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The University of Arizona

Holographic Video Display System

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Outline

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- Review Photorefractive System
- Review “Streaming” Telepresence System
- New HVD Program Requirements
- HVD-WSS System
- SPB of the display

Photorefractive Display

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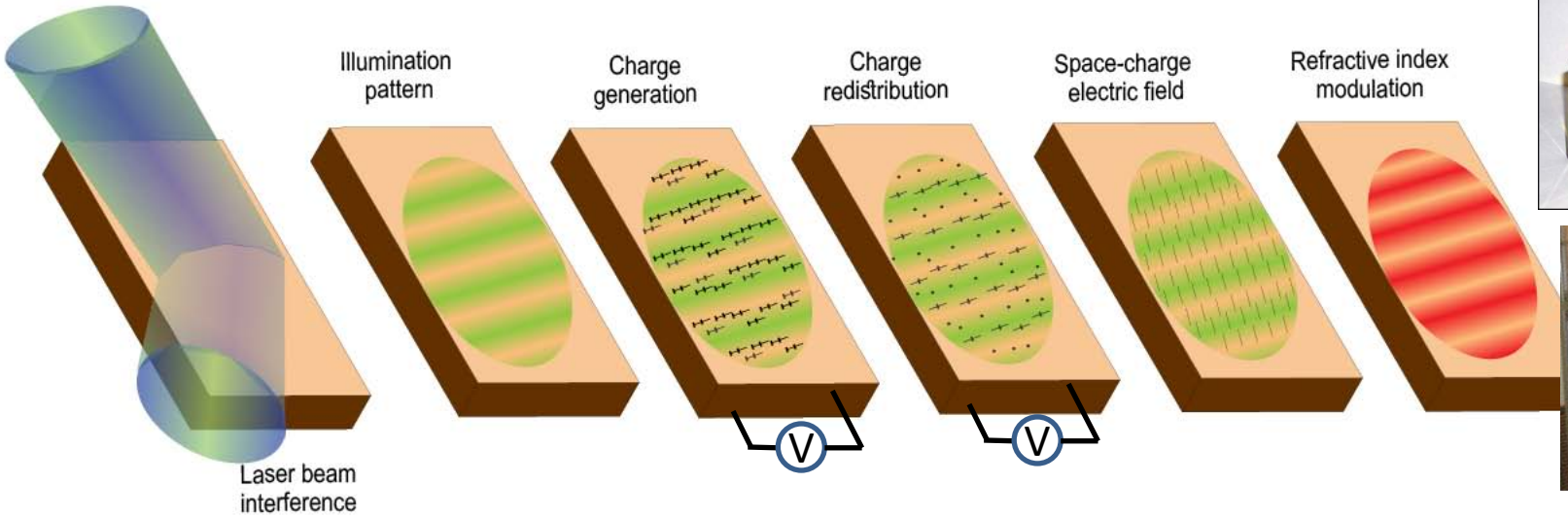
- Photorefractive materials experience a change in refractive index when exposed to light



