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(August 2001)

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**Education**

B.Sc. 1974 University of Toronto (Mathematics)  
M.A. 1975 Princeton University (Mathematics)  
Ph.D. 1978 Princeton University (Electrical Engineering/  
Computer Science and Applied Mathematics: Advisor - Bede Liu )  
M.A. 1996 Dartmouth College (Honorary)

**Professional Employment**

1992-present Dorothy and Walter Gramm Professor of Engineering  
Thayer School of Engineering  
Dartmouth College, Hanover, NH 03755-8000

1988-1992 Associate Director, Center for Supercomputing Research  
and Development  
Professor of Electrical and Computer Engineering  
Professor of Computer Science  
Research Professor, Coordinated Science Laboratory  
University of Illinois at Urbana-Champaign  
Urbana, IL 61801

1978-1988 Assistant and Associate Professor (Chairman in 1985-1986)  
Department of Computer Science,  
Tufts University, Medford, MA 02155

1986-1988 Visiting Scientist, Laboratory for Information and  
Decision Systems, MIT, Cambridge, MA 02139

1984-1986 Visiting Scientist, Statistics Center,

MIT, Cambridge, MA 02139

1982-1983 Associate Program Director  
Division of Mathematical and Computer Sciences  
National Science Foundation  
Washington, DC 20550

1981 Spring Visiting Scientist  
Department of Computer Science  
Stanford University  
Stanford, CA 94305

1980 Fall Visiting Scientist  
Laboratory for Information and Decision Systems  
MIT, Cambridge, MA 02139

### **Professional Activities**

Fellow of the IEEE.

Member, SIAM.

DARPA ISAT Study on Mobility and Security, 2000, Co-Chair.

Kloosterman Distinguished Visiting Professor of Mathematics and Computer Science, Leiden University, Netherlands, 1996.

Board of Governors (elected), International Neural Network Society (1999-present).

Editor-in-Chief (1994-2000), Editorial Board (1992-1994, 2000-present) IEEE/AIP Computing in Science and Engineering

Associate Editor, Applied Numerical Mathematics (1998-present);

Associate Editor, IEEE Transactions on Information Theory (1989-1992).

Associate Editor, Mathematics of Control, Signals and Systems, Springer-Verlag (1988-2000).

Co-Managing Editor, SIAM Journal on Matrix Theory and Analysis (1990-1995).

Associate Editor, University of Manchester Press, series on Advanced Algorithms and Architectures for Scientific Computation.

Associate Editor, Neural Networks (1991-present).

External Advisory Board, Minnesota Supercomputer Institute (1996-1999).

Advisory Board, Institute for Mathematics and its Applications, University of Minnesota (1998-2000).

Advisory Committee, Lorentz Center for Physics, Astrophysics, Mathematics and Computer Science, Leiden University, Netherlands (1998-present).

External Review Board, Mathematical and Computer Sciences, Argonne National Laboratory, University of Chicago, (1996-1999).

Editor, IEEE Technical Committee on Supercomputer Applications Newsletter (1990-1993).

Associate Editor, *Advances in Computational Mathematics* (1992-1995).

Guest editor (with J. Martin, IBM) of special issue of *Proceedings of IEEE on Computer Performance Evaluation*, August 1993.

Board of Directors, Special Interest Group in Numerical Mathematics (SIGNUM), Association for Computing Machinery, 1983-1986 term. Elected as Secretary-Treasurer (1985-1987 term).

Program co-chair, IPPS/SPDP 1999, San Juan, Puerto Rico.

Member of Advisory Committee 1986-1989 term, SIAM Activity Group on Control and Systems Theory.

Member of Organizing Committee, Applied Linear Algebra Year, Institute for Mathematics and its Applications, University of Minnesota, 1991-1992.

Organizer, Mathematics of High Performance Computing and Communications Special Year, IMA, University of Minnesota, 1996-1997.

Member of Program Committee, American Conference on Decision and Control, 1985 and 1986.

Member of Program Committee, SIAM Conference on Linear Algebra in Systems, Control and Signal Processing, San Francisco, 1990.

Member organizing committee, SIAM Applied Linear Algebra Conference, Minneapolis, 1991.

