IPR and OC

Integrated Photonics Research and Optics in Computing

Topical Meetings and Tabletop Exhibits

June 16-20, 2003
Wyndham City Center, Washington, D.C.

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**Denotes the OSA Technical Council Representative*

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About Integrated Photonics Research

June 16-18, 2003

The Integrated Photonics Research topical meeting will cover all aspects of research in integrated and/or guided-wave photonics. The meeting will be co-located with the Optics in Computing Topical Meeting. Original papers will be solicited from the international guided-wave community in the general areas listed under the scope.

IEEE/LASERS and Electro-Optics Society is a Technical Co-Sponsor of IPR.

Meeting Scope

This year's meeting will feature innovative science-and-engineering results on active and compound semiconductor devices, dielectric waveguides and waveguide devices, modeling and numerical simulation, nanophotonics and microphotonics.

The plenary session will examine the important role of integrated photonics in the telecom recovery. A vision of next-generation computer systems will be presented in which integrated photonics can make significant contributions. The technical sessions will include invited and contributed papers on wavelength converters, high index-contrast devices, silicon and silica photonic bandgap structures, quantum dot lasers, light-emitting diodes, large-scale computational methods, planar lightwave circuits, semiconductor micro-ring resonators, polymer-enabled devices, integrated active-waveguide devices, applications of numerical simulation, silicon-based devices, and nanoscale photonic structures. There will be a joint IPR and OC session on nanofabrication technology.

About Optics in Computing

June 18-20, 2003

The meeting will explore the processing of information by photonic means including data sensing and imaging, storage, interconnects and communications. A special emphasis will be placed on emerging areas of bio-sensing and bio-manipulation with light, quantum computing/communications, and nano-systems. The meeting will be co-located with Integrated Photonics Research (IPR) Topical Meeting with an emphasis on guided-wave devices and modeling and together both meetings will provide a comprehensive review of the state of the art in the photonics field ranging from materials and devices to applications.

Optics in Computing Topical Meeting is in cooperation with:

SPIE - The International Society for Optical Engineering

ICO - International Commission for Optics

Meeting Scope

Topics to be Considered

Papers are solicited in all areas of Photonics Information Processing including:

- **Technologies**
  Massively parallel photonics (10,000 channels)
  Ultra fast photonics (100 GHz)
  Nanophotonics, photonic crystals
  Biophotonics
  Quantum optics
  Heterogeneous integrations of photonic components and materials
  MOEMs, Nano-Electro-Mechanical Systems
  3-D optical engineering, 3-D micro fabrication
- **Applications**
  Computing (optical logic, header computation/recognition,

encryption)
Data storage and photonic elastic buffers
Optics for communication systems and Interconnects inside the box
Sensing and sensor networks
Bio-sensing and bio-manipulation

- **Information Theoretic Analysis of Photonic Information Systems**

Fundamental limits in information transfer on optical fields
Spectral, temporal, spatial, coherence channels
Storage, sensing, interconnectivity, communication and computing
Classical and quantum approaches
Information capacity of imaging systems

- **Innovative Volumetric Optical Systems**

3-D Imaging and Sensing Systems
3-D Displays and related components
3-D Storage
3-D Optical Engineering Transforms

IPR Speakers

Plenary Speakers

Integrated Photonics Inside the Computer, David A. B. Miller, Stanford Univ., USA [IMA2]

Integrated Photonics: Key to the Telecom Recovery!?, Rod Alferness, Lucent Tech., USA [IMA1]

Invited Speakers

The preliminary list of invited presentations for the technical Integrated Photonics Research program includes the following invited speakers as of April 21, 2003:

Analytic and Semi-analytic Modelling of Photonic Circuits, T.M. Benson, *Univ. of Nottingham, UK* [ITuB1]

Eigenmode Expansions Using Perfectly Matched Layers, Peter Bienstman, G*hent Univ., Belgium* [ITuD1]

Subwavelength Replication Methods for Nanophotonics, Stephen Y. Chou, *Princeton Univ., USA* [JWC6]

Widely-tunable Chip-scale Transmitters and Wavelength Converters, L. Coldren, *Univ. of California, Santa Barbara, USA* [IMB1]

UV Emitters or Ultra-high-efficiency Blue and White LEDs, Steve Denbaars, *Univ. of California, Santa Barbara, USA* [IMF3]

High T p-type Quantum Dot Lasers, Dennis Deppe, *Univ. of Texas at Austin, USA* [IMF1]

Simulation of High Capacity WDM Systems, Rene'-Jean Essiambre, Bell Labs., *Lucent Tech., USA* [ITuF1]

Tunable Photonic Crystals, Venkatraman Gopalan, *Pennsylvania State Univ., USA* [IMD1]

Channel Dropping Filter Based on Ring Resonators and Integrated SOAs, H. Heidrich, Dominik Rabus, *Heinrich Hertz Inst., Germany* [ITuE1]

Progress in Finite Element Modelling of Integrated Optics, Hugo Hernandez Figueroa, *Univ. Estadual de Campinas, Brazil* [IME1]

Numerical Models of Out-of-Plane Losses of Photonic Crystal Waveguides, G.R. Hadley, *Sandia National Labs., USA* [IME3]

Raman Emission in Silicon Waveguides, Bahram Jalali, *UCLA, USA* [ITuC3]

Athermal All-Polymer Arrayed Waveguide Gratings, Norbert Keil, *Heinrich Hertz Institut, Germany* [ITuG1]

High-Performance Interleave Filters Composed of Planar Lightwave Circuits on Silicon, Masaki Kotoku, *NTT Photonics Lab., Japan* [IMG1]

Physics Driven Calculations for High Q, High Transmission One-Dimensional Planar Cavity Structures, Philippe Lalanne, *Inst. D'Optique/CNRS, France* [ITuF4]

Self-assembly Methods for Photonic Crystals, Preston Landon, *UT Dallas, USA* [IMD6]

Nanoparticle Engineering of Colloidal Microsphere Crystallization, Jennifer A. Lewis, *Univ. of Illinois, USA* [IWA1]

Advances in Microring Resonators, Brent Little, *Little Optics Inc., USA* [ITuE6]

Advances in PLC Hybrid Integration Technology, Shinji Mino, *NTT Photonics Laboratory, Japan* [IMG3]

Integration of a Waveguide Optical Isolator with a Semiconductor Laser, Tetsuya Mizumoto, *Tokyo Inst. of Tech., Japan* [IWB1]

Advances in Silicon Oxynitride Waveguides, Bert Jan Offrein, *IBM Zurich Lab., Switzerland* [IMC1]

Telecom Grade Quantum Dot Lasers, Hans Peter Reithmaier, *Germany* [IMF2]

All Optical Wavelength Converter Integrated with Tunable Laser, Meint Smit, *Delft Univ. of Tech., Netherlands* [IMB4]

Advances in Integrated Magneto-Optics, Oleksandr Zhuromskyy, *Dupont Photonics, USA* [ITuA2]

OC Speakers

Keynote Speaker

Demetri Psaltis, *California Institute of Technology, USA*

Invited Speakers

The preliminary list of invited presentations for the Optics in Computing program includes the following invited speakers as of April 21, 2003:

Integrated Si-based optoelectronic devices performances and applications, Salvator Coffa, *ST Microelectronics Corp., USA* [OThD1]

Ultrafast information processing with optical nonlinearities, Yeshayahu Fainman, *University of California-San Diego, USA* [OThC3]

Dynamic holographic optical tweezers: Transforming mesoscopic matter with light, David Grier, *Univ. of Chicago, USA* [OThB1]

Optoelectronic devices and integration for highly parallel interconnects, Mary Hibbs-Brenner, *Honeywell, Inc., USA* [OWA1]

Quantum optics and quantum information science, Hideo Mabuchi, *California Inst. of Tech., USA* [OThC2]

Drug response measurements using optical forces, Philippe Marchand, *Genoptix, USA* [OThB4]

Photonic Crystal Devices, John D. O'Brien, *University of Southern California, USA* [JWC3]

Optical interconnects in Europe, Henri Rajbenbach, *European Commission, Belgium* [OWB1]

The role of lithography and metrology in nanophotonics fabrication, Henry I. Smith, *Massachusetts Institute of Technology, USA* [JWC1]

Next-generation 3D display and related technologies, Yasuhiro Takaki, *Tokyo University of Agriculture & Technology, Japan* [OFB1]

Functional extension of this observation module by bound optics (TOMBO), Jun Tanida, *Osaka University, Japan* [OFA1]

Optical Processing: From signal processing to ultra-dense wavelength division multiplexed communication, Terry Turpin, *ESSEX Corp., USA* [OThA1]

Publications

Advance Program

The Advance Program will be available only via the website in April 2003. A broadcast email will be sent to all previous registrants and authors notifying them of the availability of the online program.

Technical Digests

The IPR and OC Technical Digests will be comprised of the camera-ready summaries of papers being presented during the meeting. At the meeting, each registrant will receive a copy of one Technical Digest of their choice. Extra copies can be purchased at the meeting for a special price of $45 US.

