A Technical Seminar On
HOLOGRAPHIC DATA STORAGE

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Introduction

- Magnetic and conventional optical data storage technologies are approaching physical limits beyond which individual bits may be too small or too difficult to store.
- Holographic data storage is an approach of storing information throughout the volume of a medium—not just on its surface.
- With the rapidly increasing demand for increased storage capacity in a smaller space, this technology offers an economy in price.

Rajesh Kumar Talasu
Fundamentals of Holographic Data Storage

- In holographic data storage, an entire page of information is stored at once as an optical interference pattern within a thick, photosensitive optical material.
Hardware For Holographic Data Storage

- The optical system shown in Figure, with two lenses separated by the sum of their focal lengths, is called the “4-f” configuration.
- Advantage: Point defects on the storage material do not lead to lost bits, but result in a slight loss in signal-to-noise ratio at all pixels and the storage material can be removed and replaced in an offset position, yet the data can still be reconstructed correctly.

Rajesh Kumar Talasu
Holographic Digital Data Storage Testers

- In order to study the recording physics, materials and system issues of holographic digital data storage in depth, two precision holographic recording testers have been built.

Rajesh Kumar Talasu
Coding And Signal Processing

- In a data-storage system, the goal of coding and signal processing is to reduce the BER to a sufficiently low level while achieving such important figures of merit as high density and high data rate.

- The various coding and signal-processing elements which can help in dealing with several sources of noise and distortions are

  ✓ Binary Detection
  ✓ Interpixel Interference
  ✓ Error Correction
  ✓ Predistortion

Rajesh Kumar Talasu
Associative Retrieval

(a) SLM (input data) → Reference beam → Storage material

(b) Reconstructed data page → Detector array → Reference beam

(c) Correlation detector → Reconstructed referenced beam

Search data
Recording Materials

• Optical quality, Recording properties, and Stability are the three properties which directly affect their data density and capacity.

• Holographic recording properties are characterized in terms of sensitivity and dynamic range.

• Increase in the thickness helps the materials to store more independent diffraction gratings with higher selectivity in reading out individual data pages.

Rajesh Kumar Talasu
Outlook

- In contrast to surface storage techniques such as CD-ROM, where the density is inversely proportional to the square of the wavelength, holography is a volumetric technique, making its density proportional to one over the third power of the wavelength.

- In principle, laser beams can be moved with no mechanical components, allowing access times of the order of 10 μs, faster than any conventional disk drive will ever be able to randomly access data.

Rajesh Kumar Talasu
Outlook

Extended DRAM product
- Total capacity: 25 GB
- Access time: 10 ns
- Nonvolatile cache

Hard disk drive (DASD) product
- High capacity: 1 TB
- Access time: 10 ns
- High reliability/availability

Hard disk drive (CDROM-type) product
- High capacity: 1 TB
- Access time: 10 ns
- High capacity/low cost

Rack-mounted archive product
- High capacity: 1 PB
- Access time: 10 s
- High volumetric density
Conclusion

- Holographic data storage although conceived decades ago, has made recent progress toward practicality.

- In addition, it has shown the capability of rapid parallel search through the stored data via associative retrieval. So it might be the successor of the DVD’s and can lead to new devices such as content addressable database machines.
Thank You...

Rajesh Kumar Talasu