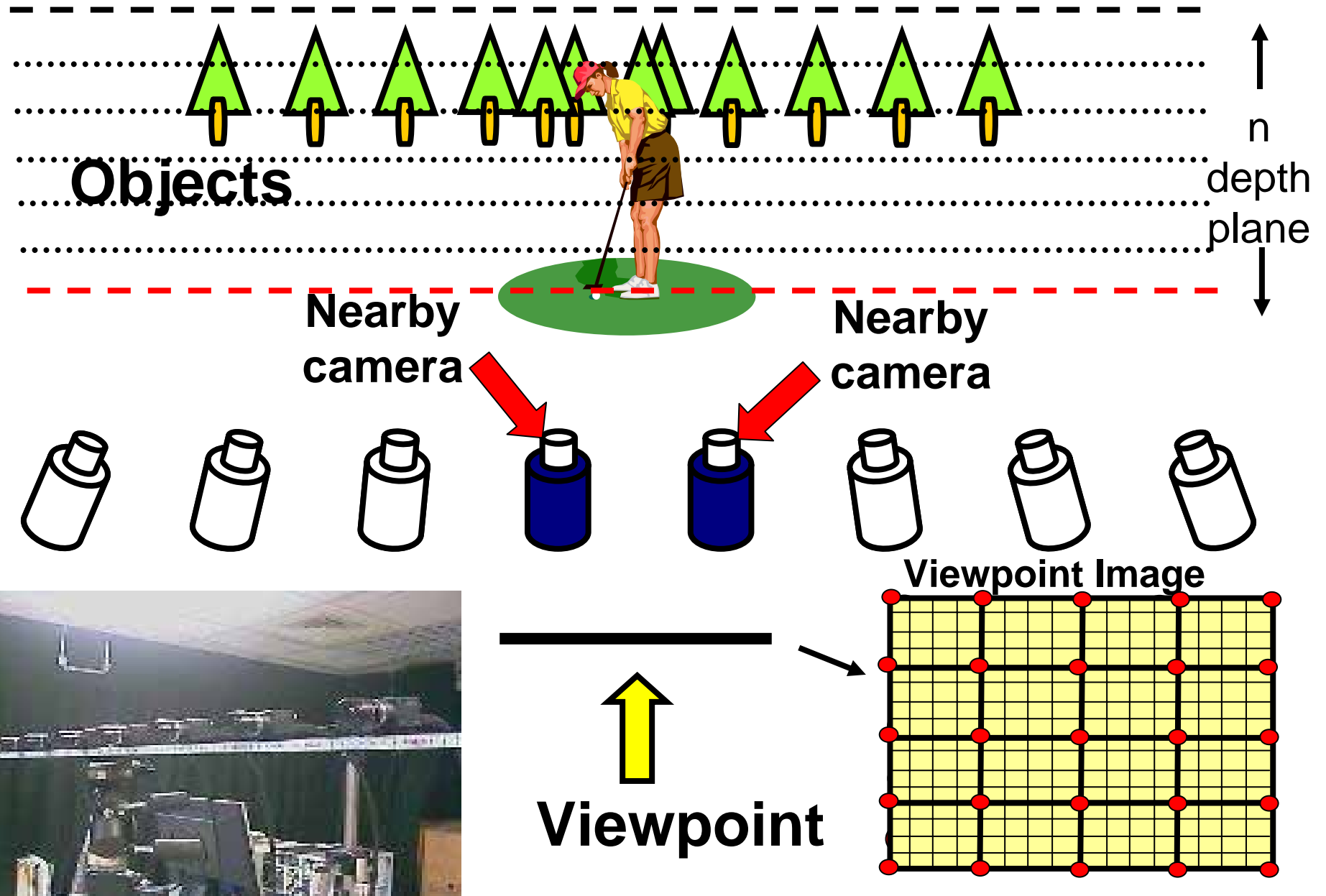


42" 9-view

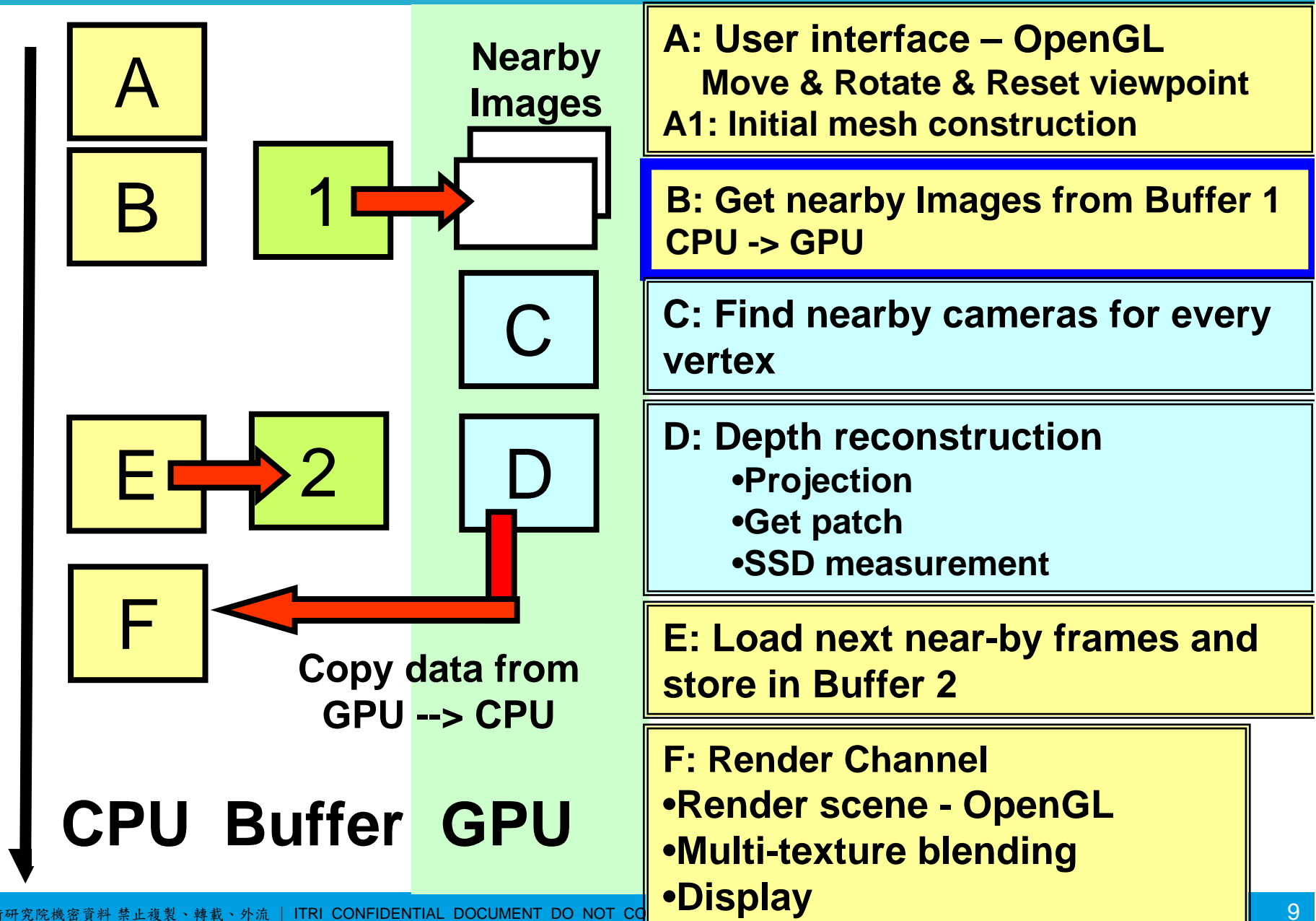


i-Screen 3D

Multi-view Free Viewpoint Synthesis



CPU-GPU Framework



Data Processing for Free Viewpoint Synthesis

- Find nearby cameras for each vertex:

Total threads we set :

