Proceedings of the Fourth

International Conference
Massively Parallel Processing
Using Optical Interconnections
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International Conference
Massively Parallel Processing
Using Optical Interconnections

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Edited by
J. Goodman, S. Hinton, T. Pinkston, and E. Schenfeld

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# Table of Contents

Message from the General Chair ............................................................. viii
Message from the Program Chair ......................................................... ix
Message from the Steering Committee Chair ................................... x
Conference Committees ..................................................................... xi

## Tutorial Session I

High-performance Optoelectronic Physical Layers in Systems ............ 2
   A.F.J. Levi, USC

### SESSION I: Guided-Wave Optical Interconnects

**Chair: J. Rowlette, AMP**

Parallel Optical Interconnection for Massively Parallel Processor RWC-1 ........ 4
   T. Yoshikawa, H. Matsuoka, T. Yokota, and J. Shimada
Si COMS Process Compatible Guided-wave Multi-Gbit/sec Optical
Clock Signal Distribution System for Cray T-90 Supercomputer .......... 10
   R.T. Chen, L. Wu, F. Li, S. Tang, M. Dubinovsky, J. Qi, C.L. Schow,
   J.C. Campbell, R. Wickman, B. Pico, M. Hibbs-Brenner, J. Bristow,
   Y.S. Liu, S. Rattan, and C. Noddings
Experimental Verification of the Pulse Shepherdng Concept in Dispersion-Shifted
Single-Mode Fiber for Bit-Parallel Wavelength Links ...................... 25
   L. Bergman, J. Morookian, C. Yeh, and S. Monacos

### SESSION II: TDM and WDM Optical Interconnects

**Chair: Steve Scott, Cray Research/SGI**

On Wavelength Assignment in WDM Optical Networks ...................... 32
   E.J. Harder, S.-K. Lee, and H.-A. Choi
Multicasting Control and Communications on Multihop Stack-Ring OPS Networks .... 39
   A. Ferreira, E. Fleury, and M.D. Grammatikakis
Inexpensive Local Interconnect Solutions Using Side-coupling Polymer
Optical Fibers .................................................................................. 45
   Y. Li, T. Wang, and K. Fasanella

### SESSION III: Free Space Optical Interconnects

**Chair: Andy Walker, Heriot-Watt University**

Applying Optical Interconnects to Electronic Systems Promise vs. Practicality ..... 54
   J. Bristow, J. Lehman, M. Hibbs-Brenner, and Y. Liu
Two-Bounce Free-space Arbitrary Interconnection Architecture ........... 61
   M.P. Christensen and M.W. Haney
Design of a Compact Alignment Tolerant Optical Interconnect for Photonic Backplane
Applications ................................................................................ 68
   B. Robertson
HADLOP - A Hardware Description Language for the Design
of Digital 3-D Optoelectronic Circuits ............................................. 78
   G. Grimm, M. Degenkolb, and D. Fey
# CONFERECE PANEL

The Evolution of Optical Interconnects Capabilities, Limitations, and Markets

**Moderator:** Frank Tooley, McGill University  
Julian Bristow, Honeywell

**Panelists:**  
R. Wickman, Cray  
C. DeCusatis, IBM  
C. Lund, Mercury  
R. Wallace, Nortel  
H. Hesselbom, Ericsson

# Tutorial Session II

Switching Techniques, Adaptive Routing and Deadlock Handling in Interconnection Networks

*Jose Duato, Universidad Politecnica de Valencia*

# SESSION IV: Massively Parallel Processor Interconnects

**Chair:** Ted Szymanski, McGill University

- Commercial MPP Networks: Time for Optics?  
  C.B. Stunkel  
  Application of Massively Parallel Processors to Real Time Processing of High Speed Images
  Y.J. Joo, S. Fike, K.S. Chung, M. Brooke, N.M. Jokerst, and D. Scott Wills

# SESSION V: Guided and Free-Space Optical Systems

**Chair:** Louis Lome, BMDO

- Wavelength Recognizing Switches: Architectures and System Applications
  B. Hoanca and A.A. Sawchuk
- Free-Space Modules and Fiber Array Data Links for Optical Interconnect Systems
  R.K. Kostuk, S. Kemme and R. Boye
- 8.5 Gbit/s/port Synchronous Optical Packet-switch
  Y. Maeno, A. Tajima, Y. Suemura, and N. Henmi