SUNDAY, JUNE 15, 2003		
4:00pm-6:00pm	Registration, **City Center Ballroom Foyer**	
MONDAY, JUNE 16, 2003		
	IPR Sessions *Room: New Hampshire 3*	IPR Sessions *Room: New Hampshire 2*
7:00am-5:30pm	Registration/Speaker Check-in, **City Center Ballroom Foyer**	
8:15am-8:30am	IPR Opening Remarks	
8:30am-10:00am	IMA, Plenary Session	
10:00am-10:30am	Coffee Break, **City Center Ballroom**	
10:30am-12:00pm	IMB, Integrated Wavelength Converters	IMC, High Index-Contrast Devices
12:00pm-1:30pm	Lunch Break	
1:30pm-3:30pm	IMD, Silicon/Silica Photonic Crystal Structures	IME, Large Scale Computational Methods
3:30pm-4:00pm	Refreshment Break	
4:00pm-5:30pm	IMF, Advanced Lasers and LEDs	IMG, Planar Lightwave Circuits
6:00pm-7:30pm	IPR Conference Reception, **City Center Ballroom**	
TUESDAY, JUNE 17, 2003		
	IPR Sessions *Room: New Hampshire 3*	IPR Sessions *Room: New Hampshire 2*
7:30am-6:30pm	Registration/Speaker Check-in, **City Center Ballroom Foyer**	
8:30am-9:45am	ITuA, Novel Waveguide Devices	ITuB, Simulation Methods
9:45am-10:30am	Coffee Break, **City Center Ballroom**	
10:30am-11:45am	ITuC, Silicon-Based Devices	ITuD, Design Techniques
11:45am-1:30pm	Lunch Break	
1:30pm-3:30pm	ITuE, Semiconductor Micro-Ring Resonators	ITuF, Applications of Numerical Simulation
3:30pm-4:00pm	Refreshment Break	
4:00pm-5:00pm	ITuG, Polymer-Enabled Devices	
5:00pm-6:30pm	IPR Poster Session, **City Center Ballroom**	
WEDNESDAY, JUNE 18, 2003		
	IPR Sessions *Room: New Hampshire 3*	OC Sessions *Room: New Hampshire 2*
7:00am-6:00pm	Registration/Speaker Check-in, **City Center Ballroom Foyer**	
8:15am-8:30am		OC Opening Remarks
8:30am-10:00am	IWA, Nanoscale Photonic Structuring	OWA, Optical Interconnects: Systems 1
10:00am-10:30am	Coffee Break, **City Center Ballroom**	

10:30am-12:00pm	IWB, Integration of Active Waveguide Devices	OWB, Optical Interconnects: Systems 2
12:00pm-1:30pm	Lunch Break	
1:30pm-3:45pm	JWC, IPR/OC Joint Session on Nanofabrication Technologies	
3:45pm-4:15pm	Refreshment Break, **City Center Ballroom**	
4:15pm-5:45pm	IPR Postdeadline Paper Session	OWD,Optical Interconnects: Receivers
THURSDAY, JUNE 19, 2003		
		OC Sessions *Room: New Hampshire 2*
7:30am-6:00pm	Registration/Speaker Check-in, **City Center Ballroom Foyer**	
8:30am-10:00am		OThA, Optical Processing and Computing
10:00am-10:30am	Coffee Break, **City Center Ballroom**	
10:30am-12:00pm		OThB, Biophotonics
12:00pm-1:30pm	Lunch Break	
1:30pm-3:15pm		OThC, Future Directions
3:15pm-3:45pm	Refreshment Break, **City Center Ballroom**	
3:45pm-6:00pm		OThD, Optical Interconnects: Demonstrations
6:30pm-8:00pm	OThE, OC Poster Session, **City Center Ballroom**	
FRIDAY, JUNE 20, 2003		
		OC Sessions *Room: New Hampshire 2*
8:00am-12:30pm	Registration/Speaker Check-in, **City Center Ballroom Foyer**	
8:30am-10:00am		OFA, Imaging Systems
10:00am-10:30am	Coffee Break, **City Center Ballroom**	
10:30am-11:45am		OFB, Volumetric Systems
11:45am-12:30pm		OC Postdeadline Paper Session

**Please note ending session times may be approximate. Refer to abtracts for specific session times.*

■ **Sunday**
■ **June 15, 2003**

Room: City Center Ballroom Foyer
4:00pm – 6:00pm
■ **Registration**

■ **Monday**
■ **June 16, 2003**

Room: City Center Ballrom Foyer
7:00am – 5:30pm
■ **Registration/Speaker Check-in**

Room: New Hampshire 3
8:15am – 8:30am
■ **IPR Opening Remarks**

Room: New Hampshire 3
8:30am - 10:00am
IMA ■ IPR Plenary Session
R. Soref, AFRL/SNHC, Hanscom AFB, MA, USA, Presider

IMA1 8:30am ◈ Plenary
Integrated photonics: Key to the telecom recovery!?, *R. Alferness, Lucent Tech., Holmdel, NJ, USA*.
In this talk, we examine the potential opportunities, challenges and status of integrated photonics against the backdrop of the telecom recovery.

IMA2 9:15am ◈ Plenary
Integrated photonics inside the computer?, *D. Miller, Stanford Univ., Stanford, CA, USA.*
Innovative optical, optoelectronic, and array integration technologies create significant opportunities for solving growing interconnect scaling problems inside electronic machines, and continued CMOS scaling with such optics suggest a convergence of optical network and interconnect technologies.

Room: City Center Ballroom
10:00am – 10:30am
Coffee Break

Room: New Hampshire 3
10:30am - 12:00pm
IMB ■ Integrated Wavelength Converters
M. Dagenais, Quantum Photonics Inc., Jessup, MD, USA, Presider

IMB1 10:30am ◈ Invited
Widely-tunable chip-scaletransmitters and wavelength converters, *L. Coldren, Univ. of California, Santa Barbara, CA and Agility Comm., Santa Barbara, CA, USA.*
In this paper we review the current status of InP-based integrated optical transmitters, which are monolithically integrated on a single chip and cover the full C or L-bands, we will also give an update on the recent application of devices within monolithically-integrated widely-tunable wavelength converters.

IMB2 11:00am
Fabrication of all-optical wavelength converter based on electro-absorption nonlinear directional coupler, *N. Sroymadee, Y. Nakano, Univ. of Tokyo, Tokyo, Japan*.
We demonstrate fabrication and characterization of an all-optical wavelength converter based on a directional coupler incorporated with nonlinear electro-absorption. By optical pump pulse, wavelength conversion operation has been confirmed, and all-optical transfer function has been determined.

IMB3 11:15am

Optically-switched dual-diode electroabsorption modulator, *V. Sabnis, H. Demir, O. Fidaner, J. Harris, D. Miller, Stanford Univ., Stanford, CA; J. Zheng, Intel Corp., Santa Clara, CA; N. Li, T. Wu, Y. Houng, OEPIC Corp., Sunnyvale, CA, USA.*

We introduce the monolithic integration of a waveguide electroabsorption modulator with a surface-normal photodiode for the realization of a novel, low-power, optically-controlled optical switch. We demonstrate a selective-area regrowth technique that meets the integration requirements.

IMB4 11:30am ◈ Invited

A wavelength converter with integrated tunable laser, *M. Smit, TU Eindhoven, Eindhoven, Netherlands.*

An interferometric wavelength converter has been monolithically integrated with a digitally tunable 4-channel laser. Conversion to all laser channels has been demonstrated and excellent static extinction ratios of over 20 dB have been observed. An extinction ratio improvement of 13 dB has been measured.

Room: New Hampshire 2

10:30am - 12:00pm

IMC ■ High Index-Contrast Devices

B. Weiss, Univ. of Surrey, Guildford, Surrey, United Kingdom, Presider

IMC1 10:30am ◈ Invited

Advances in silicon oxynitride waveguides, *B. Offrein, D. Wiesmann, G. Salis, M. Sousa, I. Meijer, F. Horst, R. Germann, T. Brunschwiler, D. Webb, G. Bona, IBM Res., Rüschlikon, Switzerland.*

The silicon-oxynitride planar waveguide technology combines a minimum bending radius of 0.55 mm with excellent optical properties. It is an ideal platform for the realization of high functionality optical devices, latest examples will be presented.

IMC2 11:00am

Ring resonators with polarization diversity using integrated polarization beam splitters, *C. Madsen, E.J. Laskowski, M. Cappuzzo, E. Chen, L. Gomez, A. Griffin, A. Wong-Foy, Bell Labs., Murray Hill, NJ, USA.*

Polarization beam splitters are demonstrated in 4% index-contrast Ge-doped silica waveguides with extinction ratios exceeding 24dB over a wavelength range of 80nm. Integration with ring resonators and a double-pass, reflective architecture are also presented.

IMC3 11:15am

Polarization splitting and rotating through adiabatic transitions, *M. Watts, H. Haus, MIT, Cambridge, MA, USA; G. Gorni, M. Cherchi, Pirelli Corp., Milan, Italy.*

A polarization splitter and rotator that is compatible with optical integration is presented. In contrast to prior efforts to achieve this functionality, the adiabatic nature of this approach allows for nearly ideal performance over the 1.5-1.6 micron regime.

IMC4 11:30am

+/- 1350 ps/nm tuning operation of tunable chromatic dispersion compensator based on silica waveguide ring resonator with symmetric MZI coupler, *H. Takahashi, P. Carlsson, K. Nishimura, M. Usami, KDDI R&D Labs. Inc., Saitama, Japan.*

Tunable chromatic dispersion compensator based on silica waveguide all-pass ring resonator having no crossing point of waveguides was studied both theoretically and experimentally. Tuning range over +/- 1350 ps/nm with 24GHz FSR was demonstrated.

IMC5 11:45am
PMD and PDL emulation using integrated variable delay lines, *C. Madsen, E.J. Laskowski, M. Cappuzzo, E. Chen, L. Gomez, A. Griffin, A. Wong-Foy, Bell Labs., Murray Hill, NJ, USA.*
An integrated PMD emulator is demonstrated with a differential delay tuning range over 200 ps and a PDL range over 30 dB. This device may also be used to implement higher-order PMD.

12:00pm – 1:30pm
Lunch on your own

Room: New Hampshire 3
1:30pm - 3:30pm
IMD ■ Silicon/Silica Photonic Crystal Structures
D. Prather, Univ. of Delaware, Newark, DE, USA, Presider

IMD1 1:30pm ◈ Invited
Tunable photonic crystals, *V. Gopalan, N. Malkova, D. Scrymgeour, S. Kim, Pennsylvania State Univ., University Park, PA, USA.*
The Jahn-Teller effect in electronic solids is an example of electron-phonon interaction, which lifts the degeneracy of orbitally degenerate electronic states by symmetry lowering distortions of nuclear configurations.

IMD2 2:00pm
Engineering dispersion properties of photonic crystals for spatial beam routing and non-channel waveguiding, *A. Sharkawy, Caihua Chen, Shouyuan Shi, Dennis W. Prather, Univ. of Delaware, Newark, DE, USA.*
In this research we present various implementations of novel photonic devices using photonic crystals, by engineering the dispersive properties of these periodic structures. Applications such as spatial beam routing, and non-channel waveguiding can be attained through careful optimization of various Equi-Frequency Contours (EFC).