$$\frac{Width}{Mesh_size} * \frac{Height}{Mesh_size} = Vertex_num$$

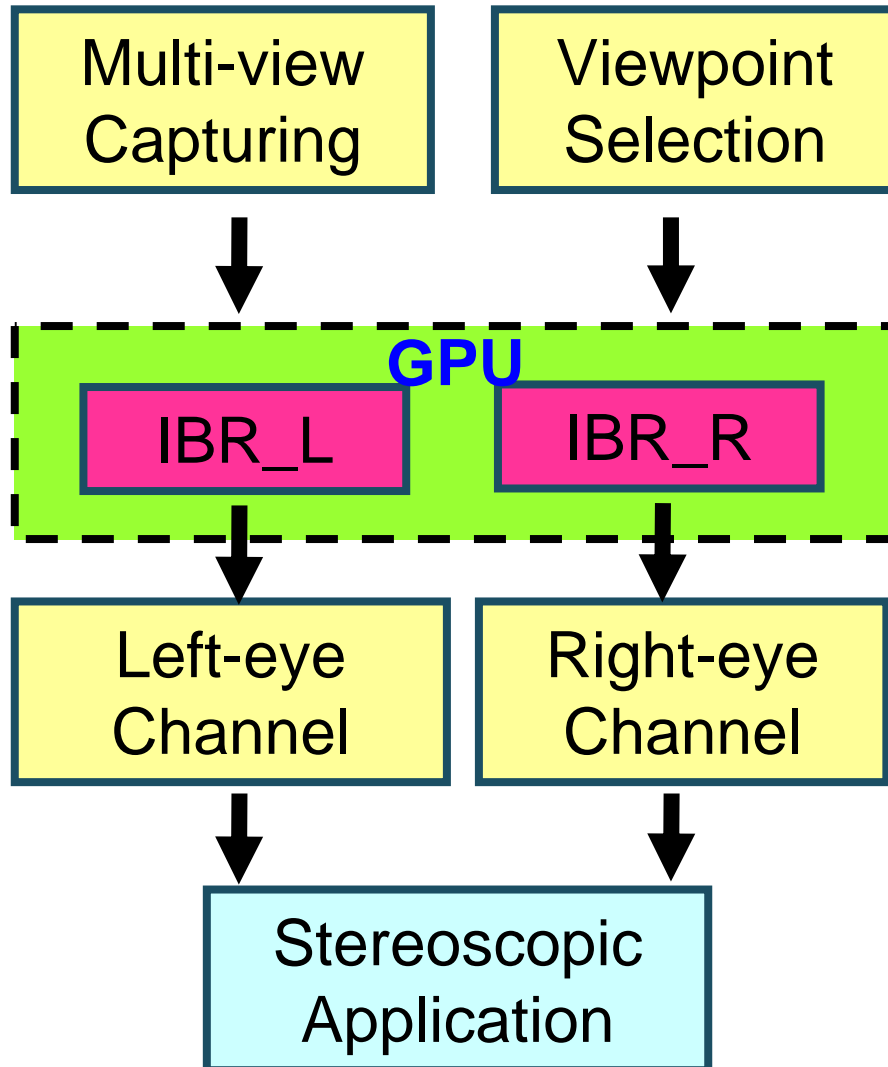
- Depth Reconstruction:

Total threads we set :