Program Chairman, 1991 Allerton Conference on Control, Communications and Computing.

Co-Chairman of Program Committee, Society of Photoelectric Instrumentation Engineers Annual Conference, San Diego August 1987.

Member of Naval Research Laboratory Advisory Board, National Research Council.

Minisymposium organizer, Third SIAM Conference on Applied Linear Algebra, Madison, Wisconsin, May 1988.

Minisymposium organizer, SIAM conference on Linear Algebra in Systems, Control and Signal Processing (Boston, August 1986).

Minisymposium organizer, SIAM National Meeting, San Diego, July 1989.

## **Publications**

1. Error analysis of Durbin's, Levinson's, and Trench's algorithms, *Proceedings of 1979 International Conference on Acoustics, Speech and Signal Processing*, Washington, DC

- 1979, pp.498-501.
2. Numerical stability of the Levinson-Durbin algorithm for Toeplitz systems of equations, *SIAM Journal on Scientific and Statistical Computing*, 1, 1980, pp.203-220.
  3. Rounding errors and the non-optimality of lattice methods, *Proceedings of 14th Annual Princeton Conference on Information and Decision Systems*, Princeton, NJ, 1980.
  4. Error analyses of methods for Toeplitz systems and linear prediction, in *Circuit Theory and Design* (R. Boite and P. Dewilde, eds.), North-Holland, 1981, pp. 379-386.
  5. Locations of zeroes of predictor polynomials, *IEEE Transactions on Automatic Control*, AC-27, 1982, pp. 235-238.
  6. Low rank Toeplitz approximations and moment problems, *Circuits, Systems, and Signal Processing*, 1, 1982, pp. 345-366.
  7. Estimating point spectra using the Lanczos algorithm, *Proceedings of American Conference on Decision and Control*, Orlando, FL, 1982, pp.46-51.
  8. Affine Minimax Problems and Semi-Infinite Programming, *Tufts University Computer Science Technical Report*, 1982.
  9. A general orthogonalization technique with applications to time series analysis and signal processing, *Mathematics of Computation*, 40, 1983, pp. 323-336.
  10. The theory of ideal spectra, *Proceedings of 17th Annual Princeton-Johns Hopkins Conference on Information Systems and Sciences*, 1983, pp. 78-82.
  11. Restrictions of normal operators, Pade approximations and autoregressive modelling, *SIAM Journal on Mathematical Analysis*, 15, 1984, pp.753-767.
  12. Fast approximation of dominant harmonics, *SIAM Journal on Scientific and Statistical Computing*, 5, 1984, pp. 317-331.
  13. On the eigenstructure of Toeplitz matrices, *IEEE Transactions on Acoustics, Speech and Signal Processing*, 32, 1984, pp.918-920.
  14. The numerical stability of lattice algorithms for least squares linear prediction problems, *BIT* Vol. 24, pp.441-455, 1984.
  15. Computing Pisarenko frequency estimates, *Proceedings of 18th Annual Princeton Conference on Information Systems and Sciences*, March 1984, pp. 587-591.
  16. Fast structured singular value computations, *Technical Report, Tufts University, Department of Computer Science* 1984.
  17. Computing the minimal eigenvalue of Toeplitz matrices, (with C. Van Loan), *SIAM Journal on Scientific and Statistical Computing*, 7, 1986, pp. 123-131.
  18. Hypercube embedding is NP-complete, (with D.W. Krumme and N. Venkataraman), *Hypercube '86* (M.T. Heath, ed.) pp.148-157, SIAM, Philadelphia, 1986.
  19. The conditioning of eigenvector methods for beamforming problems, *Proceedings of 1986 Princeton Conference on Information Systems and Sciences*, pp. 125-131, March

1986.