IMD3 2:15pm
Characterization of photonic crystal coupled waveguides, *D. Pustai, A. Sharkawy, S. Shi, J. Murakowski, D. Prather, Univ. of Delaware, Newark, DE, USA.*
In this research, we present an analysis of coupled photonic crystal (PhC) waveguides. Fabricated planar PhC coupled waveguides are characterized and experimental results are presented. Applications for PhC directional couplers include frequency selective filters, dispersion compensators, and optical switches.

IMD4 2:30pm
Hybrid photonic crystal and low refractive index contrast waveguide structures, *S. Kim, G. Nordin, J. Cai, J. Jiang, Univ. of Alabama in Huntsville, Huntsville, AL, USA.*
Integration of limited photonic crystal (PhC) regions with conventional waveguides (CWGs) having low refractive index contrast preserves the advantages of CWGs while using PhCs to overcome their limitations. We present simulation results that demonstrate the promise of this approach to realize very compact devices.

IMD5 2:45pm

Low power compact silicon electro-optic modulator, *C. Barrios, V. Almeida, R. Panepucci, B. Schmidt, M. Lipson, School of Electrical and Computer Engineering, Cornell Univ., Ithaca, NY, USA.*

We propose a micron-size planar waveguide silicon electro-optic modulator based on a Fabry-Perot cavity. Both optical and carrier confinement into the cavity region lead to very low dc power consumption for modulation.

IMD6 3:00pm ◈ Invited

Self-assembly methods for photonic crystals, *P. Landon, R. Glosser, A. Zakhidov, UT Dallas, Richardson, TX, USA.*

Colloidal silica spheres self-assembled along the [100] direction of the FCC lattice templating the growth of vertical crystallites and large elongated crystallites were obtained by controlling the geometry of sedimenting dispersions.

Room: New Hampshire 2

1:30pm - 3:15pm

IME ■ Large Scale Computational Methods

P. Sewell, Univ. of Nottingham, Nottingham, United Kingdom, Presider

IME1 1:30pm ◈ Invited

Progress in finite element modelling of integrated optics, *H. Figueroa, Univ. Estadual de Campinas, Brazil.*

A general classification of all numerical strategies applied to model integrated optics devices is given. Taking it as reference, the finite element method virtues and drawbacks are pointed out. Finally, current challenges and tendencies are presented.

IME2 2:00pm

A stable and efficient reflective beam propagation method, *N. Feng, W. Huang, McMaster Univ., Hamilton, ON, Canada; C. Xu, Apollo Inc., Hamilton, ON, Canada; D. Fang, Nanjing Univ. of Science and Tech., Nanjing, China.*

A stable and efficient reflective beam propagation method (RBPM) is developed by using a paraxial pre-conditioner, which is highly effective in facilitating robust, efficient and accurate reflective BPM for optical waveguide discontinuities.

IME3 2:15pm ◈ Invited

Numerical models of out-of-plane losses of photonic crystal waveguides, *G. Hadley, Sandia Natl. Labs., Albuquerque NM, USA.*

Photonic crystals offer considerable promise as means of achieving ultra-compact photonic circuitry. It can be shown that most of the devices common in ordinary planar waveguide circuitry, such as splitters, MMIs and couplers, can be reproduced using photonic crystals, often on a reduced spatial scale.

IME4 2:45pm

Finite element design of single-polarization single-mode photonic crystal fibers, *K. Saitoh, M. Koshiba, Hokkaido Univ., Sapporo, Japan.*

A new structure of single-polarization single-mode photonic crystal fiber (PCF) is proposed and designed through a full-vector finite element method. The PCF propagates only the slow-axis mode within the wavelengths ranging from 1500nm to 1600nm.

IME5 3:00pm

Time-domain beam propagation method for nonlinear optical propagation analysis and its application to photonic crystal circuits, *T. Fujisawa, M. Koshiba, Hokkaido Univ., Sapporo, Japan.*
A time-domain beam propagation method based on a finite element scheme is newly formulated for nonlinear optical propagation analysis. A nonlinear photonic crystal grating structure is proposed, and the optical limiting and switching are demonstrated.

Room: City Center Ballroom
3:30pm – 4:00pm
Refreshment Break

Room: New Hampshire 3
4:00pm - 5:30pm
IMF ■ Advanced Lasers and LEDs
L. Coldren, Univ. of California, Santa Barbara, CA, USA, Presider

IMF1 4:00pm ◈ Invited

High to p-type quantum dot lasers, *D. Deppe, O. B. Shchekin, J. Ahn, H. Huang, Univ. of Texas at Austin, Austin, TX, USA.*
The optical gain and differential gain of quantum dot lasers can be dramatically improved through p-type modulation doping. The linewidth enhancement factor can be positive, zero, or even negative.

IMF2 4:30pm ◈ Invited

Telecom grade quantum dot lasers, *H. Reithmaier, Univ. of Wuerzburg, Wuerzburg, Germany.*
Abstract not available.

IMF3 5:00pm ◈ Invited

UV emitters or ultra-high-efficiency blue and white LEDs, *S. Denbaars, Univ. of California, Santa Barbara, CA, USA.*
Abstract not available.

Room: New Hampshire 2
4:00pm - 5:15pm
IMG ■ Planar Lightwave Circuits
W. Lui, NEL America Inc., Saddle Brook, NJ, USA, Presider

IMG1 4:00pm ◈ Invited

High-performance interleave filters composed of planar lightwave circuits on silicon, *M. Kohtoku, M. Oguma, NTT Photonics Lab., Kanagawa, Japan.*
This paper describe the design, fabrication, and performance of an interleave filter fabricated on a planar lightwave circuit on Si. We discuss several key techniques for improving the performance of this filter including design optimization, a stabilized coupler, and a heater phase trimming method.

IMG2 4:30pm

Monosilane embedded nanocomposite possessing variable in plane index of refraction (VIPIR) to construct complex waveguide optical systems, *R. Kubacki, Ionic Systems Inc., San Jose, CA, USA.*
We are reporting on the development of a nanoengineered material, a monosilane nanocomposite. The material undergoes large change in index of refraction (> 1.0) with photoexposure that enables complex optical structures integration in waveguide form.

IMG3 4:45pm ◈ Invited

Advances in PLC hybrid integration technology, *S. Mino, NTT Science and Core Tech. Lab. Group, Naka-Gun, Ibaraki, Japan.*
PLC hybrid integration technology allows the construction of a highly functional large-scale optical subsystem that is compact and inexpensive. This paper reviews recent advances in the hybrid integration of DFB-LDs, $LiNbO_3$ waveguides, and electronic ICs, with PLCs.

Room: City Center Ballroom
6:00pm – 7:30pm
■ IPR Conference Reception

■ Tuesday
■ June 17, 2003

Room: City Center Ballrom Foyer
7:30am – 6:30pm
■ Registration/Speaker Check-in

Room: New Hampshire 3
8:30am - 9:30am
ITuA ■ Novel Waveguide Devices
R. Penty, Cambridge Univ., Cambridge, United Kingdom, Presider

ITuA1 8:30am
Digital optical switch based on fast thermal gradient switching in InGaAsP waveguides, *S. Janz, P. Barrios, A. Delâge, I. Golub, J.J. He, W.R. McKinnon, P. Poole, Natl. Res. Council Canada, Ottawa, ON, Canada. S. Abdalla, D. Celo, S. El-Mougy, S. Ng, T.J. Smy, B. Syrett, Carleton Univ., Ottawa, ON, Canada.*
Optical switching using a dynamic index gradient across a waveguide is demonstrated using simulations and measurements on InGaAsP/InP Y-junction waveguide switches. Microsecond transition times are achieved by modulating a thermal gradient across the input waveguide.

ITuA2 8:45am ◈ Invited
Advances in integrated magneto-optics, *O. Zhuromskyy, J. Fujita, R. Gerhardt, L. Eldada DuPont Photonics Tech., Wilmington, MA, USA.*
The integration of magneto-optical devices enables cost and size reduction in optical commutication systems. Nonreciprocal phase shifters can be used to build polarization independent isolators and circulators. New photonic bandgap materials with high Faraday rotation make conventional magneto-optic device concepts suitable for PLC integration.

ITuA3 9:15am
Stratified grating couplers for waveguide applications, *D. Chambers, B. Wang, G. Nordin, J. Jiang, Univ. of Alabama, Huntsville, Huntsville, AL, USA.*
Stratified grating couplers (SGCs) designed to couple normally incident light into single mode, low-index contrast waveguides are discussed. SGCs are composed of multiple, shifted, binary grating layers. Preliminary simulations using a micro-genetic algorithm show an in-coupling efficiency of 68%.

Room: New Hampshire 2
8:30am - 9:45am
ITuB ■ Simulation Methods
A. Gopinath, Univ. of Minnesota, Duluth, Minneapolis, MN, USA, Presider

ITuB1 8:30am ◈ Invited
Analytic and semi-analytic modelling of photonic circuits, *T. Benson, A Vukovic, S. V. Boriskina, S. C. Greedy, C. Styan, P. Sewell, Univ. of Nottingham, United Kingdom.*
Semi-analytical and analytical methods enable fast and accurate photonic simulation. Further advantage can be gained by combining them with general numerical methods in a hybrid approach or within automated optimization procedures.

ITuB2 9:00am
Rigorous modelling of non-linear photonic components with mode expansion and spatial index discretisation, *B. Maes, P. Bienstman, R. Baets, Ghent Univ. - IMEC, Ghent, Belgium.*
We present a numerical method to accurately simulate the third order Kerr effect in wavelength scale dielectric structures, expanding upon the linear mode expansion method by computing the non-linear refractive index on a spatial grid.

ITuB3 9:15am
Algorithm developments with applications to calculations of nonlinear effects on the carrier-envelope phase for ultrashort pulses, *P. Goorjian, NASA Ames Res. Ctr., Moffett Field, CA; S. Cundiff, JILA, Natl. Inst. of Standards and Tech. and Univ. of Colorado, Boulder, CO, USA.*
Calculations, using the full-vector Maxwell equations, are presented of nonlinear effects on the carrier-envelope phase for pulse durations in the two-optical-cycle range. The pulses are optical solitons or propagate in sapphire crystal.

