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# The Use of a Surface-Emitting Micro-Laser Array for Optical Computing

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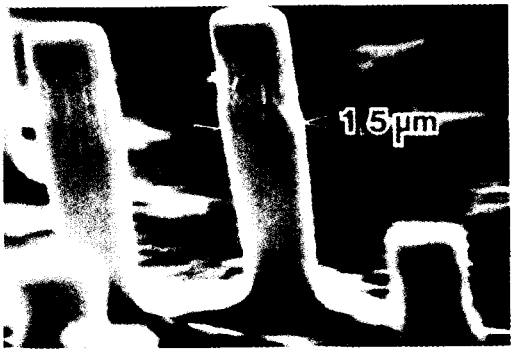
Surface emitting microlaser arrays have many features that make them highly desirable for use in optical computing. In this talk, we will describe various applications of the novel device for optical computing, with emphasis on neural network implementations.

## OUTLINE

- Surface-Emitting Micro-Laser Diode Array (SELDA)
  - Characteristics
- Compact and Ultra-Fast Holographic Associative Memory Using a SELDA
  - Reconstruction
  - Recognition (Correlator)
- Time Division Multiplexing
- Wavelength Division Multiplexing
- Conclusion

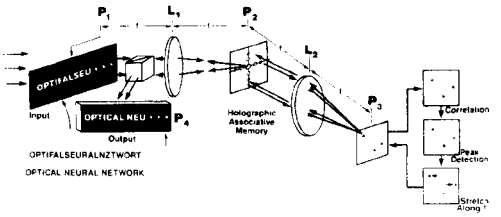
## CHARACTERISTICS OF SELDA

1. Large number of "μ-lasers" > $10^6$ / $cm^2$
2. Coherent
   - Wavelength : 980 nm
   - Linewidth : 0.01 nm
     Coherence length : 10 cm
     Spectral resolution : $10^5$
   - Not phase locked ( independent)
3. Low Threshold Current : 1.3 mA
4. High Light Output > 1 mW
5. Fast Switching < 1 nsec
6. High Contrast