$$Vertex_num * num_Depth_planes$$

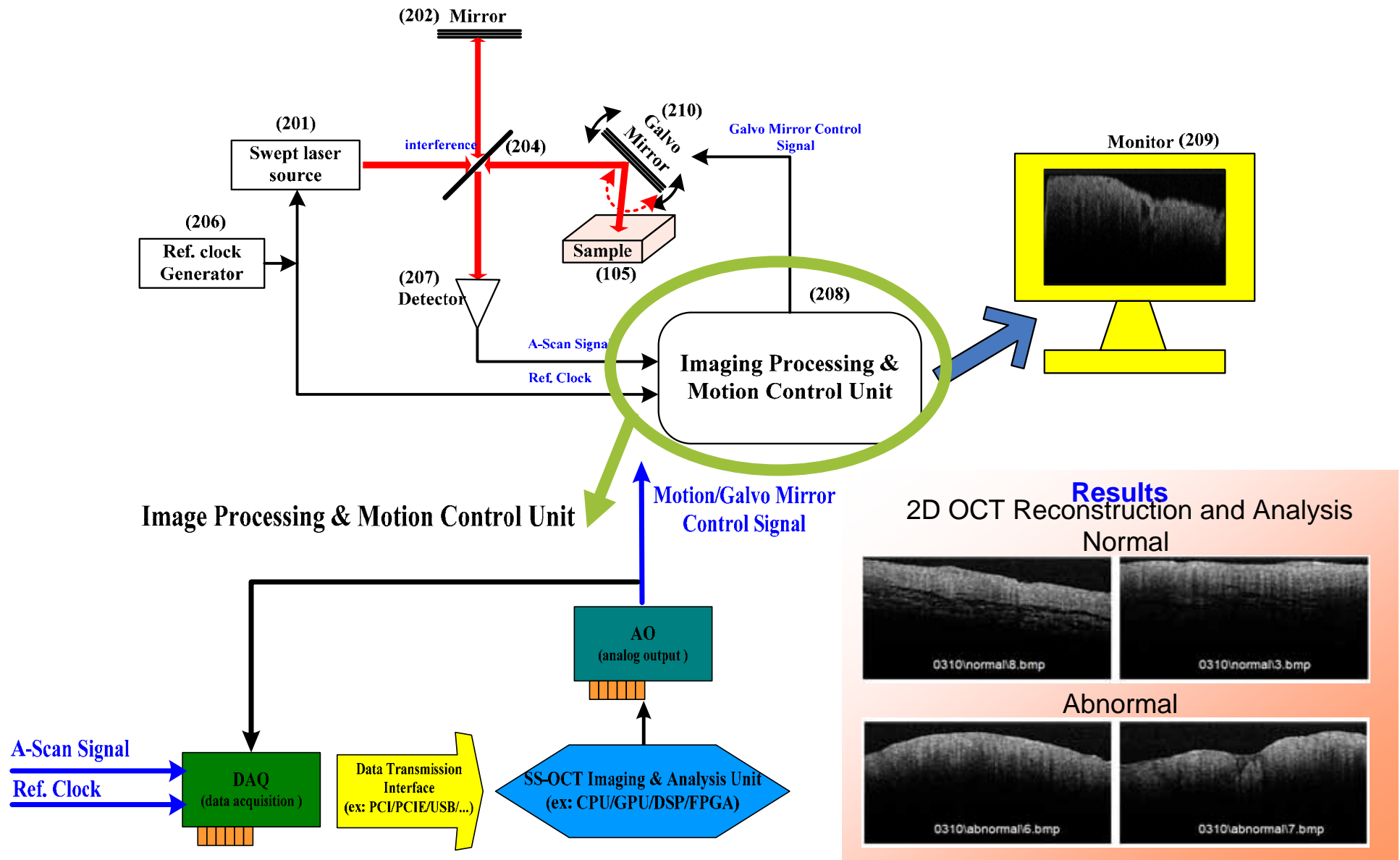
Mesh size	2	5	10
Depth Reconstruction (ms) – GPU	171.42	17.70	5.52
Total (ms)	319.62	45.50	18.69
Fps – GPU	3.12	22.00	53.50
Depth Reconstruction (ms) – CPU	566.13	90.38	23.13
Total (ms)	678.92	137.48	62.59
Fps - CPU	1.5	7.3	16
Depth Reconstruction Speed-up	3.3x	5.1x	4.1x
Total Speed-up	2x	3x	3.3x

Data Processing for Stereo Viewpoint Synthesis

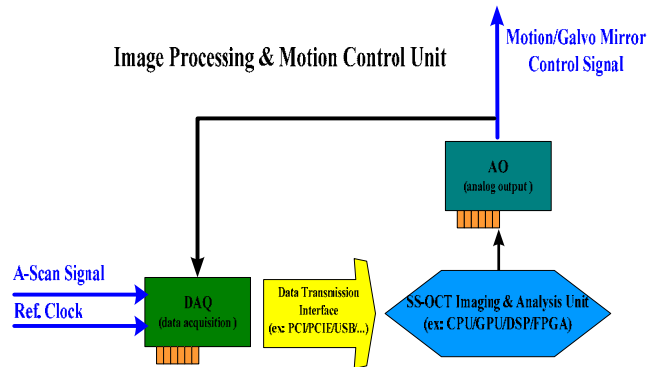


GTX 280	Left Eye	Right Eye
Reconstruct Depth (ms)	6.1636	5.2210
Render Scene (ms)	3.0298	5.1264
Copy Data (ms)	3.0885	
Total and Fps	28.2496(ms) & 35 Fps	

Optical Coherence Tomography (OCT)



Data Processing



	BF	FFT	AF	Total
CPU	0.11ms	0.297s	0.07s	0.484s
GPU	2.948ms	22.665ms	4.995ms	30.568ms
Speed-up	37x	13x	16x	15x