ITuB4 9:30am
Mode determination of a general multilayer waveguide using a simple and fast numerical method, *M. Kwon, S. Shin, Dept. of Electrical Engineering, Korea Advanced Inst. of Science and Tech., Taejon, Republic of Korea.*
We propose a simple and fast numerical method for determining modes of a general multilayer waveguide. It is based on a complex root-finding algorithm reported recently. To reduce calculation time, we use an efficient scheme for the evaluations of the eigenvalue function and its derivative.

Room: City Center Ballroom
9:45am – 10:30am
Coffee Break

Room: New Hampshire 3
10:30am - 11:45am
ITuC ■ Silicon-Based Devices
C. Madsen, Bell Labs., Murray Hill, NJ, USA, Presider

ITuC1 10:30am
Monolithic integration of optical waveguides and micromechanical switching in silicon-on-insulator, *H. Stuart, F. Baumann, A. Wong-Foy, Bell Labs., Lucent Tech., Holmdel, NJ, USA.*
We describe a 1x2 micromechanical optical waveguide switch fabricated entirely within SOI. A suspended cantilever beam acting as a single mode silicon ridge waveguide is electrostatically actuated to enable switching between two output waveguides.

ITuC2 10:45am
Integrated optical spectroscopy of low-index gases and liquids using ARROW waveguides, *H. Schmidt, Y. Dongliang, Univ. of California, Santa Cruz, Santa Cruz, CA; A. Hawkins, Brigham Young Univ., Provo, UT, USA.*
We propose optical waveguide structures for on-chip spectroscopy of gases and liquids that have a lower refractive index than the waveguide materials. Simulations based on transverse antiresonant waveguide structures are presented.

ITuC3 11:00am ◈ Invited
Raman Emission in Silicon waveguides, *B. Jalali, R. Claps, D. Dimitropoulos, Y. Han, UCLA, Los Angeles, CA, USA.*
The strong optical confinement in Si/SiO_2 structures creates an opportunity for observing and exploiting 3^{rd}-order nonlinear optical phenomena in silicon. This paper describes Raman emission in silicon-on-insulator waveguides and explores the prospect for silicon optical amplifiers.

ITuC4 11:30am
Oxidation kinetics of waveguide roughness minimization in silicon microphotonics, *D. Sparacin, MIT, Cambridge, MA; K. Wada, L. Kimerling, MIT, Microphotonics Ctr., Materials Processing Ctr., Cambridge, MA, USA.*
Waveguide roughness causes severe signal attenuation in Si waveguides. Oxidation smoothing kinetics are simulated using SUPREME and measured by AFM. We find short period roughness is reduced fastest and an unexpected saturation phenomenon in oxidation smoothing kinetics. Waveguide transmission experiments are reported.

Room: New Hampshire 2
10:30am - 11:45am
ITuD ■ Design Techniques
W. Pascher, Fern Univ., Hagen, Germany, Presider

ITuD1 10:30am ◈ Invited
Eigenmode expansions using perfectly matched layers, *P. Bienstman, Roel Baets, Ghent Univ., Belgium.*
We present an efficient modeling method based on eigenmode expansion in z-invariant layers. Radiation losses can be modeled by using PML boundary conditions. We also discuss an efficient scheme to find modes in waveguides with an arbitrary 2D cross-section based on a two-stage process.

ITuD2 11:00am
3D analysis of waveguide couplers using a structure related beam propagation algorithm, *D. Djurdjevic, T. Benson, P. Sewell, A. Vukovic, School of Electrical and Electronic Engineering, Nottingham, United Kingdom.*
The structure related finite difference beam propagation method is applied to optical waveguide couplers. The method matches the local structure geometry, yielding accurate analysis with coarser meshes than standard schemes with significant computational resource savings.

ITuD3 11:15am
Novel semiconductor waveguides supporting only a single polarization, *A. Rahman, S. Obayya, W. Boonthittanont, City Univ., London, United Kingdom; J. Heaton, QinetiQ, Malvern, United Kingdom.*
A novel concept of an optical waveguide with a layered core, which supports only a single polarization, is introduced and its expected performance is reported by using the rigorous finite element-based beam propagation method.

ITuD4 11:30am
Complex-frequency leaky mode computations using PML boundary layers for dielectric resonant structures, *M. Popovic, MIT, Cambridge, MA, USA.*
Perfectly matched layers are used for finite-difference computation of complexfrequency leaky modes of resonant dielectric structures in cylindrical and Cartesian coordinates. Examples of dielectric-halfspace-perturbed 3D rings and 2D round, square and coupled resonators are given.

11:45am – 1:30pm
Lunch on your own

Room: New Hampshire 3
1:30pm - 3:30pm
ITuE ■ Semiconductor Micro-Ring Resonators
Y. Nakano, Univ. of Tokyo, Bunkyo-ku, Japan, Presider

ITuE1 1:30pm ◈ Invited
Channel dropping filter based on ring resonators and integrated SOAs, *D. Rabus, H. Heidrich, M. Hamacher, U. Troppenz, Heinrich Hertz Inst., Berlin, Germany.*
A key device in all-optical networks is the optical filter. Ring resonator filters on the basis of GaInAsP / InP with improved filter response and increased functionality using integrated semiconductor optical amplifiers are presented.

ITuE2 2:00pm
Microring resonators vertically coupled to buried heterostructure bus waveguides, *S. Choi, K. Djordjev, S. Choi, P. Dapkus, Univ. of Southern California, Los Angeles, CA; W. Lin, G. Griffel, R. Menna, J. Connolly, Princeton Lightwave, Inc., Cranbury, NJ, USA.*
We demonstrate optical transmission of all-epitaxial, semiconductor microring resonators vertically coupled to buried heterostructure bus waveguides for the first time. Planar, vertically stacked waveguides are successfully grown on BH mesas by conducting a two-step regrowth process.

ITuE3 2:15pm
Realization of a high-contrast optical filter by a semiconductor double-disk resonator, *Q. Yang, Seung June Choi, Kostadin Djordjev, Sang Jun Choi, P. Daniel Dapkus, Univ. of Southern California, Los Angeles, CA, USA.*
A tunable optical filter using two InP/InGaAsP microdisk resonators connected in parallel is demonstrated. Deep transmission resonances of -17dB are achieved by appropriately tuning the resonant frequencies of the two microdisks.

ITuE4 2:30pm
All-optical switching using a critically coupled InP micro-racetrack resonator, *T. Ibrahim, R. Grover, L. Kuo, S. Kanakaraju, L. Calhoun, P. Ho, Univ. of Maryland, College Park, MD, USA.*
We demonstrate all-optical switching in a critically coupled InP micro-racetrack resonator by nonlinear absorption. The switching efficiency is two orders of magnitude higher than in similar GaAs devices.

ITuE5 2:45pm
Ultracompact single-mode GaInAsP-InP microracetrack resonators, *R. Grover, T. Ibrahim, L. Kuo, T. Ding, S. Kanakaraju, L. Calhoun, P. Ho, Univ. of Maryland, College Park, MD, USA.*
We demonstrate the first truly micron-size, single-mode, laterally-coupled optical racetrack resonators in InP. To our knowledge, these are the first such devices to be demonstrated by methane-based etching.

ITuE6 3:00pm ◈ Invited
Advances in microring resonators
B. Little, Little Optics, Inc., Annapolis Junction, MD, USA.
A new high-index contrast material system is used to realize commercial quality filters based on microring resonators. Widely tunable optical filters and tracking demultiplexers incorporating first to sixth order ring cavities are demonstrated.

Room: New Hampshire 2
1:30pm - 3:00pm
ITuF ■ Applications of Numerical Simulation
J. Jackel, Telcordia Tech., Red Bank, NJ, USA, Presider

ITuF1 1:30pm ◈ Invited
Simulation of high capacity WDM systems, *R. Essiambre, P. Winzer, Bell Labs., Lucent Tech., Holmdel, NJ, USA.*
We review techniques used to model state-of-the-art fiber-optic communication systems. An example is included, demonstrating optimization procedures for dispersion mapping.

ITuF2 2:00pm
Modeling and design of a velocity-matched traveling-wave electro-optic modulator on InP, *W. Pascher, Fern Univ., Hagen, Germany; J. den Besten, D. Caprioli, X. Leijtens, M. Smit, Eindhoven Univ. of Tech., Eindhoven, Netherlands; R. van Dijk, TNO Physics and Electronics Lab., The Hague, Netherlands.*
Optical and microwave propagation in a Mach-Zehnder modulator are modeled using the vectorial method of lines.The modulator cross-section is optimized for velocity match and minimum microwave loss. Design curves and field distributions are presented.

ITuF3 2:15pm
Phase matching of GaAs electrooptic modulators by using a highly dispersion tantalium pentoxide overlayer, *S. Haxha, B. M. A. Rahman K. T. V. Grattan, City Univ., London, United Kingdom.*
Resulting from rigorous numerical simulations, a perfect phase matching between the microwave and the optical wave is possible by using tantalium pentaoxide overlayer to enhance the optical bandwidth in a GaAs modulator.

ITuF4 2:30pm ◈ Invited
Bloch-mode engineering for high Q's, small V's optical microcavities in planar systems, *P. Lalanne, Jean-Paul Hugonin, Inst. D'Optique/CNRS, Orsay, France.*
Many important devices use periodic microstructures of alternating layers of dielectric materials to enhance reflection. Usually the refractive index contrast of dielectric layers is low, typically 1% in a distributed Bragg reflector, and a large number of small reflections over a long propagation distance are needed to warrant high reflectivity.

Room: City Center Ballroom
3:30pm – 4:00pm
Refreshment Break

Room: New Hampshire 3
4:00pm - 5:00pm
ITuG ■ Polymer-Enabled Devices
L. Eldada, DuPont Photonics Tech., Wilmington, MA, USA, Presider

ITuG1 4:00pm ◈ Invited
All-polymer arrayed waveguide gratings, *N. Keil, H. H. Yao, C. Zawadzki, Heinrich Hertz Inst., Berlin, Germany. M. Bauer, C. Dreyer, J. Schneider, Fraunhofer-Inst. for Reliability and Microintegration, Teltow, Germany.*
By choosing polymeric substrates with proper CTE values, athermal and polarization-insensitive arrayed waveguide gratings (AWGs) can be realized. It confirms that the all-polymer approach is a simple way for a realizing temperature and polarization independent waveguide device without sacrificing performance.

