

CURRICULUM VITAE

Victor Y. Pan

Department of Mathematics and Computer Science
Lehman College and the Graduate Center
City University of New York
Bronx, New York 10468
Tel. (914) 737-2637 (home) and (718) 960-8568 (office)
Fax (718) 960-8969
E-Mail: [victor.pan @ lehman.cuny.edu](mailto:victor.pan@lehman.cuny.edu)
Website: <http://comet.lehman.cuny.edu/vpan/>

1 PERSONAL DATA AND EDUCATION

1.1 PERSONAL DATA

- Born in Moscow, USSR
- Immigrated to the U.S. in 1977
- U.S. Citizen since 1982
- Married
- Hobbies: Reading and writing poetry, Mountaineering, Swimming, Skiing and Cross-Country Skiing
- Languages: English, Russian, French

1.2 HIGH SCHOOL EDUCATION

- 1946–1956: 59th High School in Moscow, USSR
- Moscow School Olympiads in Math
(Prizes in 1954, 1955 and 1956)

1.3 HIGHER EDUCATION:

1956–1964: Department of Mechanics and Mathematics
Moscow State University (MGU)

- 1961: M.S. in Mathematics
- 1964: Ph.D. in Mathematics (Thesis Advisor: A. G. Vitushkin)

2 EMPLOYMENT AND CONSULTING:

2.1 EMPLOYMENT

- 1988 – Visiting Professor, Professor, and (since 2000) Distinguished Professor at the Department of Mathematics and Computer Science of Lehman College of the City University of New York (CUNY) and in the Ph.D. Programs in Computer Science and in Mathematics of the Graduate Center of CUNY
- 1979–80 and 1981–1991 – Professor at the Computer Science Department of the State University of New York at Albany (SUNYA)
- April–June 1981 – Visiting Professor
Computer Science Department, Stanford University, California
- 1980–81 – Visiting Member
the Institute for Advanced Study, Princeton, New Jersey
- 1977–79 and August 1980 – Visiting Scientist
IBM Research Center, Yorktown Heights, New York
- 1969–76 – Senior Researcher,
Department of Models for National Economy,
Institute of Economics, Academy of Science, Moscow, Russia
- 1965–69 – Senior Researcher,
Department of Computations for Economics,
Institute of Electronic Control Machines, Moscow, Russia
- 1964–65 – Junior Researcher,
Department of Computations for Economics,
Institute of Electronic Control Machines, Moscow, Russia
- August 2002 – Visiting Scientist
Ontario Research Center in Computer Algebra (ORCCA),
Waterloo and London, Western Ontario, Canada
- June 2002 – Visiting Scientist
Mathematics and Informatics Departments, University of Pisa, Italy
- August–September 1998 – Senior Key Scientist
Mathematical Science Research Institute, Berkeley, California
- July 1998 – Visiting Scientist
Fields Research Institute, Toronto, Canada
- March–August 1996 and March–June 1997 – Invited Scientist
Project SAFIR, INRIA–Sophia Antipolis, France

- January 1991 and July–August 1992 — Visiting Scientist
International Computer Science Institute, Berkeley, California
- 1989–90 – Visiting Professor
Computer Science Department, Columbia University, New York
- July 1984 – Visiting Professor
Department of Mathematics, University of Pisa and CNR, Italy

2.2 CONSULTING:

- ATT Bell Laboratories, Murray Hill, New Jersey, 1991–1993
- General Electric Research and Development Center, Schenectady, New York, 1980

3 PROFESSIONAL SOCIETIES; RESEARCH AREAS

3.1 MEMBERSHIP IN PROFESSIONAL SOCIETIES:

- American Mathematical Society
Designation of AMS Fellowship “For Contributions to the Mathematical Theory of Computation”, 2013
- Association for Computing Machinery
- Society for Industrial and Applied Mathematics
- European Association for Theoretical Computer Science
- International Linear Algebra Society

3.2 AREAS OF RESEARCH SPECIALIZATION

- Design and Analysis of Algorithms
- Polynomial Computations, General Matrix Computations
- Structured Matrix Computations
- Randomized Matrix Computations
- Numerical Algorithms
- Symbolic Algorithms
- Symbolic–Numerical Algorithms
- Graph Algorithms

4 GRANTS AND AWARDS:

- *Best Paper Award 2000, Journal of Complexity*: \$3,000 (shared)
- *NSF Grants (individual): \$1,931,143 (1980–2016)*, including
- *Special Creativity Extension Award from the Numeric, Symbolic, and Geometric Computation Program of the CCR Division in the Directorate CISE of NSF (1993)*
- *NSF Grants (joint): \$1,056,241 (2016–2020)*
- *26 PSC-CUNY Awards (individual): \$135,077, 1989–2018*
- CUNY Institute for Software Design and Development Grants: \$8,000, 2001–2002
- Shuster Foundation Award: \$4,000, 1994–2000
- Lehman College CUNY, Faculty Award for Research and Scholarship: \$1,000, 1994
- Institute for Advanced Study, Grant: \$13,000, 1980–81
- SUNY University Award: \$2,000, 1980

4.1 MOST RECENT AND PENDING:

- NSF Grant (individual) CCF-1116736,
“Novel Methods for Fundamental Matrix and Polynomial Computations”, \$350,000
(from 8/1/2011 to 12/31/2016)
- NSF Grant (joint, A. Ovchinnikov (PI), V. Pan (co-PI) and C. Yap (co-PI)) CCF - 1563942 AF: Medium: Collaborative Research: Numerical ”Algebraic Differential Equations”, \$608,205 (from 7/1/2016 to 6/30/2020)
- NSF Grant (joint, Bo Yuan (PI), V. Pan (co-PI) and Xue Lin (co-PI)), Collaborative Research: A Framework of Simultaneous Acceleration and Storage Reduction on Deep Neural Networks Using Structured Matrices, AitF, CCF-133834, \$448,086.00 (from 9/15//2017 to 8/31/2020)
- NSF Grant (Victor Pan (PI), Liang Zhao (co-PI)), CCF 1816692, AF: Small: Superfast and Accurate CUR Low Rank Approximation, pending since 11/16/2017, \$499,973.00 (from June 2018 to May 2021)
- PSC CUNY AWARD: 69813 00 48, \$11,998.92 (2017–2018)

4.2 PSC CUNY AWARDS (LISTING SINCE 2003):

- PSC CUNY AWARD 65393–0034, \$3,297
”Algebraic and Numerical Algorithms”, 6/30/2003 – 7/1/2004
- PSC CUNY AWARD 6643–7–0035, \$3,495
”Algebraic and Numerical Computing”, 6/30/2004 – 7/1/2005

- PSC CUNY AWARD 67297–0036, \$2,805
"Matrix and Polynomial Computations", 6/30/2005 – 7/1/2006
- PSC CUNY AWARD 68291–0037, \$3,176
"Matrix and Polynomial Computations", 6/30/2006 – 7/1/2007
- PSC CUNY AWARD 69330–00–38, \$3,990
"Algebraic and Numerical Algorithms
for Matrix and Polynomial Computations" 6/30/2007 – 7/1/2008
- PSC CUNY AWARD 61406–00–39, \$3,800
"Algebraic and Numerical Algorithms
for Matrix and Polynomial Computations," 6/30/2008 – 7/1/2009
- PSC CUNY AWARD 62230–00–40, \$4,300
"Algebraic and Numerical Algorithms
for Matrix and Polynomial Computations," 6/30/2009 – 7/1/2010
- PSC CUNY AWARD 63153–00–41, \$2,860
"Algebraic and Numerical Algorithms for Matrix and Polynomial Computations,"
6/30/2010 – 7/1/2011
- PSC CUNY AWARD 64512–0042, \$6,000
"Matrix and Polynomial Computations," 6/30/2011 – 7/1/2012
- PSC CUNY AWARD 65792–0043, \$11,998.92
"Matrix and Polynomial Algorithms," 6/30/2012 – 7/1/2013
- PSC-CUNY Award 67699–00 45,
"Advancing Matrix and Polynomial Computations", \$6,000
6/30/2014 – 7/1/2015
- PSC-CUNY Award 68862–00 46,
"Advancing Matrix and Polynomial Computations", \$11,998,
7/1/2015–12/31/2016

5 SERVICE TO PROFESSION

5.1 JOURNAL EDITING

Area Editor:

- Theoretical Computer Science (since 1985 to present)
- Computers and Mathematics (with Applications), (1980–2011)
- Calcolo (since 1999 to present)

Special Issues (Corresponding and Managing Editor):

- I. Z. Emiris, B. Mourrain, V. Y. Pan, Guest Editors. Special Issue on Algebraic and Numerical Algorithms, *Theoretical Computer Science*, 315, 2–3, 307–672, 2004
- Special Issue on Symbolic–Numerical Algorithms (D. A. Bini, V. Y. Pan, and J. Verschelde editors), *Theoretical Computer Science*, 409, 2, 155–331, 2008
- Special Issue on Algebraic and Numerical Algorithms (I. S. Kotsireas, B. Mourrain, and V. Y. Pan, editors), *Theoretical Computer Science*, 412, 16, 1443–1543, 2011
- Special Issue on Algebraic and Numerical Algorithms (I. S. Kotsireas, B. Mourrain, V. Y. Pan, and Lihong Zhi, editors), *Theoretical Computer Science*, 479, 1–186, 2013