Photorefractive Holograms

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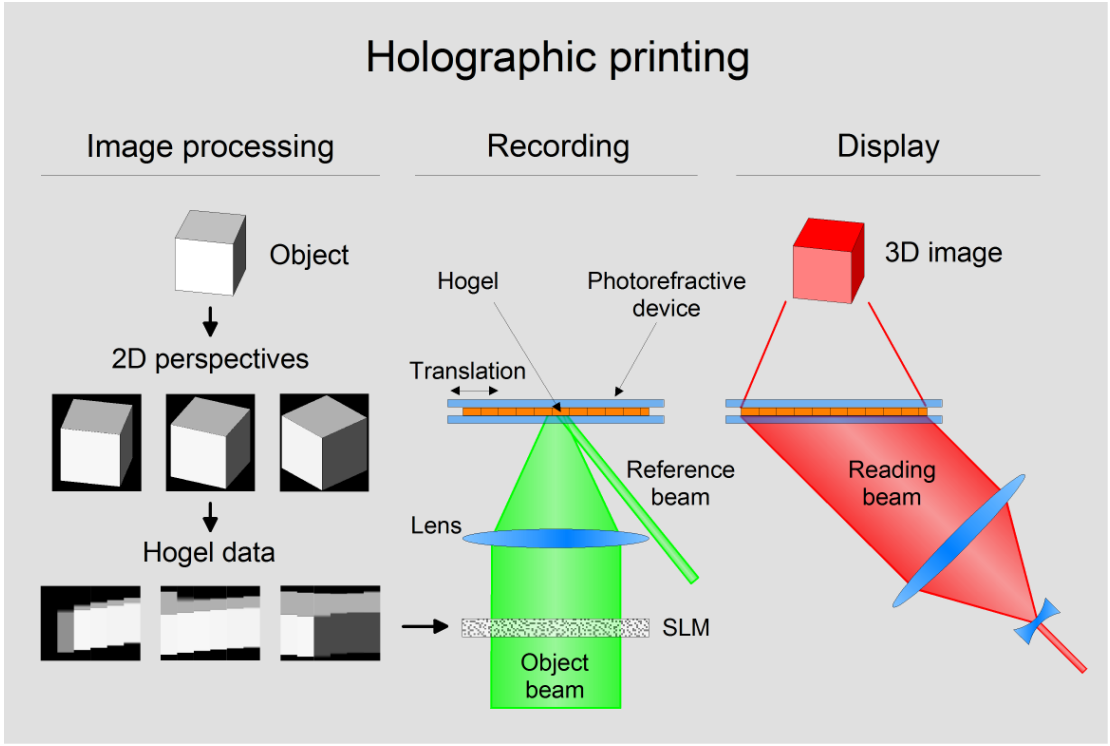
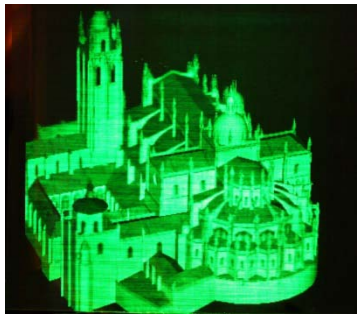
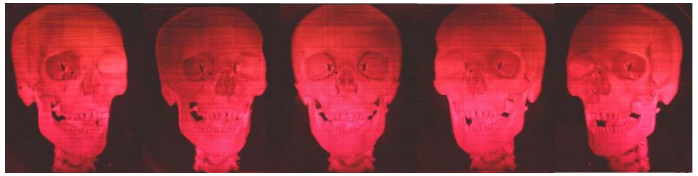
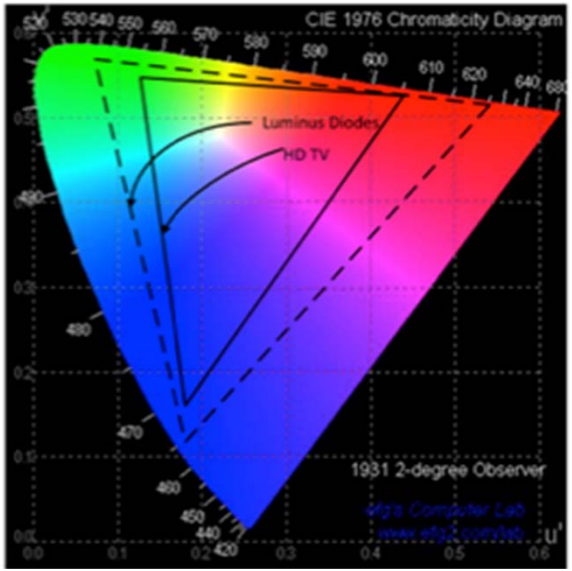
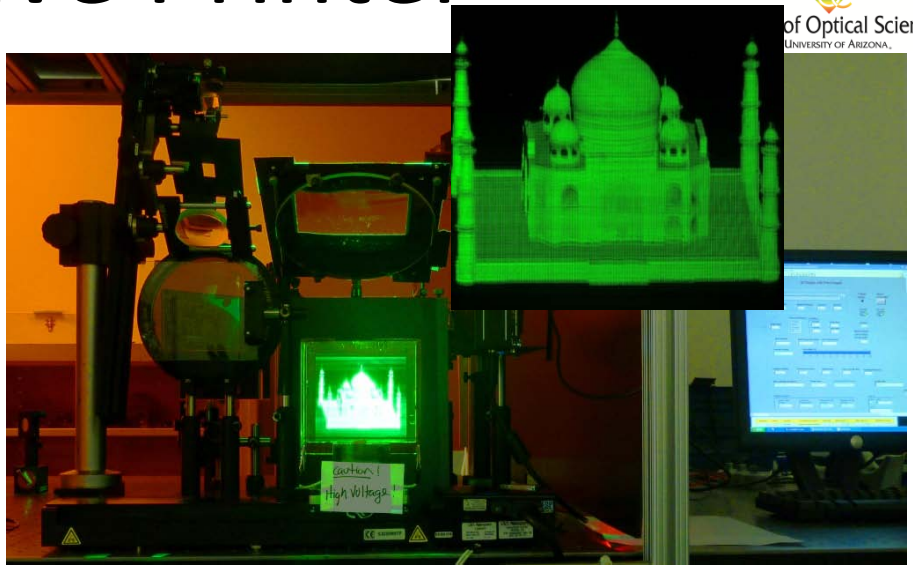