ITuG2 4:30pm
Compact single-mode benzocyclobutene microracetrack resonators, *W. Chen, R. Grover, T. Ibrahim, V. Van, P. Ho, Lab. for Physical Sciences, College Park, MD, USA.*
We demonstrate polymer microring and microracetrack resonators made from benzocyclobutene. Our devices are among the smallest reported to-date.

ITuG3 4:45pm
Modulation of light in an electrooptically-clad silica waveguide, *R. Ridgway, S. Risser, V. McGinniss, Optimer Photonics, Inc., Columbus, OH, USA.*
A silica waveguide employing an electrooptic Kerr material as a functional cladding is shown to modulate light at 10 MHz. The $V\pi$ of the modulator is shown to be inversely proportional to the bias voltage.

Room: City Center Ballroom
5:00pm - 6:30pm
ITuH ■ IPR Poster Session

ITuH1
FDTD analysis of a polarization conversion waveguide with a single sloped sidewall, *J. Yamauchi, I. Ohba, T. Ando, H. Nakano, Hosei Univ., Tokyo, Japan.*
The FDTD method is used to analyze a single-section polarization converter. The polarization conversion behavior is investigated taking into account the reflection at discontinuity junctions.

ITuH2
Design of a bent-waveguide-based multimode interference demultiplexer using the full-vectorial BPM, *J. Shibayama, K. Sadano, J. Yamauchi, H. Nakano, Hosei Univ., Tokyo, Japan.*
A wavelength demultiplexer based on a bent multimode interference coupler is designed using the full-vectorial BPM. Bending a waveguide with a radius of 1500 µm leads to a short coupler length of 170 µm.

ITuH3
Accurate finite element calculation of full vectorial modes in curved optical waveguides, *S. Obayya, B. Rahman, K. Grattan, City Univ., London, London, United Kingdom.*
Using a full vectorial finite element based beam propagation method combined with the imaginary axis propagation technique, the accurate calculation of full vectorial leaky modes of optical waveguide curves is addressed.

ITuH4
Feedback of light in two-dimensional finite-size photonic cryastal lasers, *S. Nojima, Yokohama City Univ., Yokohama, Japan.*
Photon-energy flow distributions are theoretically investigated for close-to-lasing two-dimensional finite-size photonic crystals with asymmetric and symmetric forms. The asymmetric laser oscillates by circulating photons while the symmetric laser oscillates basically in a similar way as in the ordinary one-dimensional laser.

ITuH5
Electrooptic control of functionally-clad silica waveguides, *R. Ridgway, V. McGinniss, D. Nippa, S. Risser, Optimer Photonics, Inc., Columbus, OH, USA.*
This paper documents the first demonstration of low-loss electrooptic control of silica waveguides using a functional polymer cladding. We demonstrate a 2x2 waveguide switch at 200 volts and outline methods for significantly reducing this voltage.

ITuH6
Fabrication of optical waveguide in thermosetting polymers using hot embossing, *C. Choi, J. Kim, M. Jeong, Electronics and Telecom. Res. Inst., Daejeon, Republic of Korea.*
This work presents a new hot embossing process for the fabrication of polymeric optical waveguide in thermosetting polymers. The near field pattern of the channel waveguide was observed and the propagation loss of this waveguide was evaluated at a 1550 nm wavelength.

ITuH7
Three-dimensionally profiled optical couplers fabricated by grayscale lithography, *T. Dillon, A. Balcha, J. Murakowski, D. Prather, Univ. of Delaware, Newark, DE, USA.*
We have developed writing techniques for grayscale masks that we utilize in the fabrication of tapered coupling devices. These devices provide efficient coupling into optical circuits as compared to presently employed methods. We discuss mask process development, fabrication techniques, and device performance.

ITuH8
High efficiency, small-area bends in low index contrast waveguides, *L. Li, G. Nordin, J. Jiang, J. English, Univ. of Alabama, Huntsville, Huntsville, AL, USA.*
Dramatic reductions in bend and beamsplitter size for low index contrast waveguides can be achieved with properly designed single or multiple air interfaces. Micro-genetic algorithm optimization is a useful tool for the design of such structures.

ITuH9
Novel dielectric waveguide formed by deposition onto a patterned substrate, *R. Schermer, A. Gopinath, Univ. of Minnesota, Minneapolis, MN, USA.*
A novel waveguide formed by depositing dielectric layers onto a patterned substrate is presented. Simulations produced single–mode, high index-contrast designs that can be fabricated simply on a silicon substrate.

■ **Wednesday**
■ **June 18, 2003**

Room: City Center Ballroom Foyer
7:00am – 6:00pm
■ **Registration/Speaker Check-in**

Room: New Hampshire 3
8:30am - 9:45am
IWA ■ Nanoscale Photonic Structuring
G. Nordin, Univ. of Alabama, Huntsville, Huntsville, AL, USA, Presider

IWA1 8:30am ◈ Invited
Nanoparticle-mediated assembly of colloidal crystals on patterned substrates, *J. Lewis, Carlos J. Martinez, Michael Bevan, Wonmok Lee, Paul V. Braun, UIUC, Urbana, IL, USA.*
Through fundamental studies of the phase behavior and structure of binary mixtures of attractive colloidal microspheres and highly charged nanoparticles, we have discovered a new colloidal stabilization mechanism known as nanoparticle haloing.

IWA2 9:00am
Coupling through waveguide tapers and waveguide bends in two-dimensional photonic crystals, *M. Dinu, R. L. Willett, K. Baldwin, L N. Pfeiffer, K.W. West, Bell Labs., Holmdel, NJ, USA.*
We report high coupling efficiencies from ridge waveguides to photonic crystal waveguides using photonic crystal waveguide tapers. Modified waveguide bends result in enhanced bend efficiencies and bandwidths. Experimental transmission curves agree quantitatively with calculated spectra.

IWA3 9:15am
Compact mode conversion for highly-confined waveguides, *V. Almeida, R. Panepucci, M. Lipson, Cornell Univ., Ithaca, NY, USA.*
We present a new class of compact structures for mode-size conversion between optical fibers and highly-confined waveguides. The structures are based on nano-taper couplers that enhance the coupling efficiency by one order of magnitude.

IWA4 9:30am
Polarization properties of Bragg reflector waveguides, *E. Simova, I. Golub, Inst. for Microstructural Sciences, Ottawa, ON, Canada.*
Polarization properties of Bragg reflector optical waveguides have been investigated. Grazing incidence and Brewster angle designs are compared. The proposed Brewster angle design works as a TE mode polarizer. Numerical simulations are presented.

Room: City Center Ballroom
9:45am – 10:30am
Coffee Break

Room: New Hampshire 3
10:30am - 12:00pm
IWB ■ Integration of Active Waveguide Devices
D. Dapkus, Univ. of Southern California, Los Angeles, CA, USA, Presider

IWB1 **10:30am** **◈ Invited**
Integration of a waveguide optical isolator with a semiconductor laser, *T. Mizumoto, Tokyo Inst. of Tech., Japan.*
For integrating an optical isolator with a semiconductor laser, wafer bonding of magneto-optic garnet with III/V compound semiconductor is developed. Also, the preliminary result of an interferometric isolator with a semiconductor guiding layer is shown.

IWB2 **11:00am**
Semiconductor optical amplifier and electroabsorption modulator monolithically integrated via selective area growth, *R. Stevenson, S. Choi, K. Djordjev, P. Dapkus, Univ. of Southern California, Los Angeles, CA, USA.*
A monolithically integrated semiconductor optical amplifier and electroabsorption modulator has been fabricated in the InP/InGaAsP system by selective area growth. An amplifier gain of 20dB was measured together with a modulator attenuation of 16dB at -5V reverse bias for an amplifier peak emission at 1550nm.

IWB3 **11:15am**
Monolithic integration of the BRS active waveguide with the undoped upper cladded passive waveguide for the 4x4 SOA gate switch matrix application, *J. Song, H. Kim, E. Sim, J. Park, J. Kim, K. Oh, Y. Baek, Electronics and Telecomm. Res. Inst., Daejeon, Republic of Korea.*
A new fabrication process is proposed to integrate low loss undoped-upper-cladded passive waveguides with a buried ridge stripe semiconductor optical amplifiers. A lossless 4x4 semiconductor optical amplifier gate switch matrix was successfully fabricated using this process technology.

IWB4 **11:30am**
InP-based single-mode vertically integrated waveguide photodetectors: characterization and performance analysis, *V. Tolstikhin, A. Densmore, K. Pimenov, MetroPhotonics Inc., Ottawa, ON, Canada.*
A high performance integrated waveguide photodetector for WDM monitoring applications is reported based on the single mode vertical integration technique. Active-passive integration concepts and important design considerations are described along with the results and analysis of the device characterization.

IWB5 **11:45am**
Modulation of light by light in silicon-on-insulator waveguides, *S. Stepanov, S. Rushin, Tel Aviv Univ., Tel Aviv, Israel.*
We report light modulation based on direct free-carrier absorption induced by visible light irradiation in silicon-on-insulator waveguides. An amplitude modulation depth of 80% was measured for waveguide light carrier at a wavelength of 1.32 microns.

12:00pm – 1:30pm
Lunch on your own

Room: New Hampshire 3
1:30pm - 3:45pm
JWC ■ IPR/OC Joint Session on Nanofabrication Technologies
G. Barbastathis, MIT, Cambridge, MA, USA, Presider

JWC1 **1:30pm** **◈ Invited**
The role of lithography amd metrology in nanophotonics fabrication, *H. Smith, MIT, Cambridge, MA, USA.*
Abstract not available.