# SESSION VI: Switches and Topological Embedding

**Chair:** Afonso Ferreira, CNRS-LIP

- Switches and Switch Interconnections
  L.M. Ni, W. Qiao, and M. Yang
- BPC Permutations on The OTIS-Mesh Optoelectronic Computer
  S. Sahni and C.-F. Wang
- Embedding Binary Trees in Arrays with Optical Buses
  Y. Mei and C. Qiao
- Self-routing in 2-D Shuffle Networks with Dimension-dependent Switches and Interconnections
  J. Giglmayr
SESSION VII: Optoelectronics in MPP Computing Systems

Chair: A. Louri, University of Arizona

Optics Inside Future Computers ................................................................. 156
C. Lund
Systolic Processing Architectures Using Optoelectronic Interconnects ............. 160
S.M. Chai, A. Lopez-Lagunas, D.S. Wills, N.M. Jokerst, and M.A. Brooke
Free-space Optical Interconnections within SIMD Massively Parallel Computers ........ 167
P. Scheer, T. Collette, and P. Churoux
Three-dimensional Optoelectronic Architectures for Massively Parallel Processing Systems ................................................................. 178
H. Van Marck and J. Van Campenhout

SESSION VIII: Optical Interconnect Modeling and Experimentation

Chair: James G. Grote, WPAFB

Fundamentals of Optical Interconnections – a Review ..................................... 184
H.M. Ozaktas
Realization of a Smart-Pixel Parallel Optoelectronic Computing System .............. 190
N. McArdle, M. Naruse, T. Komuro, and M. Ishikawa,
A Pipelined TDM Optical Bus with Conditional Delays .................................... 196
Y. Li, Y. Pan, and S.Q. Zheng
Four Multiplexed, 8x8-bit 2-D Parallel Transmission based upon Space-CDMA .... 202
M. Nakamura, K.-I. Kitayama, Y. Igasaki, and K. Kaneda

Author Index ..................................................................................................... 209
Message from the General Chair

Welcome to this, the fourth meeting on Massively Parallel Processing using Optical Interconnects. We hope you will find the program stimulating and of help in this highly interdisciplinary field.

A major goal of the conference is to bring together researchers in the rather separate fields of computer architecture and photonics. Computer architects are in the best position to identify the most important interconnect problems to face the computer industry, and are generally quite familiar with the capabilities and limitations of electrical approaches to solving such problems. Those working in the field of photonics have a good sense of the unique attributes of optics as an interconnect medium, and can project what the capabilities of such approaches may ultimately be, as well as identify the outstanding photonic device and systems problems that require further development.

The computer architecture field finds itself at a juncture where different philosophies compete for the future. The massively parallel machine remains of high interest, but to a smaller number of companies than ever before. Interest in networks of workstations as a parallel-computing paradigm appears to be growing. Tight coupling of machines through networks with low-protocol overheads are important, as are new schemes for maintaining cache coherency. The bandwidth demanded of interconnects continues to rise dramatically, and the pressure to keep latencies low is extremely strong.

In the photonics area, significant progress has been made over the past few years in developing low-cost parallel fiber links for interconnections over distances of the order of ten meters (or less). Photonics appears poised to move a level lower in the interconnect hierarchy, perhaps entering a single machine. Whether this is at the backplane or board level is uncertain, and will be influenced greatly by the costs of photonic solutions. Wavelength division multiplexing, which is having a profound impact on long-distance links in the national networks, may find a role at shorter distances as well.

All these developments (and more) make this an exciting time in the field covered by this conference. I am confident that this excitement will be felt by those attending, and hopeful that this meeting can serve a useful purpose in furthering progress in this field.

Joseph W. Goodman
Stanford University
General Chair
Message from the Program Co-Chairs

Welcome to Montreal and the fourth MPPOI conference. Indeed, it has been our pleasure serving as program chairs for this important cross-disciplinary meeting which brings together top researchers in the fields of parallel processing and optical interconnects. To reflect the current state of the art in this research area we have encouraged authors to submit manuscripts demonstrating original unpublished research in the following topical areas.