5.2 PROGRAM AND SCIENTIFIC COMMITTEES MEMBER

- ACM Annual International Symposium on Symbolic and Algebraic Computation (ISSAC 1999), Vancouver, British Columbia, Canada, July–August 1999
- ACM Annual International Symposium on Symbolic and Algebraic Computation (ISSAC 2007), Waterloo, Ontario, Canada, July–August 2007
- The 2nd International Workshop on Symbolic-Numeric Computation (SNC 2007), London, Ontario, Canada, July 2007
- The Annual International Conference on Polynomial Computer Algebra, St. Petersburg, Russia, Aprils of 2008–2017 (Ten Committees)
- The 4th International Workshop on Symbolic-Numeric Computation (SNC 2011), San Jose, California, June 2011
- International Symposium on Linear Algebra (ILAS 2013), Providence, RI, June 2013
- The 5th International Workshop on Symbolic-Numeric Computation (SNC 2014), Shanghai, China, July 2014

5.3 LOCAL CHAIR

ACM Annual International Symposium on Symbolic and Algebraic Computation (ISSAC 2018), New York, NY, the Graduate Center of CUNY, July 2018

5.4 OTHER PROFESSIONAL ACTIVITIES

- Organization of Conferences and Conference Minisymosia
- Refereeing and Reviewing for Professional Journals, Conferences and Surveys
- Lectures and Invited Lectures at Conferences in Computer Science, Mathematics, and Applied Mathematics in North and South Americas, Europe, Asia, and Australia (see the Lists of Publications and Talks at the Conferences)
- Colloquium Lectures at the Universities and Research Centers

6 SERVICE TO LEHMAN COLLEGE AND CUNY

6.1 SERVICE TO LEHMAN COLLEGE:

- Personnel and Budget Committee Member, 2017–2020
- Supervising Syllabi in Computer Science
- Advising students in Mathematics and Computer Science
- Observing Junior Instructors in Mathematics and Computer Science

6.2 SERVICE TO CUNY:

- Teaching at the Graduate School and University Center (1989–2017, except for the sabbatical year of 1996–97)
- Advising of Ph.D. Students: 23 Ph.D. Defenses (see the List of Ph.D. Defenses)
- Serving As the Chair of 23 PhD Defense Committees in Mathematics and Computer Science (since 1991)
- Member of Distinguished Professor Selection Committee (2005-2007, 2013 and 2016)
- Member of the Leadership Committee of PhD Program in Computer Science (member, 2012–2013)
- Member of the PhD Defense Committees in Mathematics (13) and Computer Science (13) since 1991

7 Ph.D. STUDENTS OF CUNY SUPERVISED AND MENTORED BY VICTOR PAN

STUDENT NAME, PhD THESIS DEFENSE, GRADUATION DATE, Ph.D. PROGRAM

- Atinkpahoun, A., April 11, 1995; June 1995, Computer Science
- Cebecioglu, H., May 23, 2001; October 2001, Mathematics
- Chen, Z.Q., November 9, 1999; February 2000, Mathematics
- Dias, O., November 26, 1996; January 1997, Mathematics
- Huang, X., July 1997; October 1997, Mathematics
- Landowne, E., November 1995; February 1996, Computer Science
- Lin, Y., March 1991; June 1991, Computer Science
- Murphy, B., March 27, 2007; May 2007, Computer Science
- Providence, S., December 14, 1999; February 2000, Computer Science
- Rami, Y., February 22, 2000; June 2000, Mathematics

- Retamoso Urbano, I.O., December 17, 2014; February 2015, Mathematics
- Rosholt, R.E., April 4, 2003; May 2003, Computer Science
- Sadikou, A., January 12, 1996; October 1996, Computer Science
- Serme, A., February 2008; May 2008, Mathematics
- Sobze, I., April 12, 1994; June 1994, Computer Science
- Stuart, C., April 1998; June 1998, Computer Science
- Tabanjeh, M.A., November 9, 1999; February 2000, Mathematics
- Taj-Eddin, I., March 27, 2007; September 2007, Computer Science
- Wang, X., April 4, 2003; May 2003, Mathematics
- Wolf, J., January 7, 2015; May 2015, Mathematics
- Yan, X., January 29, 2015; February 2015, Computer Science
- Yu, Y., April 1998; June 1998, Computer Science
- Zhao, L., April 6, 2017 June 2017 Mathematics
- Zheng, A., October 16, 1997; January 1998, Mathematics

A. Atinkpahoun, O. Dias, S. Providence, A. Sadikou, A. Serme, and I. Sobze are African-Americans. H. Celecioglu, O. Dias and Y. Lin are females. At all the listed defenses, Victor Pan has served as the Mentor, the Advisor and the Chair of the Examination Committees.

Currently he advises five PhD students of CUNY: John Svadlenka, Qi Luan, Harpriya Chakraborty, James Diotte, and Vitaly Zaderman.

8 SELECTED PUBLICATIONS

8.1 BOOKS

1. “How to Multiply Matrices Faster”, Lecture Notes in Computer Science, vol. 179 (XI + 212 pages), Springer, Berlin (1984).
2. “Polynomial and Matrix Computations”, Volume 1: “Fundamental Algorithms” (XVI + 415 pages) (by D. Bini and V. Y. Pan), in the series Progress in Theoretical Computer Science (R.V. Book editor), Birkhäuser, Boston (1994).
3. “Structured Matrices and Polynomials: Unified Superfast Algorithms” (XXV + 278 pages), Birkhäuser/Springer, Boston/New York (June 2001).
4. “Numerical Methods for Roots of Polynomials” (by J. M. McNamee and V. Y. Pan), Part 2 (XXII + 718 pages), Elsevier (2013).

8.2 CHAPTERS IN BOOKS AND SURVEY ARTICLES (12 ITEMS SELECTED OUT OF 24). *Items 1, 2, 3-5, 8, and 9 included new research results.*

1. "On Methods of Computing the Values of Polynomials", *Uspekhi Matematicheskikh Nauk*, 21, 1 (127), 103–134 (1966). (Transl. *Russian Mathematical Surveys*, 21, 1 (127), 105–137 (1966).)
2. "How Can We Speed Up Matrix Multiplication?", *SIAM Review*, 26, 3, 393–415 (1984).
3. "Complexity of Computations with Matrices and Polynomials," *SIAM Review*, 34, 2, 225–262 (1992).
4. "Parallel Solution of Sparse Linear and Path Systems", in *Synthesis of Parallel Algorithms* (J. H. Reif, editor), Chapter 14, pp. 621–678. Morgan Kaufmann publishers, San Mateo, CA (1993).
5. "Solving a Polynomial Equation: Some History and Recent Progress", *SIAM Review*, 39, 2, 187–220 (1997).
6. "Solving Polynomials with Computers", *American Scientist*, 86, 62–69 (January-February 1998).
7. "Some Recent Algebraic/Numerical Algorithms", *Electronic Proceedings of IMACS/ACA'98* (1998): <http://www-troja.fjfi.cvut.cz/aca98/sessions/approximate>
8. "Newton's Iteration for Structured Matrices and Linear Systems of Equations" (by V. Y. Pan, S. Branham, R. Rosholt, and A. Zheng), *SIAM volume on Fast Reliable Algorithms for Matrices with Structure* (T. Kailath and A. H. Sayed, editors), chapter 7, pages 189–210, SIAM Publications, Philadelphia (1999).
9. "Root-finding with Eigen-solving" (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, X. Wang, and X. Yan), pages 185–210 in *Symbolic-Numeric Computation* (Dongming Wang and Lihong Zhi, editors), Birkhäuser, Basel/Boston (2007).
10. "Fast Fourier Transform and Its Applications" (by I. Z. Emiris and V. Y. Pan, in *Algorithms and Theory of Computations Handbook*", Second Edition, Volume 1 (1016 pages): General Concepts and Techniques, pages 1–31 in Chapter 18 (Mikhail J. Atallah and Marina Blanton, editors), CRC Press Inc., Boca Raton, Florida (2009).
11. "Algebraic Algorithms" (by I. Z. Emiris, V. Y. Pan, and E. Tsigaridas), Chapter 10 (pages from 10-1 to 10-40) of *Computing Handbook* (Third edition), Volume I: Computer Science and Software Engineering (Allen B. Tucker, Teo Gonzales, and Jorge L. Diaz-Herrera, editors), Taylor and Francis Group (2014).
12. "Fast Matrix Multiplication and Its Algebraic Neighborhood", *SB MATH* (Mathematical Sbornik), 208, 11 (2017) DOI:10.1070/SM8833 (available in Russian and in English).