20. The sensitivity of beamforming problems, *Proceedings of IEEE Workshop on Spectrum Estimation*, pp. 233-234, November 1986.
21. The token broadcast problem, (with D.W. Krumme and N. Venkataraman) in *Proceedings of the International Conference on Parallel and Distributed Computing*, Lake Charles, IL 1986.
22. An interactive graphics system for displaying parallel program executions (extended abstract), in *Proceedings of Workshop on Measurement and Performance Analysis of Parallel Computers*, Argonne National Laboratory, 1986.
23. Fixed hypercube embedding, (with D.W. Krumme and N. Venkataraman), *Information Processing Letters*, Vol. 25, pp. 35-39, April 1987.
24. An explicit formula for Lanczos polynomials, *Linear Algebra and Applications*, Vol. 88, pp.99-115, 1987.
25. Fast Toeplitz orthogonalization using inner products, *SIAM Journal on Scientific and Statistical Computing*, Vol. 8, pp.734-740, September 1987.
26. Hypercube implementations of tracking algorithms, (with T.G. Allen, J. Polito, C. Angelli), in *Proceedings of JDL Workshop on Command and Control*, Washington, DC, pp.145-153, 1987.
27. Parallel algorithms for classification and clustering, (with T.G. Allen) , in *Proceedings of SPIE Conference on Advanced Architectures and Algorithms for Signal Processing*, San Diego, CA, pp. 126-132, August 1987.
28. Practical parallel union-find algorithms for transitive closure and clustering, (with T.G. Allen and J. Polito) *International Journal of Parallel Programming*, Vol. 17, pp.403-423, 1988.
29. Load balancing and partitioning for parallel signal processing and control algorithms, in *Advanced Computer Concepts and Techniques in Control Engineering*, (M.Denham and A. Laub, Editors) Springer, New York, pp. 391-409, 1988.
30. An SVD analysis of resolution limits for harmonic retrieval problems (with J.R.Casar), in *SVD and Signal Processing*, (Ed.F. Deprettere, editor) North-Holland, Amsterdam, pp.461-467, 1988.
31. Debugging support for parallel programs (with D.W. Krumme and A.L. Couch) in *Proceedings of the International Conference on Vector and Parallel Computing*, Tromso, Norway, June 1988.
32. Continuous valued neural networks: approximation theoretic results, in *Proceedings of 1988 Interface of Statistics and Computer Science*, Reston, VA , pp.174-184, 1988.
34. Recent Trends in Signal Processing, *SIAM News*, September 1988, pp.18-19.
35. Continuous neural networks with two hidden layers are sufficient, *Tufts University, Department of Computer Science, Technical Report* 1988 .

35. The Perfect Club: A New Era in Benchmarking, *SIAM News*, September 1989 (with L. Pointer and M. Berry).
36. Dynamic Load Balancing for Distributed Memory Multiprocessors, *Journal on Parallel and Distributed Computing*, Vol. 7, pp.279-301, 1989.
37. Approximation by superpositions of a sigmoidal function, *Mathematics of Control, Signals and Systems*, Vol. 2, pp.303-314, 1989.
38. Heterogeneous processes on a homogeneous multiprocessor, (with D.W. Krumme, N. Venkataraman, and A. Couch) in *Medium Scale Multiprocessors* (Arthur Wouk, Editor), SIAM Publications, pp.97-108, 1989.
39. Designing neural networks, in *Proceedings of First International Conference on Artificial Neural Networks*, London, pp.1-3, addendum, 1989.
40. Hyperbolic Householder algorithms for structured matrices (with M. Berry), *SIAM Journal on Matrix Analysis and Applications*, pp. 499-520, October 1990.
41. Higher order wavelets and quadrature mirror filters, (with B. Usevitch) in *Proceedings of 2nd International Workshop on SVD and Signal Processing*, Kingston, RI, June 1990.
42. Supercomputer performance analysis and the Perfect Benchmarks, (with L. Kipp, L. Pointer, D. Kuck) in *Proceedings of 1990 International Conference on Supercomputing*, Amsterdam, 1990.
43. Mathematical problems in neural computing, in *Signal Processing, Scattering and Operator Theory, and Numerical Methods*, pp.47-65, Birkhauser, Boston, 1990.
44. Complexity theory of neural networks and classification problems, *Neural Networks*, ed. L. Almeida, Lecture Notes in Computer Science, Springer-Verlag, pp.26-45, 1990.
45. Supercomputer performance trends and the Perfect Benchmarks, *Supercomputing Review*, April, 1991.
46. VISTA: A system for remote visualization, (with A. Tuchman et al.), (extended abstract) in *Proceedings of SIAM Conference on Parallel Computing*, Houston, March 1991.
47. Neural networks, backpropagation and automatic differentiation, (with S. Saarinen and R. Bramley), in *Automatic Differentiation, edited by A. Griewank*, SIAM Publications 1991.
48. Multidimensional binary partitions: distributed data structures for spatial partitioning, (with T.G. Allen), *International Journal on Control*, Vol. 54, pp. 1335-1352, 1991.
49. A survey of scientific benchmarks, (with M. Berry, J. Larson) *Parallel Computing*, Vol. 17, pp. 1173-1194, 1991.
50. Run-time visualization of program data, (with A. Tuchman and D. Jablonowski), in *Proceedings of Visualization '91*.
51. Parallel computing and the Perfect Benchmarks, (with S. Ho, J. Bruner, S. Sharma),