-Optical Interconnections and Reconfigurable Architectures.
-Interconnection Networks.
-Embedding and Mapping of Applications and Algorithms.
-Packaging and Layout of Optical Interconnections.
-Electro-Optical and Opto-Electronic Components.
-Relative Merits of Optical Technologies (free-space, fibers, wave guides).
-Passive Optical Elements.
-Data Distribution and Partitioning.
-Characterizing Parallel Applications-Cost/Performance Studies.

The review process required submitted papers were reviewed by at least three different reviewers with the final decisions being made by the program chairs based on the recommendations given by the program committee members. The result of this review process is a program consisting of two tutorial speakers, ten invited talks, and twenty regular papers.

To encourage cross-disciplinary education we have included two tutorial sessions, one at the beginning of each day, covering the key issues and latest advancements in "high-performance opto electronic physical layers in systems" by Tony Levi (USC) and "switching techniques, adaptive routing and deadlock handling in interconnection networks" by Jose Duato (U. Valencia). We have also included two panel sessions to provide an opportunity for open discussion. The first panel discussion, organized by Frank A.P. Tooley (McGill) and Julian Bristow(Honeywell), focuses on "The Evaluation of Optical Interconnects Capabilities, Limitations, and Markets." The second panel discussion, organized by D. Scott Wills (GaTech) and Julian Bristow (Honeywell), focuses on "Interconnect Architectural Issues." We also have included a few more invited talks this year so that this conference can be a bit more focused on the themes presented in the tutorial sessions. Each session follows a theme set by the invited talk(s). Regular papers are grouped together within sessions as they related to these themes.

We thank the hard work and dedication of the program committee who are listed in these proceedings. We also thank D. Scott Wills, Frank Tooley, and Julian Bristow for organizing the two panel sessions. We acknowledge the help of Eugen Schenfeld (NEC Research Institute) in keeping things running smoothly, and we are grateful to Sue Bredhoff (NEC Research Institute) for facilitating administrative duties. Finally special thanks go to Joe Goodman (Stanford), the general chair, for guiding us to another successful conference.

Enjoy the conference!

H. Scott Hinton
University of Colorado at Boulder

Timothy M. Pinkston
University of Southern California
Message from Steering Committee Chair

Welcome to the fourth meeting on Massively Parallel Processing Using Optical Interconnections (MPPOI'97). We, the MPPOI Steering Committee, strive to maintain and build this forum as the prime interaction conference, between computer and optical scientists and engineers. The role technology plays in computer and communication industry is a prime one. Optics is an emerging technology. It seems that optics is well based in the telecommunication domain, as well starting to have a role in the shorter distances of 10-100 meters. Computer systems were historically most influenced from technology that was primarily introduced in related products. Such was the case for the punch cards (to program weaving machines for the cloth industry), relays (used first in the telephone switching industry), vacuum tubes (many consumer applications such as radios, telephones, etc.), transistors, integrated circuits, micro-processors, etc. Through history, it seems that the first emerging technology was for consumer applications, and then computer architects and engineers, look at ways to use these consumer technology for computation.

What is the next to happen consumer technology to affect computation? As the scope of this conference suggest, we think it will be a mix of cheap consumer commodity communication that will allow the connections of 100's to 1000's single-chip DRAM+CPU+Communication components, into a scalable computation system.

There are many problems to overcome, and we as scientists and engineers should be happy that there are problems (so we can suggest solutions!). From addressing the issue of packaging of optical network (alignment, cheap consumer production, etc.) to programming paradigms, network architectures and new algorithms, that will cleverly take advantage of the new optical technology yet avoiding any possible pitfalls.

The MPPOI steering committee wishes to welcome all of you to the 4th conference and looks forward to your future participation, suggestions and comments.

I would like to thank all the authors and the participants for contributing to the success of this conference. Special thanks go to J. Goodman, MPPOI'97 General Chair, and to Scott Hinton and Tim Pinkston MPPOI'97 Program Co-Chairs for their many contributions and extensive work towards putting together a very successful program. I would also like to thank all the many people that helped with the conference, including the session chairs and the IEEE Computer Society personnel. Last, but not least, I would like to thank my secretary, Ms. Susan Bredhoff who was so helpful, patient and kind during the process of putting the conference together, and kept everything in order and under check.

Eugen Schenfeld
MPPOI Steering Committee Chair
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