8.3 RESEARCH PAPERS (in journals and refereed proceedings of conferences). 30 SELECTED FROM 268

1. "Strassen's Algorithm Is Not Optimal. Trilinear Technique of Aggregating, Uniting and Canceling for Constructing Fast Algorithms for Matrix Multiplication", *Proceedings of the 19th Annual IEEE Symposium on Foundations of Computer Science (FOCS'78)*, 166–176, IEEE Computer Society Press, Long Beach, California (1978). Journal version: "New Fast Algorithms for Matrix Operations", *SIAM J. on Computing*, 9, 2, 321–342 (1980).
2. "Methods of Aggregations" (by W. L. Miranker and V. Y. Pan), *Linear Algebra and Its Applications*, 29, 231–257 (1980).

3. "New Combinations of Methods for the Acceleration of Matrix Multiplications", *Computers and Mathematics (with Applications)*, 7, 73–125 (1981).
4. "Trilinear Aggregating with Implicit Canceling for a New Acceleration of Matrix Multiplication", *Computers and Mathematics (with Applications)*, 8, 1, 23–34 (1982).
5. "Complexity of Parallel Matrix Computations", *Theoretical Computer Science*, 54, 65–85 (1987).
6. "On Computations with Dense Structured Matrices", *Mathematics of Computation*, 55, 191, 179–190 (1990). Proceedings version in ISSAC 1989.
7. "An Improved Newton Iteration for the Generalized Inverse of a Matrix, with Applications" (by V. Y. Pan and R. Schreiber), *SIAM J. on Scientific and Statistical Computing*, 12, 5, 1109–1131 (1991).
8. "On Practical Algorithms for Accelerated Matrix Multiplication" (by J. Laderman, V. Y. Pan and H-X. Sha), *Linear Algebra and Its Applications*, 162–164, 557–588 (1992).
9. "Fast and Efficient Parallel Solution of Sparse Linear Systems" (by V. Y. Pan and J. Reif), *SIAM J. on Computing*, 22, 6, 1227–1250 (1993). Proceedings version in STOC 1985.
10. "Optimal and Nearly Optimal Algorithms for Approximating Polynomial Zeros", *Computers and Mathematics (with Applications)*, 31, 12, 97–138 (1996). Proceedings version: "Optimal (up to Polylog Factors) Sequential and Parallel Algorithms for Approximating Complex Polynomial Zeros", *Proc. 27th Annual ACM Symposium on Theory of Computing (STOC'95)*, 741–750, ACM Press, New York (1995).
11. "Planar Integer Linear Programming Is NC-equivalent to Euclidean GCD" (by D. F. Shallcross, V. Y. Pan and Y. Lin-Kriz), *SIAM Journal on Computing*, 27, 4, 960–971 (1998). Proceedings version in IEEE FOCS 1993.
12. "Fast Rectangular Matrix Multiplication and Applications" (by X. Huang and V. Y. Pan), *J. of Complexity*, 14, 257–299 (1998). Proceedings version in PASCO 1997.
13. "Approximating Complex Polynomial Zeros: Modified Quadtree (Weyl's) Construction and Improved Newton's Iteration", *J. of Complexity*, 16, 1, 213–264 (2000).
14. "Multivariate Polynomials, Duality and Structured Matrices" (by B. Mourrain and V. Y. Pan), *J. of Complexity*, 16, 1, 110–180 (2000).
15. "Univariate Polynomials: Nearly Optimal Algorithms for Numerical Factorization and Root-Finding", *J. of Symbolic Computation*, 33, 5, 701–733 (2002). Proceedings version in ISSAC 2001.
16. "Inversion of Displacement Operators" (by V. Y. Pan and X. Wang), *SIAM J. on Matrix Analysis and Applications*, 24, 3, 660–677 (2003).
17. "Inverse Power and Durand-Kerner Iteration for Univariate Polynomial Root-Finding" (by D. A. Bini, L. Gemignani and V. Y. Pan), *Computers and Mathematics (with Applications)*, 47, 2/3, 447–459 (2004).
18. "Fast and Stable QR Eigenvalue Algorithms for Generalized Semiseparable Matrices and Secular Equation" (by D. A. Bini, L. Gemignani and V. Y. Pan), *Numerische Mathematik*, 3, 373–408 (2005).
19. "Improved Algorithms for Computing Determinants and Resultants" (by I. Z. Emiris and V. Y. Pan), *J. of Complexity*, 21, 1, 43–71 (2005).
20. "Homotopic Residual Correction Algorithms for General and Structures Matrices" (by V. Y. Pan, M. Kunin, R. Rosholt, and H. Kodai), *Mathematics of Computation*, 75, 345–368 (2006).
21. "Degeneration of Integer Matrices Modulo an Integer" (by V. Y. Pan and X. Wang), *Linear Algebra and Its Applications*, 429, 2113–2130 (2008).

22. “Solving Homogeneous Linear Systems with Randomized Preprocessing” (by V. Y. Pan and G. Qian), *Linear Algebra and Its Applications*, 432, 3272–3318 (2010).
23. “New Progress in Real and Complex Polynomial Root-Finding” (by V. Y. Pan and A.-L. Zheng), *Computers and Mathematics (with Applications)*, 61, 1305–1334 (2011).
24. “Solving Linear Systems of Equations with Randomization, Augmentation and Aggregation” (by V. Y. Pan and G. Qian), *Linear Algebra and Its Applications*, 437, 2851–2876 (2012).
25. “Randomized Preconditioning versus Pivoting” (by V. Y. Pan, G. Qian, and A.-L. Zheng), *Linear Algebra and Its Applications*, 438, 4, 1883–1889 (2013).
26. “Transformations of Matrix Structures Work Again”, *Linear Algebra and Its Applications*, 465, 1?–32 (2015).
27. “Random Multipliers Numerically Stabilize Gaussian and Block Gaussian Elimination: Proofs and an Extension to Low-rank Approximation”, *Linear Algebra and Its Applications*, 481, 202–234 (2015).
28. “Nearly Optimal Refinement of Real Roots of a Univariate Polynomial” by Victor Y. Pan and Elias Tsigaridas, *J. of Symbolic Computations*, 74, 181–204 (2016). Proceedings version in ISSAC 2013.
29. “How Bad Are Vandermonde Matrices?”, *SIAM Journal of Matrix Analysis*, 37, 2, 676–694 (2016).
30. “Numerically Safe Gaussian Elimination with No Pivoting” (by Victor Y. Pan and Liang Zhao), *Linear Algebra and Its Applications*, 527, 349–383 (2017).
<http://dx.doi.org/10.1016/j.laa.017.04.007>

8.4 RESEARCH PAPERS (in journals and refereed proceedings of conferences). 70 SELECTED FROM 268

1. “Strassen’s Algorithm Is Not Optimal. Trilinear Technique of Aggregating, Uniting and Canceling for Constructing Fast Algorithms for Matrix Multiplication”, *Proceedings of the 19th Annual IEEE Symposium on Foundations of Computer Science (FOCS’78)*, 166–176, IEEE Computer Society Press, Long Beach, California (1978).
2. “Fields Extension and Trilinear Aggregating, Uniting and Canceling for the Acceleration of Matrix Multiplication”, *Proceedings of the 20th Annual IEEE Symposium on Foundations of Computer Science (FOCS’79)*, 28–38, IEEE Computer Society Press, Long Beach, California (1979).
3. “Methods of Aggregations” (by W. L. Miranker and V. Y. Pan), *Linear Algebra and Its Applications*, 29, 231–257 (1980).
4. “New Fast Algorithms for Matrix Operations”, *SIAM J. on Computing*, 9, 2, 321–342 (1980).
5. “New Combinations of Methods for the Acceleration of Matrix Multiplications”, *Computers and Mathematics (with Applications)*, 7, 73–125 (1981).
6. “Trilinear Aggregating with Implicit Canceling for a New Acceleration of Matrix Multiplication”, *Computers and Mathematics (with Applications)*, 8, 1, 23–34 (1982).
7. “Polynomial Division and Its Computational Complexity” (by D. Bini and V. Y. Pan), *Journal of Complexity*, 2, 179–203 (1986).