JWC2 2:00pm
2-dimensional photonic crystal beamsplitters, *C. Chen, Hung-Da Chien, Pi-Gang Luan, Yi-Jen Chan, Inst. of Optical Sciences, Jung-Li, Taiwan, Republic of China.*
We demonstrate the beamsplitters with two input ports and two output ports in two-dimensional photonic crystals. The structure consists of two orthogonally crossing line defects and one point defect in square-lattice photonic crystals. The beamsplitters can be used in photonic crystal Mach-Zehnder modulators or switches.

JWC3 2:15pm ◈ Invited
Photonic crystal devices, *J. O'Brien, Jiang-Rong Cao, Wan Kuang, Min-Hsiung Shih, Woo Jun Kim, Cheolwoo Kim, Po-Tsung Lee, Sang-Jun Choi, P. D. Dapkus, Univ. of Southern California, Los Angeles, CA, USA.*
We report on two-dimensional photonic crystal devices. We will discuss the properties of photonic crystal sources and passive waveguide components. This will include a discussion of device design and modeling as well as experimental results.

JWC4 2:45pm
Microresonator fabrication and integration for high density chip to chip optical interconnect, *R. Kubacki, Ionic Systems Inc., San Jose, CA, USA.*
Microresonators, while difficult to fabricate, present significant opportunity for photonic integration. We present a material set/fabrication process to produce high precision resonator structures and integrate them with CMOS silicon devices for ultra-dense optical chip interconnect.

JWC5 3:00pm
Nanoscale imaging interferometric lithography, *S. Brueck, A. Biswas, Univ. of New Mexico, Albuquerque, NM, USA.*
Imaging interferometric lithography (IIL) is a spatial wavelength division multiplex approach to imaging that enables dense features ~ $\lambda/3$. Combining IIL, immersion, and nonlinear interpolation techniques, a route to features as small as 22 nm using optics is proposed.

JWC6 3:15pm ◈ Invited
Subwavelength replication methods for nanophotonics, *S. Chou, Princeton Univ., Princeton, NJ, USA.*
A variety of subwavelength optical elements (passive and active), their unique properties for integrating optical elements on a chip, and their fabrication in wafer-scale by nanoimprint lithography will be presented.

Room: City Center Ballroom
3:45pm – 4:15pm
Refreshment Break

Room: New Hampshire 3
4:15pm – 5:45pm
■ **IPR Postdeadline Paper Session**

■ **Wednesday**
■ **June 18, 2003**

Room: City Center Ballroom Foyer
7:00am – 6:00pm
■ **Registration/Speaker Check-in**

Room: New Hampshire 2
8:15am – 8:30am
■ **Opening Remarks**

Room: New Hampshire 2
8:30am - 10:00am
OWA ■ Optical Interconnects: Systems 1
J. Ford, Univ. of California, San Diego, La Jolla, CA, USA. Presider

OWA1 8:30am ◈ Invited
Optoelectronic devices and integration for highly parallel interconnects, *M. Hibbs-Brenner, Y. Liu, G. Park, K. Johnson, B. Hawkins, J. Guenter, Honeywell, Minneapolis, MN, USA.*
Optical interconnects have been touted for many years as a way to achieve dense, interference free, high speed interconnects from box to box, board to board and chip to chip. However, optical interconnects based upon integrated laser/detector arrays have not yet achieved widespread commercial application.

OWA2 9:00am
Can optical interconnects be sufficiently parallel to support the needs of computer systems, *D. Huang, T. Sze, H. Davidson, Sun Microsystems, San Diego, CA; S. Esener, Univ. of California, San Diego, San Diego, CA, USA.*
The level of parallelism required for computer interconnects represents significant opportunities and serious challenges for optical interconnects. In this presentation, we will discuss several challenges and present some potential optical interconnect solutions.

OWA3 9:15am
Comparative study of very short distance electrical and optical interconnects based on channel characteristics, *S. Esener, E. Yuceturk, ECE Dept. UCSD, La Jolla, CA; D. Huang, T. Sze, Sun Microsystems, Inc., San Diego, CA, USA.*
This paper presents a comparative study for very short distance (less than 1 meter) electrical and optical interconnects in terms of channel characteristics. We also predict when and where optical interconnect may replace their electrical counterpart.

OWA4 9:30am
Memory access protocol for the HOLMS low latency opto-electronic memory system, *R. Barbieri Carrera, P. Lukowicz, M. Wirz, G. Tröster, Swiss Federal Inst. of Tech., Zürich, Switzerland; P. Benabés, A. Gauthier, J. Oksman École Supérieure d'Électricité, Gif-sur-Yvette, France.*
High fanin and fanout is among the chief advantages of optics allowing low latency, direct interconnects. Unfortunately high fanin system often have problems with access conflicts. We present an opto-electronic memory access protocol used in the HOLMS system that efficiently solves such access problems.

OWA5 9:45am
Electro-optical printed circuit board (EO-PCB) device connectivity enables greater application execution efficiency, *R. Stevens, K. Thorson, J. Esch, Lockheed Martin, Eagan, MN, USA.*
The use of an Electro-Optical integrated Printed Circuit Board (EO-PCB) enables the interconnect of multiple fiber optic channels between devices utilizing a hybrid optical and copper Ball Grid Array (BGA) package. This higher bandwidth optical interconnect dramatically improves the efficiency of resident application programs.

Room: City Center Ballroom
10:00am – 10:30am
Coffee Break

Room: New Hampshire 2
10:30am - 12:00pm
OWB ■ Optical Interconnects: Systems 2
M. Hibbs-Brenner, Honeywell MN65-2500, Minneapolis, MN, USA, Presider

OWB1 10:30am ◈ Invited
Optical interconnects in Europe, *H. Rajbenbach, European Commission, Bruxelles, Belgium.*
Abstract not availbale.

OWB2 11:00am
Cascadable planar-integrated fan-out module for parallel free-space optical short-haul interconnects, *M. Gruber, R. Kerssenfischer, J. Jahns, Fern Univ. Hagen, Hagen, Germany.*
We report about design, fabrication, and test of a cascadable planar-integrated free-space optical fan-out module that can be used in an optical cross-connect switch for short-haul interconnects. For a 1 x 4 fan-out a coupling efficiency of -11.4 dB per channel was obtained.

OWB3 11:15am
On-chip optical clocking signal distribution, *J. Zheng, F. H. Robertson, Intel Corp., Santa Clara, CA; E. Mohammed, I. Young, Intel Corp., Hillsboro, OR; D. Ahn, K. Wada, J. Michel, L.C. Kimerling, MIT, Cambridge, MA, USA.*
SiO_xN_y waveguide-based optical clocking signal distributions with 64 nodes were fabricated in 3mmx5mm Silicon chip area. The network circuitry consists of 3-levels of waveguide H-trees with decreasing bending radii. A novel splitter structure demonstrates < 3% loss at split and 49:51 power splitting uniformity.

OWB4 11:30am
Rigorous coupled wave analysis of grating coupled surface-emitting guided-wave devices, *M. Moharam, E. Johnson, L. Vaissie, A. Greenwell, School of Optics/CREOL, Orlando, FL, USA.*
An extremely efficient rigorous vector electromagnetic analysis of grating-coupled surface-emitting lasers (GCSEL) is developed by constructing an artificially periodic structure with the GCSEL device as its unit cell and utilizing the rigorous coupled wave approach for the analysis of grating diffraction.

OWB5 11:45am
Board-to-board optical interconnects using a parabolic mirror for high angular misalignment tolerance, *M. Gross, D. Song, S. Esener, Univ. of California, San Diego, La Jolla, CA, USA.*
A free space optical board-to-board interconnect is presented, utilizing a parabolic mirror to achieve high angular tolerance. A relation between the input and output angle of the system is calculated and simulation results are given.

12:00pm – 1:30pm
Lunch on your own

Room: New Hampshire 3
1:30 pm - 3:45 pm
JWC ■ IPR/OC Joint Session on Nanofabrication Technologies
G. Barbastathis, MIT, Cambridge, MA, USA, Presider

JWC1 1:30pm ◈ Invited
The role of lithography amd metrology in nanophotonics fabrication
H. Smith, MIT, Cambridge, MA, USA.
Abstract not available.

JWC2 2:00pm
2-dimensional photonic crystal beamsplitters, *C. Chen, H. Chien, P. Luan, Y. Chan, Inst. of Optical Sciences, Jung-Li, Taiwan Republic of China.*
We demonstrate the beamsplitters with two input ports and two output ports in two-dimensional photonic crystals. The structure consists of two orthogonally crossing line defects and one point defect in square-lattice photonic crystals. The beamsplitters can be used in photonic crystal Mach-Zehnder modulators or switches.

JWC3 2:15pm ◈ Invited
Photonic crystal devices, *J. O'Brien, J. Cao, W. Kuang, M. Shih, W. Kim, C. Kim, P. Lee, S. Choi, P. Dapkus, Univ. of Southern California, Los Angeles, CA, USA.*
We report on two-dimensional photonic crystal devices. We will discuss the properties of photonic crystal sources and passive waveguide components. This will include a discussion of device design and modeling as well as experimental results.

JWC4 2:45pm
Microresonator fabrication and integration for high density chip to chip optical interconnect, *R. Kubacki, Ionic Systems Inc., San Jose, CA, USA.*
Microresonators, while difficult to fabricate, present significant opportunity for photonic integration. We present a material set/fabrication process to produce high precision resonator structures and integrate them with CMOS silicon devices for ultra-dense optical chip interconnect.

JWC5 3:00pm
Nanoscale imaging interferometric lithography, *S. Brueck, A. Biswas, Univ. of New Mexico, Albuquerque, NM, USA.*
Imaging interferometric lithography (IIL) is a spatial wavelength division multiplex approach to imaging that enables dense features ~ $\lambda/3$. Combining IIL, immersion, and nonlinear interpolation techniques, a route to features as small as 22 nm using optics is proposed.

JWC6 3:15pm ◈ Invited
Subwavelength replication methods for nanophotonics, *S. Chou, Princeton Univ., Princeton, NJ, USA.*
Abstract not available.