CPU - C

Data I/O
Control

Singles
Alignment

Data
Interpolation

Hamming
Window

Show and
User Interface

OpenGL
Pixel
Buffer
Object

Image
Reconstruction

1-D 2048-point
FFT

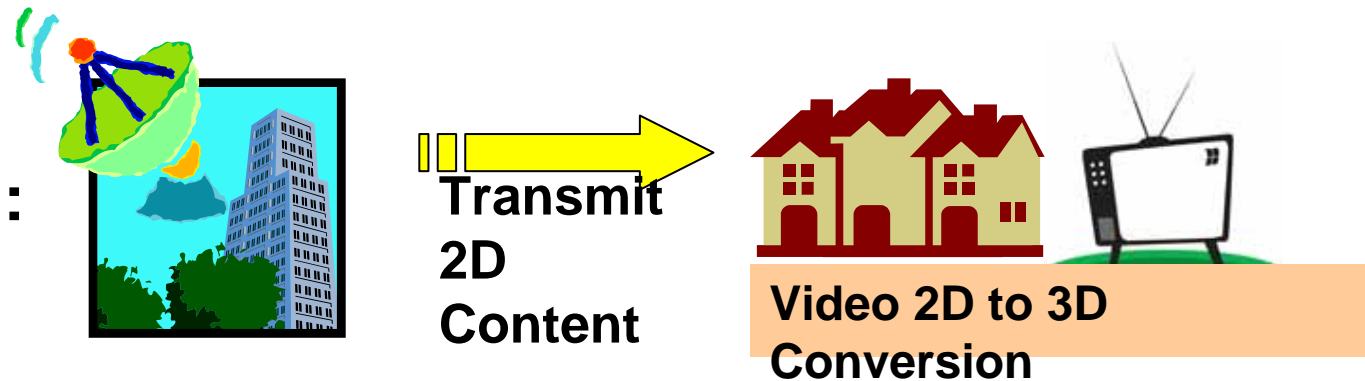
GPU - CUDA

OpenGL

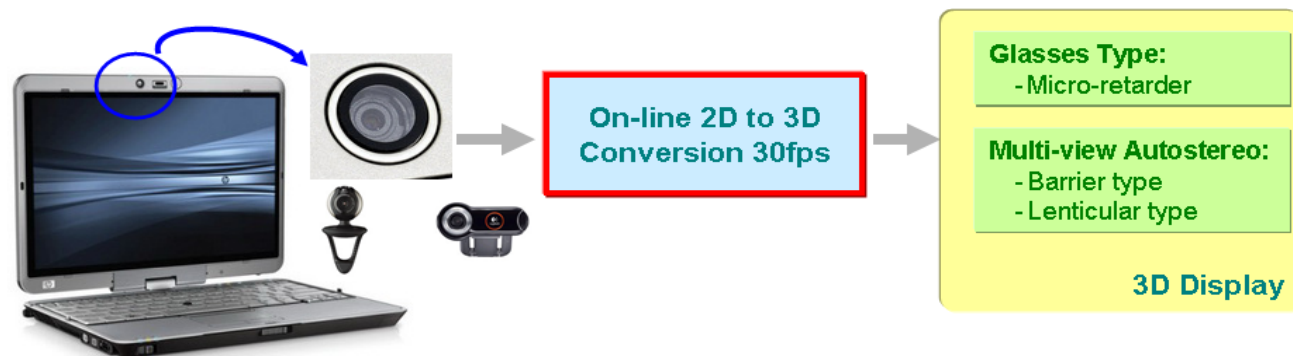
Other Researches

- Depth Estimation from 2D Video (Video 2D to 3D Conversion)
 - Algorithm Design and GPU Speed-up
 - 3fps to 30fps (10x Speed-up)

Application 1: 3DTV



Application 2: 3D Webcam (MSN, ...)



Other Researches

- Stereo to MV Rendering (Stereo Matching)
 - 3D Movie on Autostereoscopic Display (Without Glasses)
 - On-going (Currently 10fps on GPU)
- 3D Endoscopic Imaging
 - 3D Reconstruction from Single Lens
 - On-going (Target: 60fps for HD Input)
- Smart OCT System
 - On-going: Automatic Diagnosis Assisting (Database Registration, Template Matching)

Thank You Very Much !!

Kai-Che, Liu

Tel: 886-3-5917983,

Email: lkcjack@itri.org.tw

ITRI EOL