8. "Complexity of Parallel Matrix Computations", *Theoretical Computer Science*, 54, 65–85 (1987).
9. "Improved Processor Bounds for Combinatorial Problems in RNC" (by Z. Galil and V. Y. Pan), *Combinatorica*, 8, 2, 189–200 (1988).
10. "Fast and Efficient Solution of Path Algebra Problems" (by V. Y. Pan and J. Reif), *Journal of Computer and Systems Sciences*, 38, 3, 494–510 (1989).
11. "On Computations with Dense Structured Matrices", *Mathematics of Computation*, 55, 191, 179–190 (1990). Proceedings version in ISSAC 1989.
12. "Processor Efficient Parallel Solution of Linear Systems over an Abstract Field" (by E. Kaltofen and V. Y. Pan), *Proc. 3rd Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'91)*, 180–191, ACM Press, New York (1991).
13. "An Improved Newton Iteration for the Generalized Inverse of a Matrix, with Applications" (by V. Y. Pan and R. Schreiber), *SIAM J. on Scientific and Statistical Computing*, 12, 5, 1109–1131 (1991).
14. "Parametrization of Newton's Iteration for Computations with Structured Matrices and Applications", *Computers and Mathematics (with Applications)*, 24, 3, 61–75 (1992).
15. "Compact Multigrid" (by V. Y. Pan and J. Reif), *SIAM J. on Scientific and Statistical Computing*, 13, 1, 119–127 (1992).
16. "Parallel Solution of Toeplitz-like Linear Systems", *J. of Complexity*, 8, 1–21 (1992).
17. "A Fast, Preconditioned Conjugate Gradient Toeplitz Solver" (by V. Y. Pan and R. Schreiber), *Computers and Mathematics (with Applications)*, 24, 7, 17–24 (1992).
18. "On Practical Algorithms for Accelerated Matrix Multiplication" (by J. Laderman, V. Y. Pan and H.-X. Sha), *Linear Algebra and Its Applications*, 162–164, 557–588 (1992).
19. "Practical Improvement of the Divide-and-Conquer Eigenvalue Algorithms" (by D. Bini and V. Y. Pan), *Computing*, 48, 109–123 (1992). Proceedings version in SODA 1991.
20. "Processor-Efficient Parallel Solution of Linear Systems II. The Positive Characteristic and Singular Cases" (by E. Kaltofen and V. Y. Pan), *Proc. of 33rd Annual IEEE Symposium on Foundations of Computer Science (FOCS'92)*, 714–723, IEEE Computer Society Press, Los Alamitos, California (1992).
21. "Concurrent Iterative Algorithm for Toeplitz-like Linear Systems", *IEEE Trans. on Parallel and Distributed Systems*, 4, 5, 592–600 (1993).
22. "Fast and Efficient Parallel Solution of Sparse Linear Systems" (by V. Y. Pan and J. Reif), *SIAM J. on Computing*, 22, 6, 1227–1250 (1993). Proceedings version in STOC 1985.
23. "Decreasing the Displacement Rank of a Matrix", *SIAM J. on Matrix Analysis*, 14, 1, 118–121 (1993).

24. "A New Algorithm for the Symmetric Tridiagonal Eigenvalue Problem" (by V. Y. Pan and J. Demmel), *Journal of Complexity*, 9, 387–405 (1993).
25. "Improved Parallel Polynomial Division" (by D. Bini and V. Y. Pan), *SIAM J. on Computing*, 22, 3, 617–627 (1993). Proceedings version in FOCS 1992.
26. "Fast and Efficient Parallel Solution of Sparse Linear Systems" (by V. Y. Pan and J. Reif), *SIAM J. on Computing*, 22, 6, 1227–1250 (1993). Proceedings version in STOC 1985.
27. "New Resultant Inequalities and Complex Polynomial Factorization", *SIAM Journal on Computing* 23, 5, 934–950 (1994).
28. "An Algebraic Approach to Approximate Evaluation of a Polynomial on a Set of Real Points", *Advances in Computational Mathematics*, 3, 41–58 (1995).
29. "Work-Preserving Speed-up of Parallel Matrix Computations" (by V. Y. Pan and F. P. Preparata), *SIAM J. on Computing*, 24, 4, 811–821 (1995). Proceedings version in SPAA 1992.
30. "Optimal (up to Polylog Factors) Sequential and Parallel Algorithms for Approximating Complex Polynomial Zeros", *Proc. 27th Annual ACM Symposium on Theory of Computing (STOC'95)*, 741–750, ACM Press, New York (1995).
31. "Optimal and Nearly Optimal Algorithms for Approximating Polynomial Zeros", *Computers and Mathematics (with Applications)*, 31, 12, 97–138 (1996).
32. "Parallel Computation of Polynomial GCD and Some Related Parallel Computations over Abstract Fields", *Theoretical Computer Science*, 162, 2, 173–223 (1996).
33. "Efficient Parallel Algorithms for Computing All Pair Shortest Paths in Directed Graphs" (by Y. Han, V. Y. Pan and J. Reif), *Algorithmica*, 17, 399–415 (1997).
34. "Planar Integer Linear Programming Is NC-equivalent to Euclidean GCD" (by D. F. Shallcross, V. Y. Pan and Y. Lin-Kriz), *SIAM Journal on Computing*, 27, 4, 960–971 (1998). Proceedings version in FOCS 1993.
35. "Computing Matrix Eigenvalues and Polynomial Zeros Where the Output Is Real" (by D. Bini and V. Y. Pan), *SIAM J. on Computing*, 27, 4, 1099–1115 (1998). Proceedings version in SODA 1991.
36. "Fast Rectangular Matrix Multiplication and Applications" (by X. Huang and V. Y. Pan), *J. of Complexity*, 14, 257–299 (1998). Proceedings version in PASC0 1997.
37. "A Unified Superfast Algorithm for Boundary Rational Tangential Interpolation Problem and for Inversion and Factorization of Dense Structured Matrices" (by V. Olshevsky and V. Y. Pan), *Proc. 39th Annual IEEE Symposium on Foundation of Computer Science (FOCS'98)*, 192–201, IEEE Computer Society Press, Los Alamitos, California (1998).
38. "Sign Determination in Residue Number Systems" (by H. Brönnimann, I. Z. Emiris, V. Y. Pan and S. Pion), *Theoretical Computer Science*, 210, 1, 173–197 (1999).

39. “Newton’s Iteration for Structured Matrices and Linear Systems of Equations” (by V. Y. Pan, S. Branham, R. Rosholt, and A. Zheng), SIAM volume on Fast Reliable Algorithms for Matrices with Structure (T. Kailath and A. H. Sayed, editors), ch. 7, pp. 189–210, SIAM Publications, Philadelphia (1999).
40. “Approximating Complex Polynomial Zeros: Modified Quadtree (Weyl’s) Construction and Improved Newton’s Iteration”, *J. of Complexity*, 16, 1, 213–264 (2000).
41. “Multivariate Polynomials, Duality and Structured Matrices” (by B. Mourrain and V. Y. Pan), *J. of Complexity*, 16, 1, 110–180 (2000).
42. “New Techniques for the Computation of Linear Recurrence Coefficients”, *Finite Fields and Their Applications*, 6, 93–118 (2000).
43. “Computation of a Specified Root of a Polynomial System of Equations Using Eigenvectors” (by D. Bondyfalat, B. Mourrain, and V. Y. Pan), *Linear Algebra and Its Applications*, 319, 193–209 (2000).
44. “Certification of Numerical Computation of the Sign of the Determinant of a Matrix” (by V. Y. Pan and Y. Yu), *Algorithmica*, 30, 708–724 (2001).
45. “Numerical Computation of a Polynomial GCD and Extensions”, *Information and Computation*, 167, 2, 71–85 (2001).
46. “Structured Matrices and Newton’s Iteration: Unified Approach” (by V. Y. Pan, Y. Rami and X. Wang), *Linear Algebra and Its Applications*, 343/344, 233–265 (2002).
47. “Symbolic and Numerical Methods for Exploiting Structure in Constructing Resultant Matrices” (by I. Z. Emiris and V. Y. Pan), *Journal of Symbolic Computation*, 33, 393–413 (2002).
48. “Univariate Polynomials: Nearly Optimal Algorithms for Numerical Factorization and Root-Finding”, *J. of Symbolic Computation*, 33, 5, 701–733 (2002).
49. “Accelerated Solution of Multivariate Polynomial Systems of Equations” (by B. Mourrain, V. Y. Pan and O. Ruatta), *SIAM J. on Computing*, 32, 2, 435–454 (2003).
50. “Inversion of Displacement Operators” (by V. Y. Pan and X. Wang), *SIAM J. on Matrix Analysis and Applications*, 24, 3, 660–677 (2003).
51. “Inverse Power and Durand-Kerner Iteration for Univariate Polynomial Root-Finding” (by D. A. Bini, L. Gemignani and V. Y. Pan), *Computers and Mathematics (with Applications)*, 47, 2/3, 447–459 (2004).
52. “Fast and Stable QR Eigenvalue Algorithms for Generalized Semiseparable Matrices and Secular Equation” (by D. A. Bini, L. Gemignani and V. Y. Pan), *Numerische Mathematik*, 3, 373–408 (2005).
53. “Homotopic Residual Correction Algorithms for General and Structures Matrices” (by V. Y. Pan, M. Kunin, R. Rosholt, and H. Kodai), *Mathematics of Computation*, 75, 345–368 (2006).
54. “Degeneration of Integer Matrices Modulo an Integer” (by V. Y. Pan and X. Wang), *Linear Algebra and Its Applications*, 429, 2113–2130 (2008).

