Panel Discussion
“Holographic Storage”
Media-Tech Conference, October 11, 2006

Holographic Versatile Disc System

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- Summary
Dennis Gabor invented Holography (Hungary)

P. J. van Heerden made the first 3D holograms (Polaroid)

Leith & Uptnieks produced 3D image Using laser beams (Univ. of Michigan)

Horimai invented Collinear™ Holography

DARPA Project (HDSS & PRISM)
- Cal. Tech
- Stanford Univ.
- Univ. of Arizona
- IBM
- Rockwell
- Kodak
- Polaroid
- etc.

OPTWARE was established

EU Project led by Thomson (ATOS)
Collinear technology

OPTWARE demonstrated world’s first movie recording on a rotating disc

Holographic Storage using Photo Polymers (RCA)

HISS: Holographic Information Storage System

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Two Approaches for HISS

Holographic Information Storage System (HISS)

- Two Axis - Angle Multiplexing Approach
- Collinear - Shift Multiplexing Approach
Two Axis - Angle Multiplexing Approach

Laser
isolator + shutter
Filter

\[ \frac{\lambda}{2} \]

Camera
S L M
Polytopic Filter

\[ \frac{\lambda}{2} \]

Reference for Write

Rm

Angle Multiplexing by Actuators

25deg

Disk

Reference for Read

Hologram at Focal Position

“High speed holographic data storage at 100 Gbit/in2”
Ken Anderson, Edeline Fotheringham, Adrian Hill, Bradley Sissom, Kevin Curtis
InPhase Technologies, 2000 Pike Road, Longmont, Colorado 80501
edelinefotheringham@inphase-technologies.com
Collinear - Shift Multiplexing Approach

- Simple optical system.
- Simple mechanical control.
- Simple multiplexing just by rotating the disc.
- Everything is on one side of the disc.
- Pit layer is available like conventional optical disk.
- Double sided disc is possible.

Laser

Filter

Camera

SLM

Aperture

λ/4

Objective Lens

Objective Lens

Disc

Reflector

Hologram at Focal Position

Shift Multiplexing by Disc Rotation
How does Collinear Works?

Reference beam comes from the same SLM of the information beam.

Cross in the holographic recording layer
Write the Hologram

Reference

Information

Data Page Pattern

Objective Lens
Read the Hologram: Illumination

Reference

Data Page Pattern

Objective Lens
Read the Hologram: Reconstruction

Data Page Pattern

Objective Lens
Tracking and Shift Multiplexing

focusing, tracking, addressing, and timing by the red laser through the same optical axis of green laser.
Layer Structure of HVD

- Substrate
- Meta Data Layer
- Dichroic Mirror Layer
- Gap Layer 1
- Holographic Recording Layer (Photo Polymer)
- Gap Layer 2
- Cover Layer
Dimension of HVD

20,172 pit tracks
1.6um +/-0.1mm: track pitch
1.6um +/-0.1mm: track pitch, average

1st Pit Track
22.4mm
+0.2mm
-0.0mm

15.0mm
+0.15mm
-0.00mm

120.0mm
+0.3mm
-0.3mm
**Standardization Activity at ecma International**

- HVD-R 200GB, HVD-ROM 100GB and its Case
- Dec 2004, project proposal at TC44
- Oct 2006, final drafts to General Assembly
- Dec 2006, approval for ISO fast track
- Jan 2006, show up on the ecma web site
- June 2006, ISO standard
Standardization and Commercialization of HVD

http://www.hvd-alliance.org/
HVD Evaluation System by Pulstec

SHOT500

SHOT1000

SHOT2000
(to be a reference drive)
Research Center for Advanced Photonic Information Memories established in October 2006 @ Toyohashi University of Technology

Hologram Memory Core

Coding Material and Media Core

Peripheral Technology Core

Advanced HVD technologies

E-Mail: APIM-admin@maglab.eee.tut.ac.jp
Updates by the Optware:
Prototype Drive System

HVD®
Holographic Versatile Disc

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© 2006 OPTWARE
Updates by the Optware:
Prototype Drive System

HVD®
Holographic Versatile Disc
Focus & Track Servo Mechanism

Requirement of Position Accuracy

~ 50nm

~ 0.05um

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Updates by Optware:
Opt-Mechanical Unit of Proto.

HVD®
Holographic Versatile Disc

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“Simple” is the strong point of the collinear.

HVD System includes the collinear approach.

HVD Standard is ready for approval of ecma.

HVD Development is accelerated by team work.

Technology Updates were shown by Optware.