- Proceedings of 1991 International Symposium on Supercomputing*, Kyushu, Japan.
52. Gossiping in minimum time , (with D.W. Krumme and N. Venkataraman) *SIAM Journal on Computing*, Vol. 21, pp. 111-139, 1992.
  53. Revolution or Evolution? (with D.J. Kuck), *IEEE Spectrum*, Vol. 29, pp 39-41, September 1992.
  54. The numerical solution of neural network training algorithms, (with S. Saarinen and R. Bramley) *SIAM J. on Scient. and Stat. Computing*, Vol. 14, pp. 693-714, 1993.
  55. Adaptive memory systems (with S. Saarinen), *Proceedings of SPIE*, Orlando, 1993.
  56. Toeplitz Algorithms for Signal Processing, SIAM Short Course Lecture Notes, Seattle, 1993.
  57. Review of *Computation and Cognition*, edited by C.W. Gear, SIAM Review, Vol. 35, pp.147-148, 1993.
  58. A survey of scientific benchmarks, (with M. Berry, J. Larson) *Advances in Parallel Computation*, Vol. 17, pp. 127-148, 1993.
  59. An approximate k-nearest neighbor method,(with S. Saarinen), in *Adaptive and Learning Systems II*, Firooz A. Sadjadi, Editor, Proc. SPIE 1962, 120-127 (1993).
  60. On the unreasonable effectiveness of memory-based methods, in *Proceedings of IEEE Workshop on Large Scale Computation*, Prague, CZ, pp. 1-9, 1993. (Winner of best paper award)
  61. Signal Processing Models for Information Retrieval, in *Proceedings of COST '94 Workshop on Emergent Techniques in Signal Processing and Communications*, VIGO, Spain, pp. 34-45, 1994.
  62. Information Theoretic Principles of Agents, (with Robert Gray, Alexy Khrabrov and Yunxin Wu), in *CIKM Workshop on Intelligent Information Agents, Third International Conference on Information and Knowledge Management (CIKM '94)*, 1994, Gaithersburg, Maryland, Editors, Yannis Labrou and Tim Finin.
  63. Information Agents as Organizers, (with Robert Gray, Alexy Khrabrov and Yunxin Wu), in *CIKM Workshop on Intelligent Information Agents, Third International Conference on Information and Knowledge Management (CIKM '94)*, 1994, Gaithersburg, Maryland, Editors, Yannis Labrou and Tim Finin.
  64. Perfect reconstruction filtering with unitary operators and projections, (with. M. Stewart), *Linear Algebra and its Applications*, Vol. 208, pp. 97-133, 1994.
  65. Theory of Just-in-Time Modeling, in *From Estimation to Learning*, edited by S. Bittanti, Springer Verlag, 1995.
  66. The future of information technology, in *Optoelectronics for Data Communications*, (edited by U. Osterberg and R. Lansky), Academic Press, pp. 311-320, 1995.
  67. Signal Processing in The National Information Infrastructure, (with R. Gray et al.), National Science Foundation Report, 1995.