55. “Solving Homogeneous Linear Systems with Randomized Preprocessing” (by V. Y. Pan and G. Qian), *Linear Algebra and Its Applications*, 432, 3272–3318 (2010).
56. “Additive Preconditioning for Matrix Computations” (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, and X. Yan), *Linear Algebra and Its Applications*, 432, 1070–1089 (2010).
57. “Newton’s Iteration for Matrix Inversion, Advances and Extensions”, pp. 364–381, in *MATRIX METHODS: THEORY, ALGORITHMS AND APPLICATIONS* (dedicated to the Memory of Gene Golub, edited by Vadim Olshevsky and Eugene Tyrtyshnikov), World Scientific Publishing, New Jersey, ISBN-13 978-981-283-601-4, ISBN-10-981-283-601-2 (2010).
58. “Randomized Preconditioning of the MBA Algorithm” (by V. Y. Pan, G. Qian, and A.-L. Zheng), in *Proc. International Symposium on Symbolic and Algebraic Computation (ISSAC’2011)*, San Jose, California, June 2011 (edited by Anton Leykin), 281–288, ACM Press, New York (2011).
59. “New Progress in Real and Complex Polynomial Root-Finding” (by V. Y. Pan and A.-L. Zheng), *Computers and Mathematics (with Applications)*, 61, 1305–1334 (2011).
60. “Solving Linear Systems of Equations with Randomization, Augmentation and Aggregation” (by V. Y. Pan and G. Qian), *Linear Algebra and Its Applications*, 437, 2851–2876 (2012).
61. “Randomized Preconditioning versus Pivoting” (by V. Y. Pan, G. Qian, and A.-L. Zheng), *Linear Algebra and Its Applications*, 438, 4, 1883–1889 (2013).
62. “Estimating the Norms of Circulant and Toeplitz Random Matrices and Their Inverses” (by V. Y. Pan, J. Svadlenka, and L. Zhao), *Linear Algebra and Its Applications*, 468, 197–210 (2015).
63. “Transformations of Matrix Structures Work Again”, *Linear Algebra and Its Applications*, 465, 1–32 (2015).
64. “Random Multipliers Numerically Stabilize Gaussian and Block Gaussian Elimination: Proofs and an Extension to Low-rank Approximation”, *Linear Algebra and Its Applications*, 481, 202–234 (2015).
65. “Low-rank Approximation of a Matrix: Novel Insights, New Progress, and Extensions” by Victor Y. Pan and Liang Zhao, *Proc. of the Eleventh International Computer Science Symposium in Russia (CSR’2016)*, (Alexander Kulikov and Gerhard Woeginger, editors), St. Petersburg, Russia, June 2016, *Lecture Notes in Computer Science (LNCS)*, Volume 9691, 352–366, Springer International Publishing, Switzerland (2016).
66. “Nearly Optimal Refinement of Real Roots of a Univariate Polynomial” by Victor Y. Pan and Elias Tsigaridas, *J. of Symbolic Computations*, 74, 181–204 (2016).
67. “How Bad Are Vandermonde Matrices?”, *SIAM Journal of Matrix Analysis*, 37, 2, 676–694 (2016).

68. “Real Polynomial Root-finding by Means of Matrix and Polynomial Iterations” by V. Y. Pan and L. Zhao, *Theoretical Computer Science, Special Issue on Symbolic–Numerical Algorithms* (Stephen Watt, Jan Verschelde, and Lihong Zhi, editors), 681, 101–116 (2017), <http://dx.doi.org/10.1016/j.tcs.2017.03.032>
69. ”Numerically Safe Gaussian Elimination with No Pivoting” (by Victor Y. Pan and Liang Zhao), *Linear Algebra and Its Applications*, 527, 349–383 (2017).
<http://dx.doi.org/10.1016/j.laa.2017.04.007>
70. “Fast Approximate Computations with Cauchy Matrices and Polynomials”, *Mathematics of Computation*, in print. arXiv:1506.02285 [math.NA] (31 pages, 7 figures, 9 tables), Proceedings version in CSR’2014.

8.5 GOOGLE SCHOLAR LIST: 80 PUBLICATIONS MOST CITED ON 12/12/2017

1. Polynomial and matrix computations. *Fundamental Algorithms*, vol. 1, D Bini, V.Y. Pan, Birkhäuser, Boston, Springer Science and Business Media, citations, 1994. 626 citations.
2. Algorithms and theory of computation handbook, volume 2: special topics and techniques, MJ Atallah, M Blanton, Chapman and Hall/CRC, 2009. 442 citations.
3. Structured matrices and polynomials: unified superfast algorithms, V.Y. Pan, Birkhäuser, Boston/ Springer, NY, Springer Science and Business Media, 2001. 355 citations.
4. Solving a polynomial equation: some history and recent progress, V.Y. Pan, *SIAM review* 39 (2), 187-220, 1997. 347 citations.
5. Fast rectangular matrix multiplication and applications, X. Huang, V.Y. Pan, *Journal of complexity* 14 (2), 257-299, 1998. 194 citations.
6. Univariate polynomials: nearly optimal algorithms for factorization and rootfinding, V.Y. Pan, *Proceedings of the 2001 international symposium on Symbolic and algebraic computations*, 2001. 186 citations.
7. How to multiply matrices faster, V.Y. Pan, Springer-Verlag, New York, Inc., 1984. 176 citations.
8. Efficient parallel solution of linear systems, V.Y. Pan, J. Reif, *Proceedings of the seventeenth annual ACM symposium on Theory of computing*, 1985. 175 citations.
9. An improved Newton iteration for the generalized inverse of a matrix, with applications, V.Y. Pan, R. Schreiber, *SIAM Journal on Scientific and Statistical Computing* 12 (5), 1109-1130, 1991. 164 citations.
10. Numerical methods for roots of polynomials J.M. McNamee, V.Y. Pan, Elsevier, Newnes, 2013. 163 citations.
11. On computations with dense structured matrices, V.Y. Pan, *Mathematics of Computation* 55 (191), 179-190, 1990. 157 citations.

12. How can we speed up matrix multiplication? V.Y. Pan, SIAM review 26 (3), 393-415, 1984. 150 citations.
13. Multivariate polynomials, duality, and structured matrices, B. Mourrain, V.Y. Pan, Journal of Complexity 16 (1), 110-180, 2000. 148 citations.
14. Optimal and nearly optimal algorithms for approximating polynomial zeros, V.Y. Pan, Computers and Mathematics with Applications 31 (12), 97-138, 1996. 144 citations.
15. Fast and efficient parallel solution of sparse linear systems V Pan, J Reif SIAM Journal on Computing 22 (6), 1227-1250, 1989. 130 citations.*
16. Methods of computing values of polynomials, V.Y. Pan, Russian Mathematical Surveys 21 (1), 105-136, 1966. 129 citations.
17. The complexity of the matrix eigenproblem, V.Y. Pan, Z.Q. Chen, Proceedings of the thirty-first annual ACM symposium on Theory of computing, 1999. 126 citations.
18. Strassen's algorithm is not optimal; trilinear technique of aggregating, uniting and canceling for constructing fast algorithms for matrix operations, V.Y. Pan, 19th Annual Symposium on Foundations of Computer Science, 166-176, 1978. 122 citations.
19. Complexity of parallel matrix computations, V.Y. Pan, Theoretical Computer Science 54 (1), 65-85, 1987. 121 citations.
20. Fast and stable QR eigenvalue algorithms for generalized companion matrices and secular equations, D.A. Bini, L Gemignani, V.Y. Pan, Numerische Mathematik (3), 373-408. 2005. 111 citations.
21. Computer science handbook, A.B. Tucker, CRC press, 2004. 107 citations.
22. Processor efficient parallel solution of linear systems over an abstract field, E. Kaltofen, V.Y. Pan, Proceedings of the third annual ACM symposium on Parallel algorithms, 1991. 104 citations.
23. Efficient parallel algorithms for computing all pair shortest paths in directed graphs, Y. Han, V. Pan, J. Reif, Proceedings of the fourth annual ACM symposium on Parallel algorithms and Architecture, 1992. 101 citations.*
24. Complexity of computations with matrices and polynomials, V.Y. Pan, SIAM Review 34 (2), 225-262, 1992. 101 citations.
25. Computation of approximate polynomial GCDs and an extension, V.Y. Pan, Information and computation, 167 (2), 71-85, 2001. 87 citations.
26. Computing exact geometric predicates using modular arithmetic with single precision, H. Brönnimann, I.Z. Emiris, V.Y. Pan, S. Pion, Proceedings of the thirteenth annual symposium on Computational geometry ..., 1997. 81 citations.
27. Optimal (up to polylog factors) sequential and parallel algorithms for approximating complex polynomial zeros, V.Y. Pan, Proceedings of the twenty-seventh annual ACM symposium on Theory of Computing, 1995. 80 citations.