Room: City Center Ballroom
3:45pm – 4:15pm
Refreshment Break

Room: New Hampshire 2
4:15pm - 5:45pm
OWD ■ Optical Interconnects: Receivers
G. Simonis, Army Res. Lab., Silver Spring, MD, USA, Presider

OWD1 4:15pm
Power efficient parallel optical communication links, *X. Wang, Y. Li, F. Kiamilev, J. Ekman, A. Gonzalo, Univ. of Delaware, Newark, DE, USA.*
The development of power efficient parallel optical communication links by using end-to-end power negotiation algorithm in conjunction with a robust and low latency line code is presented.

OWD2 4:30pm

Smart optical transceiver architecture with dynamic channel encoding, *L. Selavo, D. Chiarulli, S. Levitan, Univ. of Pittsburgh, Pittsburgh, PA, USA.*

In this paper we introduce a novel dynamic channel coding technique designed to minimize errors introduced by electrical noise in the driver and receiver circuits and by channel-to-channel crosstalk in the optics.

OWD3 4:45pm

Receiver-less optical clock distribution using short pulses, *A. Bhatnagar, D. Agarwal, R. Chen, N. Helman, G. Keeler, D. Miller, Stanford Univ., Stanford, CA; C. Debaes, H. Thienpont, Vrije Univ., Brussels, Belgium.*

We have used short optical pulses to clock digital logic on CMOS, without using clock receivers. We present the benefits of this approach compared to electrical clock distribution by evaluating the resulting timing and power savings in a fan-out-of-four clock tree modeled after modern microprocessors.

OWD4 5:00pm

Skew reduction for synchronous OE-VLSI receiver applications, *M. Venditti, J. Schwartz, D. Plant, McGill Univ., Montreal, PQ, Canada.*

This paper addresses skew and latency issues in large receiver arrays intended for use in optoelectronic-VLSI (OE-VLSI). Existing receiver designs display high sensitivity to variations in input average photocurrent arising from non-uniformities across the array.

OWD5 5:15pm

Fully differential parallel optical transceivers with fast power-down capability, *P. Gui, F. Kiamilev, X. Wang, Univ. of Delaware, Newark, DE, USA.*

A Gigabit parallel optical transceiver IC with circuit-level fast power-down capability using differential optical signalling is described. With individual channel power control and power-down during both long and short idle periods, this architecture can realize considerable power savings on high-density optical interconnects.

OWD6 5:30pm

Integrated arrays of low power SOS chip-to-chip interconnects for efficient parallel communication in CMOS, *A. Apsel, Cornell Univ., Ithaca, NY; J. Liu, W. Chang, G. Simonis, Army Res. Lab., Adelphi, MD; A. Andreou, Johns Hopkins Univ., Baltimore, MD, USA.*

In this paper we present an array silicon-on-sapphire (SOS) interconnects for high speed, low power communication between CMOS integrated circuits. We demonstrate integrated 1Gbps links with total power consumption below 25 mW per channel.

■ **Thursday**
■ **June 19, 2003**

Room: City Center Ballroom Foyer
7:30am – 6:00pm
■ **Registration/Speaker Check-in**

Room: New Hampshire 2
8:30am - 10:00am
OThA ■ Optical Processing and Computing
A. Sawchuk, Univ. of Southern California, Los Angeles, CA, USA, Presider

OThA1 8:30am ◈ Invited
Optical processing from opto-mechanical processors to WDM, *T. Turpin, Essex Corp., Columbia, MD, USA.*
Optical signal processing has been around since World War II and has solved major problems in information processing and signal processing. Almost all of its successes have been classified. Much of this work has now been declassified, and this paper describes the history of optical signal processing from the Authors point of view (20 years at NSA and 20 years in industry). The hope is that lessons learned may help future efforts.

OThA2 9:00am
Photonic components for RF filtering and wide-band antenna nulling, *M. Geis, S. Spector, R. Williamson, T. Lyszczarz, S. Johnson, M. Povinelli, MIT., Lexington, MA, USA.*
This paper describes the design and implementation of monolithic silicon photonic devices for use in applications such as beamforming and adaptive nulling in phased array antenna systems. Low-loss fixed delay structures and slow-wave variable time delay structures are described.

OThA3 9:15am
Design methodology for large scale information system based on optical array logic, *K. Nitta, J. Tanida, Osaka Univ., Osaka, Japan.*
Optical array logic is studied as a methodological tool to design an electronic system for large scale information processing. This paper shows a design procedure to integrate parallel processing circuits on a silicon chip. We implement a specialized hardware to identify a gene network.

OThA4 9:30am
Optical bistability in a vertical-cavity semiconductor optical amplifier (VCSOA): Pulsed input, *P. Wen, M. Sanchez, M. Gross, S. Esener, ECE / Univ. of California, San Diego, La Jolla, CA, USA.*
We report experimental observations of optical bistability in a vertical-cavity semiconductor optical amplifier subject to an external pulsed input. Results show that the nonlinear transition exists with 1ns-duration pulsed input.

OThA5 9:45am
All-optical 2R regeneration using a non-linear vertical cavity semiconductor optical amplifier, *M. Sanchez, P. Wen, M. Gross, S. Esener, Univ. of California, San Diego, La Jolla, CA, USA.*
All-optical 2R logic regeneration is demonstrated using a vertical cavity semiconductor optical amplifier. The optical switching threshold is 1µ W, with 10 dB gain and >6:1 (8dB) extinction ratio. Performance limits are also discussed.

Room: City Center Ballroom
10:00am – 10:30am
Coffee Break

Room: New Hampshire 2
10:30am - 12:00pm
OThB ■ Biophotonics
S. Esener, ECE Dept. UCSD, La Jolla, CA, USA, Presider

OThB1 10:30am ◈ Invited
Dynamic holographic optical tweezers: Transforming mesoscopic matter with light, *D. Grier, The James Franck Inst., Chicago, IL, USA.*
This presentation introduces holographic optical trapping as a new technique, and highlights two applications: sorting mesoscopic objects with arrays of optical traps (optical fractionation) and driving microelectromechanical systems (MEMS) with arrays of optical vortices.

OThB2 11:00am
Simultaneous transport of multiple biological cells by VCSEL array optical traps, *R. Flynn, A. Birkbeck, M. Gross, B. Shao, S. Esener, UC San Diego, San Diego, CA; M. Ozkan, Univ. of California, Riverside, Riverside, CA, USA.*
We demonstrate the use of vertical cavity surface emitting laser arrays (VCSEL arrays) for simultaneous optical trapping, transport and active manipulation of live biological cells and microspheres, with impact on biochip array and assay technologies.

OThB3 11:15am
DNA hybridization acceleration by photovoltaic array, *C. Chen, Inst. of Optical Sciences, Jung-Li, Taiwan Republic of China; Willy Ku, Sung-Kay Chiu, Chi-Meng Tzeng, U-Vision Biotech, Inc., Taipei, Taiwan.*
Photovoltaic DNA microchip is fabricated in semiconductor. Under the illumination of a laser light source, positive charges generated on the surface of the microchip can attract the cDNA to enhance the hybridization efficiency.

OThB4 11:30am ◈ Invited
Drug response measurements using optical forces, *P. Marchand, M. Wang, A. Forster, W. Butler, M. Chachisvilis, J. Hall, I. Kariv Genoptix, San Diego, CA, USA.*
A novel technology, Optophoresis™, uses near-IR lasers to provide quantitative analysis of cells in their native state without labeling or cell processing. Experimental results demonstrate sensitivity and selectivity suitable for pharmaceutical and clinical applications

12:00pm – 1:30pm
Lunch on your own

Room: New Hampshire 2
1:30 pm - 3:15pm
OThC ■ Future Directions
R. Athale, DARPA, Arlington, VA, USA, Presider

OThC1 1:30pm ◈ Plenary
Keynote Speaker, *D. Psaltis, California Inst. of Tech., Pasadena, CA, USA.*
Abstract not available.

OThC2 2:15pm ◈ Invited
Quantum optics and quantum information science, *H. Mabuchi, California Ins. of Tech., Pasadena, CA, USA.*
In this talk I will review recent work in our group that illustrates connections between quantum optics and quantum information science. Particulary, I will describe our work on adaptive quantum measurements, quantum feedback control, and the use of photonic bandgap structures for quantum-optical networking.

OThC3 2:45pm ◈ Invited
Ultrafast information processing with optical nonlinearities, *Y. Fainman, D. Panasenko, R. Rokitski, D. Marom, Y. Mazurenko, P. Sun, Univ. of California, San Diego, La Jolla, CA, USA.*
We explore instantaneous response time of parametric optical nonlinearities that enable ultrafast processing of, and interaction between, spatial and temporal optical waveforms. A review of various signal-processing alternatives based on three- and four-wave-mixing arrangements among spatial and temporal information carrying waveforms will be discussed.

Room: City Center Ballroom
3:15pm – 3:45pm
Refreshment Break

Room: New Hampshire 2
3:45pm - 6:00pm
OThD ■ Optical Interconnects: Demonstrations
J. Jahns, Fern Univ., Hagen, Germany, Presider

OThD1 3:45pm ◈ Invited
Integrated Si-based optoelectronic devices, performances and applications, *S. Coffa, STMicroelectronics, Catania, Italy.*
Abstract not available.

OThD2 4:15pm
An application specific interconnect fabric (ASIF) for free-space global optical Intrachip interconnects, *M. Haney, M. McFadden, M. Iqbal, Univ. of Delaware, Newark, DE, USA.*
We propose a new architecture, in which a 3-D optoelectronic Application Specific Interconnection Fabric (ASIF) is coupled to a conventional Silicon integrated circuit to alleviate the performance-limiting aspects of long metal interconnects.

OThD3 4:30pm
Image-fiber coupler using graded-index rod-lens based 4f imaging microoptics, *M. Nakamura, Comm. Res. Lab., Tokyo, Japan; K. Kitayama, Osaka Univ., Osaka, Japan.*
We developed a 8 x 8 image-fiber branching lens system using graded-index rod-lens based 4f image relay. Optical alignment can be achieved only by butt-joint on V-grooves. Output-image configuration (erect or inverted) are uniform at all the output ports.