68. Q-Learning: A tutorial with extensions, to appear in *Mathematics of Neural Networks*, Oxford University, 1995.
69. Linear Algebra for Signal Processing, (edited with A. Bojanczyk), Springer-Verlag, New York, 1995.
70. Pattern Recognition of 3D CAD Objects (with A. Bhasin and K. Cohen), *Smart Engineering Systems Design*, 1:1-13, 1997.
71. Mathematical Models of Uncertainty in Agent Systems (with K. Moizumi), to appear in *Japanese Journal of Mathematical Modeling*, 1999.
72. Design in the Industrial Age vs. Design in the Information Age (with A. Bhasin), to appear in *Report of the NSF Workshop on Design in 2000*, edited by J. Tomlinson, 1997.
73. Mobile agents: The new paradigm for distributed computing , (Robert Gray, David Kotz, Saurab Nog, Daniela Rus and George Cybenko), in *Proceedings of 1997 Parallel and Distributed Architectures Symposium*, Aizu, Japan, March 1997.
74. Agent Tcl, in William Cockayne and Michael Zypa, editors, *Itinerant Agents: Explanations and Examples* with CDROM, Manning Publishing, 1996 (with R. Gray, D. Kotz and D. Rus).
75. Neural Networks in Computational Science and Engineering, in *IEEE Computational Science and Engineering*, Spring 1996. Vol. 3. No. 1, pp. 36-42.
76. The Shannon Machine, In *Proceedings of the 9th Yale University Workshop on Adaptive Control and Learning* June, 1996 (with R. Gray, A. Bhasin, B. Brewington).
77. The Foundation of Information Push and Pull, (with B. Brewington and R. Gray), preprint, 1997.
78. Meetingplace (editorial), in *IEEE Computational Science and Engineering*, Spring 1996, Vol. 3, No. 1, Pp. 1.
79. Scientific Standard for Scientific Computing (with H. Wijshoff), in *IEEE Computational Science and Engineering*, Fall 1996, Vol. 3, No. 3, pp. 1.
80. Dynamic programming: A discrete calculus of variations *IEEE COMPUT SCI ENG* 4: (1) 92-97 JAN-MAR 1997.
81. Knocking opportunity or opportunity knocking? *IEEE COMPUT SCI ENG* 3: (4) 1-1 WIN 1996.
82. A prototype eddy current instrument with image enhancement (with B. Brewington), in *Proceedings of SPIE Conference on Aging Aircraft and NDI*, Scottsdale, AZ, December 1996.
83. New magazine expands AIP's Computers in Physics and IEEE Computational Science and Engineering, (with L.M. Holmes) *Comput in Phys* 12: (6) 516-517 NOV-DEC 1998.
84. Introducing computing in science and engineering, *IEEE COMPUT SCI ENG* 5: (4) 1-2 OCT-DEC 1998.

85. Merger mania in CSE, *IEEE COMPUT SCI ENG* 5: (3) 1-1 JUL-SEP 1998.
86. Network awareness and mobile agent systems, (with Caripe W, Moizumi K, et al.), *IEEE COMMUN MAG* 36: (7) 44-49 JUL 1998.
87. Knowledge as commodity, *IEEE COMPUT SCI ENG* 5: (2) 1-1 APR-JUN 1998.
88. The CSE challenge in knowledge and distributed intelligence, *IEEE COMPUT SCI ENG* 5: (1) 1-1 JAN-MAR 1998.
89. Agent Tcl: Targeting the needs of mobile computers. (with David Kotz, Robert Gray, Saurab Nog, Daniela Rus, Sumit Chawla) *IEEE Internet Computing*, 1(4):58-67, July/August 1997.
90. How is CSE doing?, *IEEE COMPUT SCI ENG* 4: (4) 2-2 OCT-DEC 1997.
91. Multimedia in CSE education *IEEE COMPUT SCI ENG* 4: (3) 1-1 JUL-SEP 1997.
92. Hardly the end of science *IEEE COMPUT SCI ENG* 4: (2) 1-1 APR-JUN 1997.
93. Theme section: Microelectromechanical machines and computation *IEEE COMPUT SCI ENG* 4: (1) 10-10 JAN-MAR 1997.
94. Mobile Agents for Mobile Computing (with R. Gray, D. Kotz and D. Rus), In Dejan Milojicic, Fred Douglass, and Rick Wheeler, editors, *Mobility, Mobile Agents and Process Migration - An Edited Collection*. Addison Wesley, 1998.
95. The Foundations of Information Push and Pull (with B. Brewington), in *Mathematics of Information*, Springer, D. O'Leary editor, 1998.
96. The traveling agent problem. (with K. Moizumi) To appear in *Mathematics of Control, Signals and Systems*, 2001.
97. Tracking with text-based messages, (with Alberola C.), *IEEE INTELL SYST APP*. 14: (4) 70-78 JUL-AUG 1999.
98. The intellectual property lottery, *IEEE COMPUT SCI ENG* 1: (4) 4-5 JUL-AUG 1999
99. Mobile agents in distributed information retrieval (with Brian Brewington, Robert Gray, Katsuhiko Moizumi, David Kotz, and Daniela Rus). In Matthias Klusch, editor, *Intelligent Information Agents*, chapter 12. Springer-Verlag, 1999. ISBN 3-540-65112-8.
100. D'Agents: Security in a multiple-language, mobile-agent system. (with Robert S. Gray, David Kotz, and Daniela Rus). In Giovanni Vigna, editor, *Mobile Agent Security, Lecture Notes in Computer Science*. Springer-Verlag, 1998.
101. How dynamic is the web? (with B. Brewington), to appear in *IEEE Computer*, January 2000.
102. Agent matching conflicts (with G. Jiang), in *Proceedings of AAAI Annual Conference*, Orlando, FL, June 1999.
103. Machine Learning in Grid Applications (with G. Jiang and D. Bilar), in *Proceedings of Allerton Conference on Communications, Control and Computing*, University of Illinois