Photorefractive Printer





- Able to achieve < 10 sec writing times
- Able to shrink system to < 10ft^3 and use 200mW laser
- Able to achieve > 2,000 cd/m^2 brightness

Streaming Telepresence

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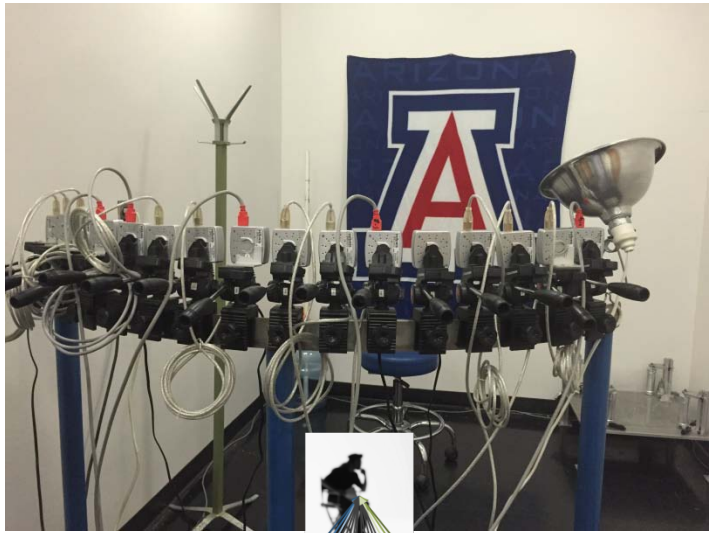
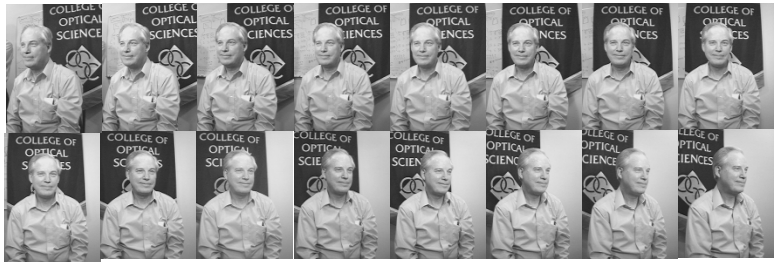
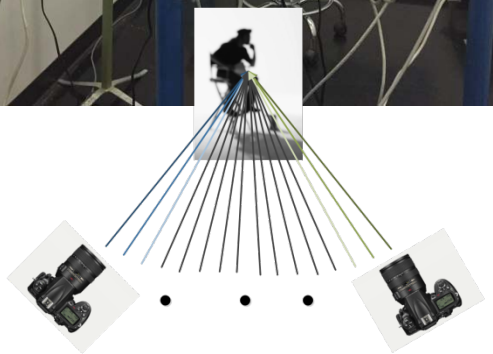
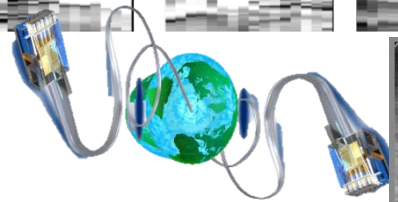




