Digital Optical Computation

Morteza Ziyadi, Salman Khaleghi, Mohammadreza Chitgarha, Joseph D. Touch (ISI), Alan E. Willner
Electrical Engineering/CSI

Stage III CIAN Box
- Optical packet switching
  - Avoid OEO to retain speed
  - Optical header processing
  - Optical logic and math

Optically?!!

Optical Math
- Optical functions in a base number set
- Optical addition

Current State of the Art
- OEO (Elec. computation)
  ~10-100 Gb/s

Optical Signal
     Elec. Signal (OOK)
O-E               E-O
Elec. Computing

Advances to State of the Art
- Optical computation ~ 1-10Tb/s
- Multi-dimensional signals
  - Amplitude -Phase -Frequency
- 1-bit per symbol
  - OOK/BPSK – too slow
- N-bit per symbol
  - M-PSK (QPSK, 8/16-PSK)
  - QAM

1-Bit per Symbol (OOK/BPSK)

Multi-Phase Symbols (M-PSK)

Optical Half Adder Implementation

- Architecture

- Experimental Setup