at Urbana-Champaign, September 1999.

104. Modeling and Analysis of Active Messages in Volatile Networks (with C. Okino) in Proceedings of Allerton Conference on Communications, Control and Computing, University of Illinois at Urbana-Champaign, September 1999.
105. The death of disciplines, *IEEE COMPUT SCI ENG* 2: (2) 2-3 MAR-APR 2000
106. Infrastructure immunology, *IEEE COMPUT SCI ENG* 1: (6) 1-1 NOV-DEC 1999
107. How dynamic is the web? (with B. Brewington) . In *Proceedings of the Ninth International World Wide Web Conference*, May, 2000. <http://www9.org/w9cdrom/index.html>
108. The Infrastructure Web, (with G. Jiang), in *Proceedings of Infrastructure Protection and Emergency Modeling Symposium*, Washington, DC, April 2000.
109. Performance Analysis of Mobile Agents for Filtering Data Streams on Wireless Networks (with D. Kotz, G. Jiang, et al.), In *Proceedings of the International Workshop on Modeling and Simulation of Wireless and Mobile Systems* (MSWiM 2000, Boston, MA).
110. Fuzzy MHT: A Fuzzy Feedback System Applied to Text-Based Vehicle Tracking Santiago Aja, Carlos Alberola, George V. Cybenko, submitted to *IEEE Transactions on Fuzzy Systems*, 2000.
111. George Cybenko and Guofei Jiang, Matching Conflicts: Functional Validation of Agents, submitted to *Autonomous Agents*, 2001.
112. George Cybenko and Guofei Jiang, Developing a Distributed System for Infrastructure Protection , *IEEE IT Professional*, vol .4, pp.17-22, July/August,2000
113. George Cybenko, Sullivan F, Tomorrow's hardest problems *COMPUT SCI ENG* 3 (3): 40-41 MAY-JUN 2001
114. George Cybenko, Reducing quantum computations to elementary unitary operations *COMPUT SCI ENG* 3 (2): 27-32 MAR-APR 2001
115. George Cybenko, The new millennium challenge *COMPUT SCI ENG* 2 (6): 4-5 NOV-DEC 2000
116. George Cybenko, Who wants more? *COMPUT SCI ENG* 2 (4): 3-3 JUL-AUG 2000
117. Guofei Jiang, George Cybenko and Dennis McGrath, , The Infrastructure Web: distributed monitoring and managing critical infrastrcutres, *Proc. of SPIE symposium on Law Enforcement Technologies*, Boston, Nov 2000.
118. Vincent Berk and George Cybenko, Law Enforcement Issues of File-Sharing Protocols, ISTS Technical Report, January 2001.