16 x 640 x 480

SLICE





2.5X HD

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HVD-GWSS

HVD GWSS Use Case Model

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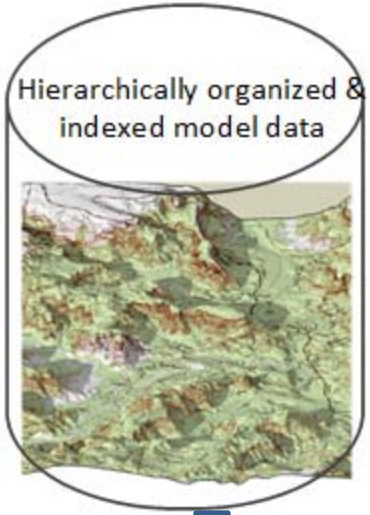
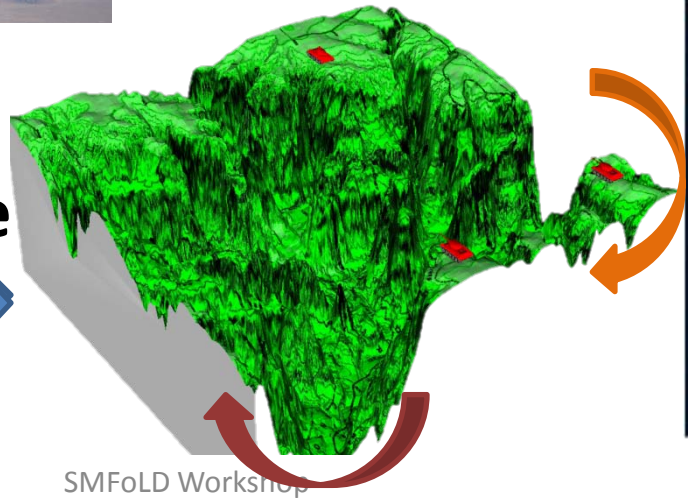


Fuse



Able to view for hours without "simulator sickness"

AF131-023
Holographic Video Display (HVD)

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Specifications	Minimum Targets	Objectives
Parallax	Full	Full
Num. FP Display Elements	1MP	2MP
Conical Viewing FOV	30 degrees	60 degrees
Update Rate	30 Hz	60 Hz
Contrast in Room light	10:1	

- Other requirements:
  - nominal viewing distance 50cm,
  - no limit to number of viewers,
  - no “lag”

Display Approach

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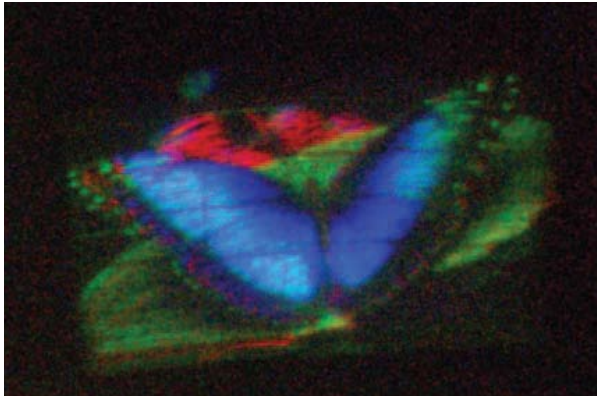
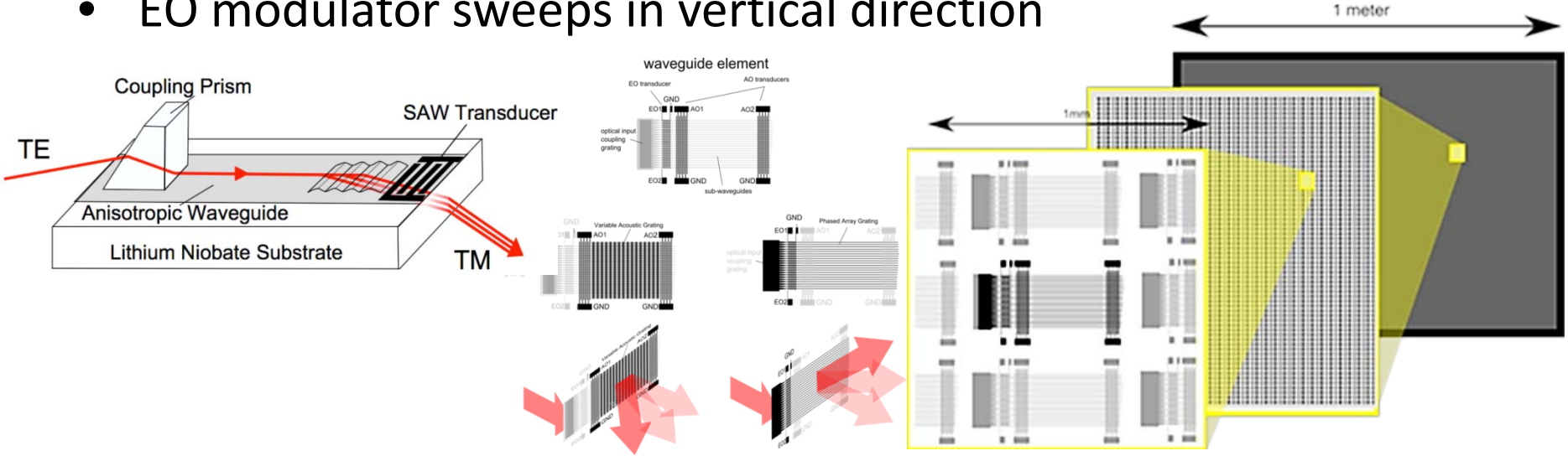
- Leverage anisotropic leaky mode scanning system developed at MIT
  - Demonstrated video rate horizontal parallax system using acousto-optic modulators. Capable of 50 Gpixels/s
  - Add electro-optic modulators to generate vertical parallax