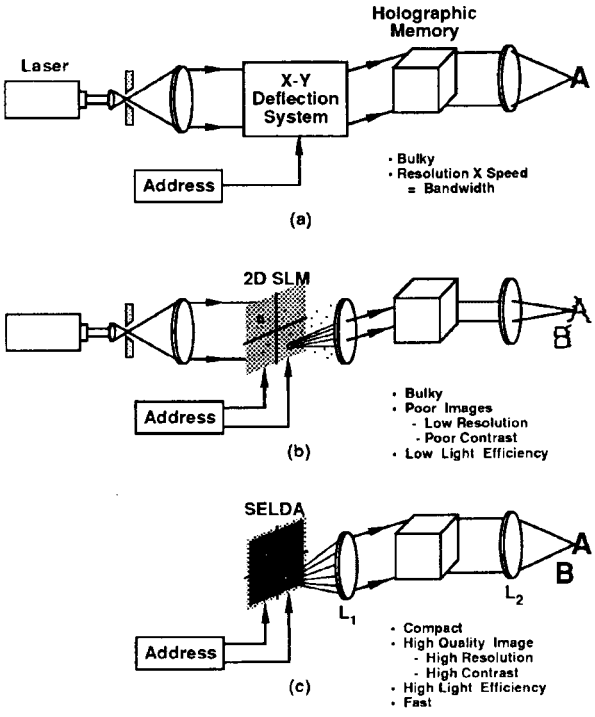


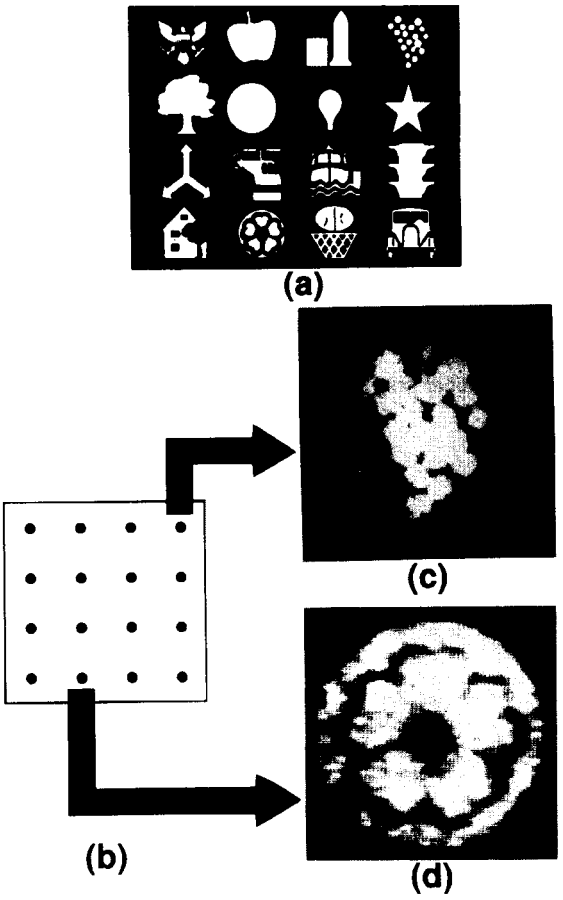

J. Jewell (AT&T Bell Labs)

## Holographic Associative Memory

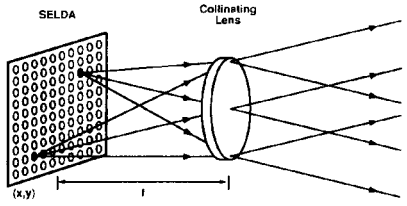


## Holographic Memory Readout

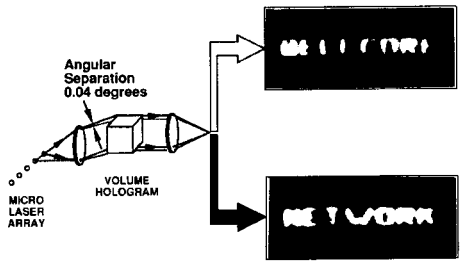


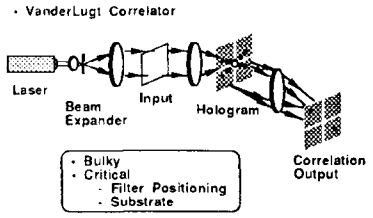

## Multiple Beam Steering Using a SELDA

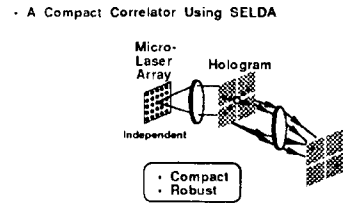


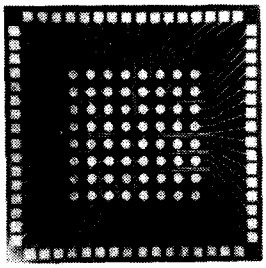

## Surface Emitting Micro-Laser Array ( Volume Holographic Memory )



## Compact 2D Correlator



A. Von Lehmen (Bellcore)

## Coherence Property of a SELDA

- Narrow Linewidth < 0.01 nm
  - Temporally Coherent
- Not phase locked ( Independent )
  - Spatially Incoherent

Therefore,
Cannot function as an SLM

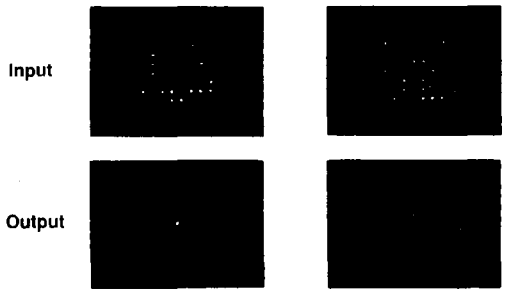
However,

Ideal Light Source for an Incoherent Correlator

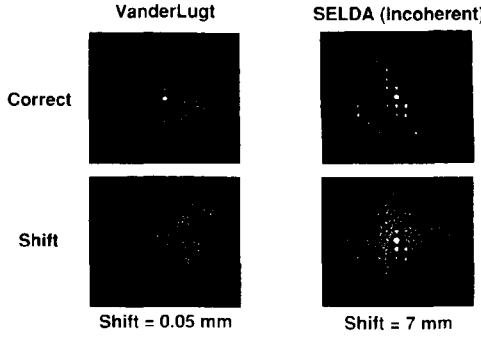
## Advantages of the SELDA-Correlator

- Fast
- High Light Efficiency
  - No Diffuser
  - No Spectral Filter
- High Resolution
  - High spectral resolution > $10^5$
- No Moving Parts
- No SLM's
- Easier Integration

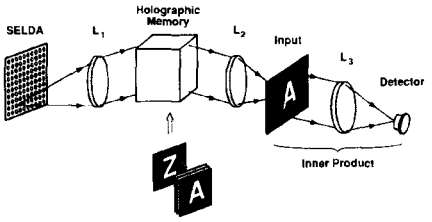
## Correlation Output
( SELDA Correlator )



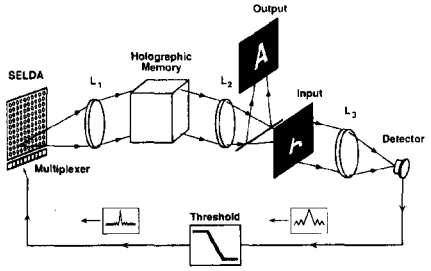

## Filter Positioning Tolerances

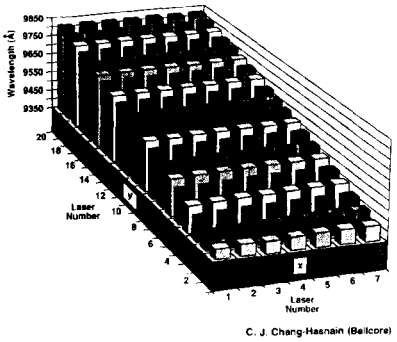


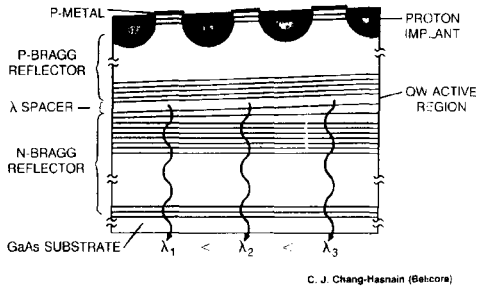
## Time Division Multiplexing by a SELDA



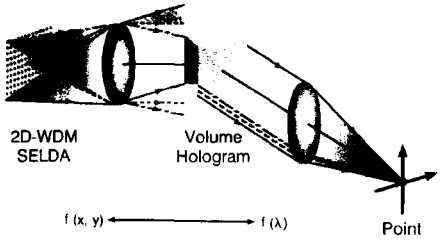

## Associative Memory by TDM using a SELDA




## *2D WDM-SELDA For Optical Computing*




## Crosstalk of 2D WDM-SELDA Processor