28. On practical algorithms for accelerated matrix multiplication, J. Laderman, V.Y. Pan, X.-H. Sha, *Linear Algebra and Its Applications* 162, 557-588, 1992. 78 citations.
29. Methods of aggregation, W.L. Miranker, V.Y. Pan, *Linear Algebra and Its Applications*, 29, 231-257, 1980. 77 citations.
30. Parametrization of Newton's iteration for computations with structured matrices and applications, V.Y. Pan, *Computers and Mathematics with Applications*, 24, (3), 61-75, 1992. 71 citations.
31. Polynomial division and its computational complexity, D. Bini, V.Y. Pan, *Journal of Complexity* 2 (3), 179-203, 1986. 69 citations.
32. Sequential and parallel complexity of approximate evaluation of polynomial zeros, V.Y. Pan, *Computers and Mathematics with Applications* 14 (8), 591-622, 1987. 66 citations.
33. Sign determination in residue number systems, H. Brönnimann, I.Z. Emiris, V.Y. Pan, S. Pion, *Theoretical Computer Science* 210 (1), 173-197, 1999. 65 citations.
34. Symbolic and numeric methods for exploiting structure in constructing resultant matrices I.Z. Emiris, V.Y. Pan, *Journal of Symbolic Computation* 33 (4), 393-413, 2002. 63 citations.
35. New fast algorithms for matrix operations, V.Y. Pan, *SIAM Journal on Computing* 9 (2), 321-342, 1980. 63 citations.
36. Structured matrices and Newton's iteration: unified approach, V.Y. Pan, Y. Rami, X. Wang, *Linear algebra and its applications* 343, 233-265, 2002. 60 citations.
37. Fast and efficient solution of path algebra problems, V.Y. Pan, J. Reif, *Journal of Computer and System Sciences* 38 (3), 494-510, 1989. 60 citations.
38. Processor-efficient parallel solution of linear systems. II. The positive characteristic and singular cases, E. Kaltofen, V.Y. Pan, *Foundations of Computer Science, 1992. Proceedings., 33rd Annual Symposium ...*, 1992. 57 citations.
39. Inverse power and Durand-Kerner iterations for univariate polynomial root-finding, D.A. Bini, L. Gemignani, V.Y. Pan, *Computers and Mathematics with Applications* 47 (2), 447-459, 2004. 56 citations.
40. Acceleration of Euclidean algorithm and rational number reconstruction, X. Wang, V.Y. Pan, *SIAM Journal on Computing* 32 (2), 548-556, 2003. 54 citations.
41. Approximating complex polynomial zeros: modified Weyl's quadtree construction and improved Newton's iteration, V.Y. Pan, *Journal of Complexity* 16 (1), 213-264, 2000. 54 citations.
42. Fast and efficient parallel algorithms for the exact inversion of integer matrices, V.Y. Pan, *International Conference on Foundations of Software Technology and ...* , 1985. 52 citations.
43. Improved algorithms for computing determinants and resultants, I.Z. Emiris, V.Y. Pan, *Journal of Complexity* 21 (1), 43-71, 2005. 51 citations.

44. A unified superfast algorithm for boundary rational tangential interpolation problems and for inversion and factorization of dense structured matrices, V. Olshevsky, V.Y. Pan, Foundations of Computer Science, 1998, Proceedings of 39th Annual Symposium on ..., 1998. 50 citations.
45. Computing the determinant and the characteristic polynomial of a matrix via solving linear systems of equations, V.Y. Pan, Information Processing Letters 28 (2), 71-75, 1988. 49 citations.
46. Additive preconditioning, eigenspaces, and the inverse iteration, V.Y. Pan, X. Yan, Linear Algebra and Its Applications 430 (1), 186-203, 2009. 48 citations.
47. Improved initialization of the accelerated and robust QR-like polynomial root-finding, D.A. Bini, L. Gemignani, V.Y. Pan, Electronic Transactions on Numerical Analysis 17, 195-205, 2004. 48 citations.
48. Asymptotic acceleration of solving multivariate polynomial systems of equations, B. Mourrain, V.Y. Pan, Proceedings of the thirtieth annual ACM symposium on Theory of computing ..., 1998. 48 citations.
49. Parallel matrix multiplication on a linear array with a reconfigurable pipelined bus system, K. Li, V.Y. Pan, IEEE Transactions on Computers 50 (5), 519-525, 2001. 48 citations.
50. Parallel solution of Toeplitzlike linear systems, V.Y. Pan, Journal of Complexity 8 (1), 1-21, 1992. 47 citations.
51. Certification of numerical computation of the sign of the determinant of a matrix, V.Y. Pan, Y. Yu, Algorithmica 30 (4), 708-724, 2001. 47 citations.*
52. The structure of sparse resultant matrices, I.Z. Emiris, V.Y. Pan, Proceedings of the 1997 international symposium on Symbolic and algebraic ..., 1997. 46 citations.
53. Decreasing the displacement rank of a matrix, V.Y. Pan, SIAM Journal on Matrix Analysis and Applications 14 (1), 118-121, 1993. 46 citations.
54. Inversion of displacement operators V.Y. Pan, X. Wang, SIAM Journal on Matrix Analysis and Applications 24 (3), 660-677, 2003. 46 citations.
55. Parallel evaluation of the determinant and of the inverse of a matrix, Z. Galil, V.Y. Pan, Information Processing Letters, 30 (1), 41-45, 1989. 46 citations.
56. Schur aggregation for linear systems and determinants, V.Y. Pan, D. Grady, B. Murphy, G. Qian, R.E. Rosholt, D. Ruslanov, Theoretical Computer Science, 409 (2), 255-268, 2008. 45 citations.
57. New combinations of methods for the acceleration of matrix multiplications, V.Y. Pan, Computers and Mathematics with Applications 7 (1), 73-125. 1981. 45 citations.
58. Field extension and trilinear aggregating, uniting and canceling for the acceleration of matrix multiplications, V.Y. Pan, Foundations of Computer Science, 1979., 20th Annual Symposium on, 28-38, 1979. 45 citations.

59. Randomized preprocessing versus pivoting, V.Y. Pan, G. Qian, A.-L. Zheng, *Linear Algebra and Its Applications*, 438 (4), 1883-1899, 2013. 45 citations.
60. Parallel complexity of tridiagonal symmetric eigenvalue problem, DBV Pant *Discrete Algorithms*, 384, 1991. 45 citations.
61. Solving special polynomial systems by using structured matrices and algebraic residues, B. Mourrain, V.Y. Pan, *Foundations of Computational Mathematics*, 287-304, 1997. 44 citations.
62. Computing matrix eigenvalues and polynomial zeros where the output is real, D. Bini, V.Y. Pan, *SIAM Journal on Computing* 27 (4), 1099-1115, 1998. 43 citations.
63. Randomized preprocessing of homogeneous linear systems of equations, V.Y. Pan, G. Qian, *Linear Algebra and Its Applications* 432 (12), 3272-3318, 2010. 42 citations.
64. Nearly optimal computations with structured matrices, V.Y. Pan, E.P. Tsigaridas, *Theoretical Computer Science*, 681, 117-137, 2017. 42 citations.
65. Concurrent iterative algorithm for Toeplitz-like linear systems, V.Y. Pan, *IEEE Transactions on Parallel and Distributed Systems* 4 (5), 592-600, 1993. 41 citations.
66. On schemes for the evaluation of products and inverses of matrices, V.Y. Pan, *Uspekhi Matematicheskikh Nauk* 27 (5), 167, 1972. 41 citations.
67. A new approach to fast polynomial interpolation and multipoint evaluation, V.Y. Pan, A. Sadikou, E. Landowne, O. Tiga, *Computers and Mathematics with Applications* 25 (9), 25-30, 1993. 40 citations.
68. Matrix computations and polynomial root-finding with preprocessing, V.Y. Pan, G. Qian, A.L. Zheng, and Z. Chen, *Linear Algebra and Its Applications* 434 (4), 854-879, 2011. 39 citations.
69. Acceleration of Euclidean algorithm and extensions, V.Y. Pan, X. Wang, *Proceedings of the 2002 international symposium on Symbolic and algebraic ...*, 2002. 39 citations.
70. New progress in real and complex polynomial root-finding, V.Y. Pan, A.-L. Zheng, *Computers and Mathematics with Applications* 61 (5), 1305-1334, 2011. 38 citations.
71. Newton's iteration for structured matrices, V.Y. Pan, S. Branham, R.E. Rosholt, A.-L. Zheng, *Fast reliable algorithms for matrices with structure*, 189-210, 1999. 37 citations.
72. Superfast algorithms for Cauchy-like matrix computations and extensions, V.Y. Pan, A.-L. Zheng, *Linear algebra and its applications* 310 (1-3), 83-108, 2000. 37 citations.
73. Additive preconditioning for matrix computations V.Y. Pan, D. Ivolgin, B. Murphy, R.E. Rosholt, Y. Tang, X. Yan, *Linear Algebra and Its Applications*, 432 (4), 1070-1089, 2010. 36 citations.
74. Homotopic residual correction processes, V.Y. Pan, M. Kunin, R. Rosholt, H. Kodal, *Mathematics of Computation* 75 (253), 345-368, 2006. 36 citations.