Smalley *et. al.*, N ATURE , Vol 498, 20 June 2103, pp 3 1 3-318

Simplified Schematic

- AO modulator generates a diffraction pattern that sweeps the light horizontally.
- EO modulator sweeps in vertical direction



Data Generation

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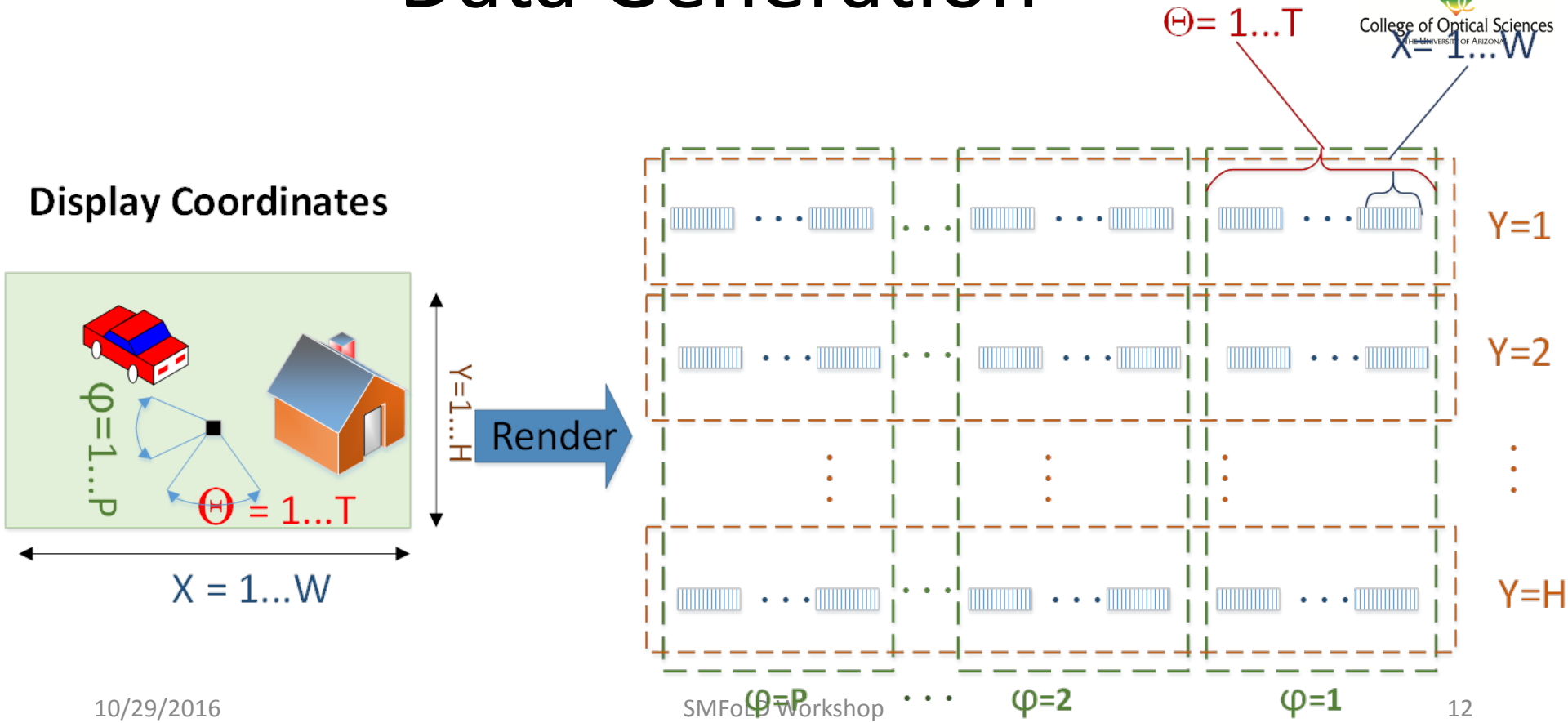
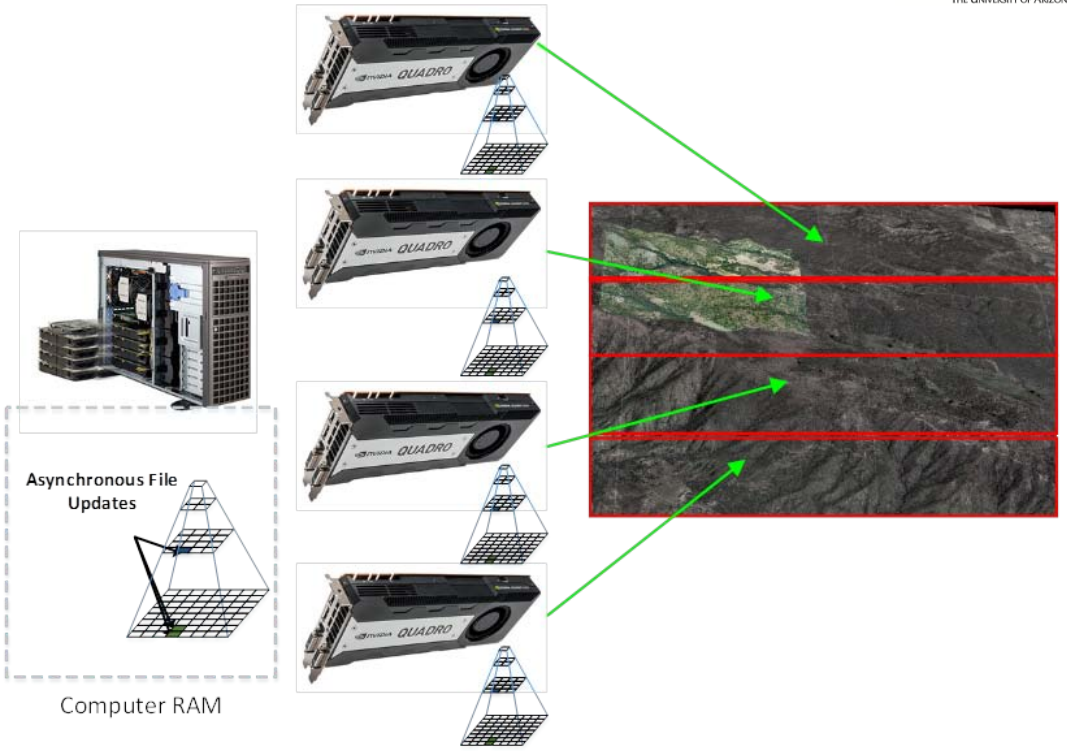


Oversimplified Render Engine

- System cost targets required COTS components where possible
- Speed requirements lead to GPU architecture



Space-Bandwidth Product

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- Space is the number of pixels
- Bandwidth is the angular range – for a smooth transition you need a "view" every 0.3°

	Minimum	Objective
Space	1MP (1280x768)	2MP (1920x 1080)
Bandwidth (views)	100 Horizontal x 100 Vertical	200 Horizontal x 200 Vertical
Rate	30Hz	60Hz
Data rate	$3x10^{11}$ pixel equivalents/sec 7 Tb/s	$5x10^{12}$ pixel equivalents/sec 115 Tb/s

It can't be that bad

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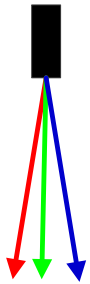
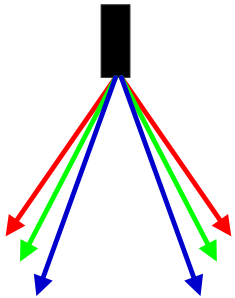
HD TV