OThD4 4:45pm

Chip-to-chip multipoint optoelectronic interconnections, *D. Chiarulli, S. Levitan, Univ. of Pittsburgh, Pittsbugh, PA; J. Hanson, M. Weisser, Schott Fiber Optics, USA.*

We present a new class of interconnection solutions for centimeter scale, board and backplane level, optoelectronic interconnections that combines the high density of free space optical interconnections with the flexibility and relaxed geometry of fiber optic links.

OThD5 5:00pm

Combining optical and electronical design constraints in the HOLMS opto-electronic MCM components, *M. Wirz, P. Lukowicz, R. Barbieri Carrera, G. Troester, Swiss Federal Inst. of Tech., Zurich, Switzerland; M. Jarczynski, J. Jahns, Fern Univ. Hagen, Hagen, Germany.*

This paper exploits the issues involved in combining electronic and optical design constraints in opto-electronic multichip (OE-MCM) modules. It focuses on the OE-MCM components used in the HOLMS EU-project aimed at implementing a low latency opto-electronic memory system.

OThD6 5:15pm

Optoelectronic multi-chip module demonstration system, *J. Bakos, D. Chiarulli, S. Levitan, Univ. of Pittsburgh, Pittsburgh, PA, USA.*

We present our work on a demonstration prototype of an optoelectronic 3-chip OE-MCM that implements a 64-channel non-blocking fiber optic switch.

OThD7 5:30pm

160 Gbps free-space multi-chip global optical interconnection system demonstration, *M. Christensen, Southern Methodist Univ., Dallas, TX; P. Milojkovic, Applied Photonics, Fairfax, VA; C. Kuznia, Peregrine Semiconductor, San Diego, CA; M. Haney, Univ. of Delaware, Newark, DE, USA.*

A design for a multi-chip fully interconnected optical interconnection module is described. The module is based on integration of Ultra-thin Silicon on Sapphire circuitry with VCSEL and detector arrays and utilizes a multi-scale optical system.

OThD8 5:45pm

Programmable interface for a 160Gbps free-space optical interconnection demonstration system, *D. Schmid, F. Kiamilev, J. Ekman, X. Wang, P. Gui, M. Haney, Univ. of Delaware, Newark, DE; M. Christensen, Southern Methodist Univ., Dallas, TX; P. Milojkovic, Applied Photonics Inc., Fairfax, VA; C. Kuznia, Peregrine Semiconductor, San Diego, CA, USA.*

We describe programmable interface hardware for a 160Gbps Free-Space Optical Interconnection (FSOI) demonstration system. Our board design uses eight (8) Xilinx Virtex-II Pro FPGAs to realize 64-channel, 2.5Gbps full-duplex links into the FSOI demonstrator system.

Room: City Center Ballroom
6:30pm - 8:00pm
OThE ■ OC Poster Session

OThE1
Fabrication of three-dimensional opal and inverse opal structure for photonic crystal devices, *Y. Xu, G. Schneider, D. Prather, Dept. of Electrical and Computer Engineering, Univ. of Delaware, Newark, DE; E. Wetzel, Army Res. Lab., Weapons and Materials Res. Directorate, Aberdeen, MD, USA.*
A new process based upon a combination of centrifugation and spin-annealing has been developed to fabricate photonic crystals with stop gaps in the mid-IR portion of the spectrum. The results of Fourier-transform IR reflection spectroscopy characterization are in excellent agreement with band structure diffraction calculations.

OThE2
High speed multi-channel optical interconnects applicable to optical computing, *J. Liu, N. Das, G. Dang, M. Gerhold, W. Chang, G. Simonis, Army Res. Lab., Adelphi, MD; A. Apsel, Cornell Univ., Ithaca, NY, USA.*
Multi-channel optical interconnects were built using ultra-thin silicon CMOS driven vertical-cavity surface-emitting laser array and photodetector array. Optical data and image communication and signal processing by diffractive optical elements (DOE) were demonstrated from the optical interconnects.

OThE3
Optical AND operation based on Vertical-Cavity Semiconductor Optical Amplifiers (VCSOAs), *P. Wen, M. Sanchez, M. Gross, S. Esener, ECE/UC San Diego, La Jolla, CA, USA.*
We have demonstrated, the first time to our knowledge, a low input intensity (16nW/mm2) high contrast (10:1) optical AND gate based on a VCSOA. In the experiment, the device also shows an optical gain of 10dB.

OThE4
Investigation of the gradient index conical lens for increased angular tolerance in free space optical interconnections, *D. Song, M. Sanchez, M. Gross, S. Esener, Univ. of California, San Diego, La Jolla, CA, USA.*
A method of using gradient index conical lenses (GRIN-CL) to increase the angular tolerance of free space optical interconnects is presented. Simulation results show that GRIN-CL has 3 times higher angular tolerances than simple microlenses.

OThE5
Free-space optical interconnects for Viterbi decoding, *P. Aksoy, George Mason Univ., Fairfax, VA; M. Haney, Univ. of Delaware, Newark, DE, USA.*
A Viterbi decoder architecture utilizing free space optical interconnects for inter-chip communications is described. The proposed system overcomes the interconnection bottleneck inherent in long constraint length parallel Viterbi decoders and achieves high speed decoding.

OThE6
Analysis and evaluation of data-arrangements in digital optical parallel computing, *Y. Awatsuji, N. Nishimura, T. Kubota, Kyoto Inst. of Tech., Kyoto, Japan.*
The authors categorize the arrangements of data processed in digital optical into two options. The options are analyzed and evaluated. Advantageous conditions for efficient optical computing are discussed and clarified in each option.

OThE7
Implementing all-optical J-K flip-flops based on a two-phonon scattering of light in a single crystal, *A. Shcherbakov, E. Tepichin Rodriguez, A. Aguirre Lopez, Natl. Inst. for Astrophysics, Optics & Electronics, Puebla, Mexico.*
Theoretical analysis and computer simulations in designing the key components for all-optical J-K flip-flops are presented. These components exploit specially elaborated regime with direct transitions between all the light modes, providing 100% efficiency of operation.

OThE8
Bio-sensor CTP ceramic array, assembled in the optical trap on the top of glass waveguide, *A. Zavalin, S. Morgan, Fisk Univ., Nashville, TN, USA.*
Using the optical trapping technique Ca-Ti-P ceramic particles were attached to the top of glass K-exchange waveguide, creating array structure. Raman and PL spectra from waveguide TE and TM modes at 795 nm were measured.

■ **Friday**
■ **June 20, 2003**

Room: City Center Ballroom Foyer
8:00am – 12:30pm
Registration/Speaker Check-in

Room: New Hampshire 2
8:30am - 10:00am
OFA ■ Imaging Systems
J. Mait, Natl. Defense Univ., Washington, DC, USA, Presider

OFA1 8:30am ◈ Invited
Functional extension of thin observation module by bound optics (TOMBO), *J. Tanida, R. Shogenji, Y. Kitamura, Osaka Univ., Suita, Japan; K. Yamada, Japan Science and Tech. Corp., Izum, Japan; M. Miyamoto, S. Miyatake, Minolta Co. Ltd., Osaka, Japan.*
The TOMBO is a compact system for image capturing based on compound-eye imaging and post digital processing. Methods for color imaging and 3-D data acquisition are considered. Several experimental results executed on the experimental TOMBO system are demonstrated.

OFA2 9:00am
Submission Withdrawn

OFA3 9:15am
Target estimation from interferometric tracking telescopes, *E. Cull, M. Sullivan, D. Brady, Fitzpatrick Center for Photonics and Comm. Systems, Duke Univ., Durham, NC, USA.*
Joint target triangulation and estimation from spatio-spectral tracking using a rotational shear interferometer on a telescope is described. The system is based on an array of three eight-inch off-axis parabolic reflector telescopes with CCD cameras used for imaging.

OFA4 9:30am
Volume holographic imaging
A. Sinha, W. Sun, K. Tian, T. Shih, G. Barbastathis, MIT, Cambridge, MA, USA.
We overview the properties of volume holographic imaging properties and design framework for depth-selective and hyperspectral imaging. The Bragg selectivity and degeneracy properties of volume holograms are used for optical slicing and space-selective dispersion.

OFA5 9:45am
3-D spatial segmentation using reference structures, *P. Potuluri, D. Brady, Duke Univ., Durham, NC, USA.*
We describe a sensor system based on 3D 'reference structures' which implements a mapping from a 3D source volume onto a 2D sensor plane. We consider examples of few reference structures and how they spatially segment a 3D source volume and present some results.

Room: City Center Ballroom
10:00am – 10:30am
Coffee Break

Room: New Hampshire 2
10:30am - 11:45am
OFB ■ Volumetric Systems
D. Brady, Duke Univ., Durham, NC, USA, Presider

OFB1 10:30am ◈ Invited
Next-generation 3D display and related technologies, *Y. Takaki, Tokyo Univ. of Agr. & Tech., Tokyo, Japan.*
A new 3D display technique which does not require wearing 3D glasses and also provides natural 3D images is presented. The measurements of ocular functions and the developments of a 3D camera and a 3D interactive image processor are also presented.

OFB2 11:00am
Two-photon volumetric optical disk storage systems experimental results and potentials, *E. Walker, Y. Zhang, A. Dvornik, P. Rentzepis, S. Esener, Call/Recall, Inc., San Diego, CA, USA.*
Recent performance in two-photon volumetric data storage is presented. Experimental results are presented and theoretical potentials are analyzed.

OFB3 11:15am
Iterative detection for imaging page-oriented optical data storage, *N. Intharasombat, A. Sawchuk, Univ. of Southern California, Los Angeles, CA, USA.*
We present iterative modulation decoding and detection techniques that overcome effects of intersymbol interference in imaging page-oriented optical data storage to improve the usable density and capacity while maintaining acceptable bit-error rates.

OFB4 11:30am
Resonant holographic optics, *K. Tian, A. Sinha, W. Sun, G. Barbastathis, MIT, Cambridge, MA, USA.*
We analyze the image quality of resonant holographic imaging systems. We show that Gaussian apodization, implemented with a Hermite-Gaussian reference beams inside a confocal cavity greatly improves image quality.

Room: New Hampshire 2
11:45pm – 12:30pm
■ OC Postdeadline Paper Session