75. Transformations of matrix structures work again, V.Y. Pan, *Linear Algebra and Its Applications* 465, 107-138, 2015. 35 citations.
76. Additive preconditioning and aggregation in matrix computations, V.Y. Pan, D. Ivolgin, B. Murphy, R.E. Rosholt, I. Taj-Eddin, Y. Tang, X. Yan, *Computers and Mathematics with Applications* 55 (8), 1870-1886, 2008. 35 citations.
77. Graeffe's, Chebyshev-like, and Cardinal's Processes for Splitting a Polynomial into Factors, D. Bini, V.Y. Pan, *Journal of Complexity* 12 (4), 492-511, 1996. 35 citations.
78. Controlled iterative methods for solving polynomial systems, D. Bondyfalat, B. Mourrain, V.Y. Pan, *Proceedings of the 1998 international symposium on Symbolic and algebraic ...*, 1998. 33 citations.
79. Improved parallel computations with Toeplitz-like and Hankel-like matrices, D. Bini, V.Y. Pan, *Linear algebra and its applications* 188, 3-29, 1993. 33 citations.
80. Parallel computation of polynomial GCD and some related parallel computations over abstract fields, V.Y. Pan, *Theoretical Computer Science* 162 (2), 173-223, 1996. 33 citations.

9 PUBLICATIONS (COMPLETE LIST)

PUBLICATIONS LISTED IN gOOGL E SCHOLAR AND DBLP INCLUDE

- 4 research monographs
- over 20 book chapters and survey articles
- over 170 refereed publications in journals
- over 80 refereed publications in conference proceedings

9.1 CLASSIFICATION BY RESEARCH SUBJECTS

ENUMERATION BELOW IS ACCORDING TO THE ORDER OF (i) THE BOOKS, (ii) SURVEYS AND BOOKS CHAPTERS AND (iii) RESEARCH PAPERS IN THE COMPLETE PUBLICATION LIST.

1. REAL AND COMPLEX FUNCTIONS: papers 1, 3.
2. ECONOMICS: papers 11-13, 15-18
3. LOWER BOUNDS IN ALGEBRAIC COMPUTATIONS: papers 5, 7, 10, 29, 49.
4. FUNDAMENTAL POLYNOMIAL OPERATIONS.
 - a) EVALUATION: survey paper 1 (containing also research results), research papers 2, 4, 6-10, 19, 62, 70, 101, 105, 121, 140, 148, 166, 247-249, 253, 263, 267.
 - b) INTERPOLATION: papers 62, 70, 105, 120, 140, 148, 159, 166, 247-249, 253, 263, 267.
 - c) MULTIPLICATION: papers 24, 118 (multivariate case), 249, 263.
 - d) DIVISION: papers 42, 48, 51-53, 58, 75, 86, 97, 103, 111, 249, 263.

5. MATH PROGRAMMING.
 - a) LINEAR PROGRAMMING: papers 13, 38, 39, 43, 50, 55, 57.
 - b) INTEGER LINEAR PROGRAMMING: papers 89, 93, 113, 152.
 - c) NONLINEAR PROGRAMMING: paper 79.
6. FAST MATRIX MULTIPLICATION: book 1, survey papers 2 and 24, and papers 14, 20, 21, 23, 25, 30, 32, 33, 36, 37, 40, 95, 145, 157, 163, 222.
7. MULTIGRID ALGORITHMS.
 - a) ALGEBRAIC MULTIGRID: paper 22.
 - b) COMPACT MULTIGRID: papers 73, 77, 93, 109.
8. PARALLEL COMPUTATIONS (ALSO SEE RELEVANT ITEMS IN PARTS 9-14).
 - a) PROCESSOR EFFICIENT ALGORITHMS IN NC: book 2 (chapter 4) and papers 44-47, 50-58, 60-64, 66-69, 72, 74, 75, 80-82, 85, 88, 90, 93, 100, 102, 103, 106, 107, 111, 112, 115, 117, 119, 123, 125, 126, 129, 131-133, 138, 147, 163, 175.
 - b) NC EQUIVALENCE OF LINEAR PROGRAMMING AND EUCLIDEAN GCD: papers 89, 113, 152.
 - c) WORK-PRESERVING SPEED-UP: papers 91, 115, 122.
9. GRAPH ALGORITHMS.
 - a) MATCHING: papers 45, 63.
 - b) PATHS: item 6 in the list of book chapters; papers 54, 56, 66, 85, 90, 91, 122, 138, 147.
10. LINEAR SYSTEMS OF EQUATIONS AND MATRIX INVERSION (GENERAL INPUT MATRICES).
 - a) NEWTON'S ITERATION AND RESIDUAL CORRECTION PROCESSES: book 3 (chapter 6), item 9 in the list of reviews and book chapters, and papers 44, 69, 83, 175, 178, 211, 216, 226, 231, 251, 268.
 - b) RANDOMIZED ALGORITHMS: see section 18.
 - c) PARALLEL ALGORITHMS: book 2 and papers 44, 47, 60, 67, 74, 81, 82, 91, 122, 175, 238.
11. LINEAR SYSTEMS OF EQUATIONS AND MATRIX INVERSION (TRIANGULAR, BANDED OR SPARSE INPUT): item 6 in the list of reviews and book chapters and papers 44, 107, 115, 117, 125.
12. LINEAR SYSTEMS OF EQUATIONS AND MATRIX INVERSION (STRUCTURED INPUT).
 - a) DISPLACEMENT TRANSFORMATION OF MATRIX STRUCTURE; APPLICATIONS TO POLYNOMIAL EVALUATION AND INTERPOLATION: book 3 and papers 71, 76, 140, 150, 156, 203, 248, 253, 259, 267.
 - b) NEWTON'S ITERATION AND RESIDUAL CORRECTION PROCESSES: book 3 (chapter 6), item 9 in the list of reviews and book chapters and papers 72, 83, 88, 93, 106, 132, 141, 178, 179, 187, 200, 201, 204, 211, 216, 229, 231, 251.
 - c) COMPRESSION OF THE DISPLACEMENTS: book 3 and papers 88, 93, 106, 108, 141, 165, 168, 175, 187, 211.
 - d) HOMOTOPIC/CONTINUATION TECHNIQUES: book 3 (chapter 6) and papers 93, 106, 178, 187, 200, 201, 211, 216, 231.
 - e) INVERSION OF DISPLACEMENT OPERATORS: book 3 and paper 194.
 - f) SOLUTION WITH LIFTING TECHNIQUES: papers 192, 226, 238.

g) SOLUTION WITH PRECONDITIONED CONJUGATE GRADIENT METHOD: papers 94, 128.

h) UNIFICATION OF SUPERFAST ALGORITHMS: book 3 and papers 71, 76, 150, 156, 159, 168.

i) OTHER METHODS: books 2 and 3 and papers 60, 62, 72, 74, 81, 102, 131-133, 168, 248, 249, 263.

j) APPLICATIONS TO POLYNOMIAL GCD AND RATIONAL INTERPOLATION: papers 133, 149, 159, 166, 195.

k) NORM ESTIMATION: papers 254, 259.

13. DETERMINANT AND CHARACTERISTIC POLYNOMIAL: papers 60, 65, 67, 143, 146, 158, 160, 180, 197, 205, 208, 221.

14. ROOT-FINDING FOR POLYNOMIALS.

a) BOOK 4 and items 8, 10, 13, 18 and 22 in the list of survey articles and book chapters.

b) NEARLY OPTIMAL DIVIDE-AND-CONQUER ALGORITHMS: papers 126, 129, 183, 184, 186, 191 and book 4 (chapter 15).

c) OTHER NEARLY OPTIMAL ALGORITHMS: papers:68, 80, 153, 169, 246, 250, 258, 262, 264.

d) STRUCTURED MATRIX METHODS: item 17 in the list of surveys and book chapters; papers 198, 202, 207, 210, 212, 227, 233, 235, 239, 243, 246, 250, 252.

e) REAL POLYNOMIAL ROOT-FINDERS: papers 68, 80, 153, 213, 235, 246, 252, 258, 261.

g) OTHER ROOT-FINDING ALGORITHMS: papers 41, 46, 59, 61, 99, 114, 116, 124, 130, 134, 135, 171, 177, 206, 210, 233-236, 239, 241, 242, 264.

h) APPLICATION TO APPROXIMATE POLYNOMIAL GCD: papers 149, 182.

15. ROOT-FINDING FOR SYSTEMS OF POLYNOMIALS: papers 136, 137, 139, 144, 151, 155, 170, 176, 185, 189, 193, 197, 208.

16. EIGEN-SOLVING: papers 64, 78, 80, 84, 96, 98, 110, 153, 167, 206, 207, 212, 218, 223, 227, 243.

17. SYMBOLIC-NUMERICAL COMPUTATIONS (ALSO SEE PARTS 8, 12-15, and 19).

a) BOOKS AND SURVEYS: books 2 and 3 and 4, 5, 8-14, 16-18 and 22 in the list of SURVEY ARTICLES AND BOOK CHAPTERS.

b) APPROXIMATE POLYNOMIAL GCD: papers 149, 182.

c) NUMERICAL COMPUTATION OF DETERMINANTS: papers 160, 180, 221.

d) RECOVERY OF A RATIONAL NUMBER FROM ITS NUMERICAL APPROXIMATION: paper 199.

e) NUMERICAL COMPUTATIONS WITH ERROR-FREE OUTPUT: papers 154, 224.

18. RANDOMIZED MATRIX ALGORITHMS: papers 214, 215, 217, 219, 221, 223, 225, 228, 230, 232, 234, 237, 244, 245, 255, 257, 260, 265, 266.