1920 x 1080 Pixels
3 8-bit colors
60 fps

Bandwidth =
3Gb/s

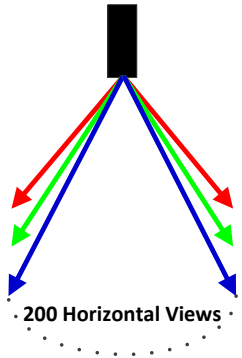
3DHD TV



1920 x 1080 Pixels
3 8-bit colors
2-views (Left eye-Right eye)
60 fps

Bandwidth =
6 Gb/s

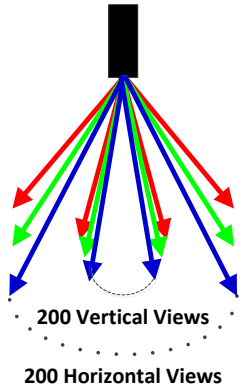
Horizontal Parallax Holographic HD TV



1920 x 1080 Pixels
3 8-bit colors
200 Horizontal Views
60 fps

Bandwidth =
600 Gb/s

Horizontal Parallax Holographic HD TV



1920 x 1080 Pixels
3 8-bit colors
200 Horizontal Views
200 Vertical Vies
60 fps

Bandwidth =
115 Tb/s

Display Port 1.3/1.4
7680x4320 @ 30Hz =
24Gb/s

40,000X HD TV bandwidth

Maybe This has been Solved

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- Square Kilometer Array 200 – 2,000 radio telescopes each generating 160Gb/s

- In the 2020's the system may generate > 1 Pb/s (1 Pb = 10^{15} bits)

https://www.skatelescope.org/signal-processing/

How much is 115 Tb/s

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- Google and Facebook are collaborating to drape another long cable system across the Pacific Ocean

Called the Pacific Light Cable Network (PLCN), it will be comprised of nearly 8,000 miles of fiber optic cable providing an **estimated network capacity of *120 terabits per second***. To put that in perspective, Time Warner Cable's current most expensive broadband Internet service costs $65 per month and provides download speeds of up to *50 megabits per second*. Google Fiber provides *one gigabit per second* download speeds for $70 per month.

October 12, 2016
http://www.digitaltrends.com/web/google-facebook-fiber-optic-cable-pacific-ocean-120tbps/

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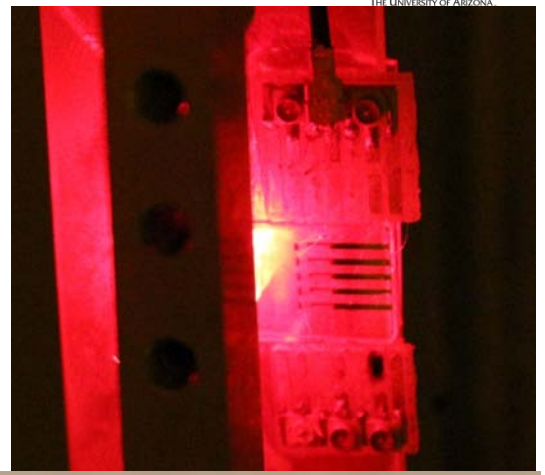
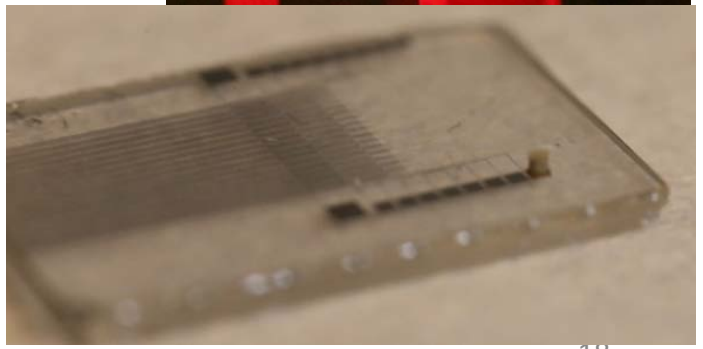
Next Steps

- Generated 374 FP element device
- Integrating multiple devices into a display
- Simplifying the fabrication process





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- Nitto Denko
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