19. DEGENERACY AND CONDITIONING: 220, 254, 259.

20. BOOLEAN COMPLEXITY OF ALGEBRAIC COMPUTATIONS: papers 26, 28, 31, 34, 40, 49, 53, 58, 73, 77, 246, 249, 250, 258, 262-264.

21. MANIPULATION WITH INTEGERS:

(a) BINARY SEGMENTATION: book 1, papers 87, 158, 224.

(b) RATIONAL RECONSTRUCTION, EUCLIDEAN ALGORITHM: papers 190, 196, 199.

22. LINEAR RECURRENCES: papers 142, 172.

9.2 BOOKS

1. “How to Multiply Matrices Faster”, Lecture Notes in Computer Science, vol. 179 (XI + 212 pages), Springer, Berlin (1984).

2. “Polynomial and Matrix Computations”, Volume 1: “Fundamental Algorithms” (XVI + 415 pages) (by D. Bini and V. Y. Pan), in the series Progress in Theoretical Computer Science (R.V. Book editor), Birkhäuser, Boston (1994).

3. “Structured Matrices and Polynomials: Unified Superfast Algorithms” (XXV + 278 pages), Birkhäuser/Springer, Boston/New York (June 2001).

4. “Numerical Methods for Roots of Polynomials” (by J. M. McNamee and V. Y. Pan), Part 2 (XXII + 718 pages), Elsevier (2013).

9.3 CHAPTERS IN BOOKS AND SURVEY ARTICLES

Subsection includes prefaces; items 1, 2, 3, 4-6, 8, 9 and 17 included new research results.

1. “On Methods of Computing the Values of Polynomials”, *Uspekhi Matematicheskikh Nauk*, 21, 1 (127), 103–134 (1966). (Transl. Russian Mathematical Surveys, 21, 1 (127), 105–137 (1966).)

2. “How Can We Speed Up Matrix Multiplication?”, *SIAM Review*, 26, 3, 393–415 (1984).

3. “Linear Systems of Algebraic Equations”, in *Encyclopedia of Physical Sciences and Technology*, 7, 304–329 (1987), (first edition, Marvin Yelles, editor); 8, 779–804 (1992) (second edition), and 8, 617–642 (2001) (third edition, Robert A. Meyers, editor), Academic Press, San Diego, California.

4. “Complexity of Algorithms for Linear Systems of Equations”, in *Computer Algorithms for Solving Linear Algebraic Equations (The State of the Art)*, (E. Spedicato, editor), NATO ASI Series, Series F: Computer and Systems Sciences, 77, 27–56, Springer, Berlin (1991) and Academic Press, Dordrecht, the Netherlands (1992).

5. “Complexity of Computations with Matrices and Polynomials,” *SIAM Review*, 34, 2, 225–262 (1992).

6. “Parallel Solution of Sparse Linear and Path Systems”, in *Synthesis of Parallel Algorithms* (J. H. Reif, editor), Chapter 14, pages 621–678. Morgan Kaufmann publishers, San Mateo, CA (1993).

7. “Algebraic Algorithms” (by A. Diaz, E. Kaltofen and V. Y. Pan), Chapter 10 in the *Computer Science and Engineering Handbook* (Allen B. Tucker, Jr., editor), pages 226–249, CRC Press Inc., Boca Raton, Florida (1997).

8. “Solving a Polynomial Equation: Some History and Recent Progress”, *SIAM Review*, 39, 2, 187–220 (1997).

9. “Newton’s Iteration for Structured Matrices and Linear Systems of Equations” (by V. Y. Pan, S. Branham, R. Rosholt, and A. Zheng), *SIAM volume on Fast Reliable Algorithms for Matrices with Structure* (T. Kailath and A. H. Sayed, editors), chapter 7, pages 189–210, SIAM Publications, Philadelphia (1999).

10. “Solving Polynomials with Computers”, *American Scientist*, 86, 62–69 (January-February 1998).

11. "Computational Complexity of Solving Large Sparse and Large Special Linear Systems of Equations", pages 1–24, in "Algorithms for Large Scale Linear Algebraic Systems: Applications in Science and Engineering" (G. Winter Althaus and E. Spedicato, editors), NATO Advanced Science Institute Series, Kluwer Academic Publishers, Dordrecht, The Netherlands (1998).
12. "Some Recent Algebraic/Numerical Algorithms", Electronic Proceedings of IMACS/ACA'98 (1998): <http://www-troja.fjfi.cvut.cz/aca98/sessions/approximate>
13. "Algebraic Algorithms" (by A. Diaz, E. Kaltofen and V. Y. Pan), Chapter 16 in Handbook "Algorithms and Theory of Computations", pages from 16–1 to 16–27 (M. Atallah, editor), CRC Press Inc., Boca Raton, Florida (1999).
14. "Fast Fourier Transform and Its Applications" (by I. Z. Emiris and V. Y. Pan), Chapter 17 in Handbook "Algorithms and Theory of Computations", pages from 17–1 to 17–30 (M. Atallah, editor), CRC Press Inc., Boca Raton, Florida (1999).
15. "Preface to the Special Issue on Algebraic and Numerical Algorithms" (by I. Z. Emiris, B. Mourrain, and V. Y. Pan), Theoretical Computer Science, 315, 2–3, 307–308 (2004).
16. "Algebraic Algorithms" (by A. Diaz, I.E. Emiris, E. Kaltofen and V. Y. Pan), Chapter 8 in the Computer Science and Engineering Handbook (Allen B. Tucker, editor), pages from 8–1 to 8–24, Chapman and Hall/CRC Press (2004).
17. "Root-finding with Eigen-solving" (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, X. Wang, and X. Yan), pages 185–210 in Symbolic-Numeric Computation (Dongming Wang and Lihong Zhi, editors), Birkhäuser, Basel/Boston (2007).
18. "Preface to the Special Issue on Symbolic-Numerical Algorithms" (by D. A. Bini, V. Y. Pan, and J. Verschelde), Theoretical Computer Science, 409, 2, 155–157 (2008).
19. "Algebraic and Numerical Algorithms" (by I. Z. Emiris, V. Y. Pan, and E. Tsigaridas), in Algorithms and Theory of Computations Handbook", Second Edition, Volume 1 (1016 pages): General Concepts and Techniques, pages 1–34 in Chapter 17 (Mikhail J. Atallah and Marina Blanton, editors), CRC Press Inc., Boca Raton, Florida (2009).
20. "Fast Fourier Transform and Its Applications" (by I. Z. Emiris and V. Y. Pan), in Algorithms and Theory of Computations Handbook", Second Edition, Volume 1 (1016 pages): General Concepts and Techniques, pages 1–31 in Chapter 18 (Mikhail J. Atallah and Marina Blanton, editors), CRC Press Inc., Boca Raton, Florida (2009).
21. "Preface to the Special Issue on Symbolic and Numerical Algorithms" (by I. S. Kotsireas, B. Mourrain, and V. Y. Pan), Theoretical Computer Science, 412, 16, 1443–1444 (2011).
22. "Preface to the Special Issue on Symbolic and Numerical Algorithms" (by I. S. Kotsireas, B. Mourrain, V. Y. Pan, and L. Zhi), Theoretical Computer Science, 479, 1–3 (2013).
23. "Algebraic Algorithms" (by I. Z. Emiris, V. Y. Pan, and E. Tsigaridas), Chapter 10 (pages from 10–1 to 10-40) of Computing Handbook (Third edition), Volume I: Computer Science and Software Engineering (Allen B. Tucker, Teo Gonzales, and Jorge L. Diaz-Herrera, editors), Taylor and Francis Group (2014).
24. "Fast Matrix Multiplication and Its Algebraic Neighborhood", SB MATH (Mathematical Sbornik), 208, 11 (2017) DOI:10.1070/SM8833 (available in Russian and in English).

9.4 RESEARCH PAPERS (in journals and refereed proceedings of conferences)

1. "On One Question by N.N. Luzin", *Nauchnye Doklady Vysshey Schkoly, Fiziko-Matematicheskie Nauki* (in Russian), 4, 59–62 (1958).
2. "Some Schemes for the Evaluation of Polynomials with Real Coefficients", *Doklady Akademii Nauk SSSR* (in Russian), 127, 2, 266–269 (1959).
3. "On Approximation of Analytic Functions by Rational Ones", *Uspekhi Matematicheskikh Nauk* (in Russian), 16, 5 (101), 195–197 (1961).
4. "Some Schemes for the Evaluation of Polynomials with Real Coefficients" *Problemy Kibernetiki* (in Russian), (edited by A.A. Lyapunov), 5, 17–29 (1961). (Transl. *Problems of Cybernetics, USSR*, 5, 14–32, Pergamon Press (1961).)
5. "On Some Methods of Computing Polynomial Values", *Problemy Kibernetiki* (in Russian), (edited by A.A. Lyapunov), 7, 21–30 (1962). (Transl. *Problems of Cybernetics, USSR*, 7, 20–30, U.S. Dept. of Commerce (1962).)
6. "Schemes with Preconditioning for the Evaluation of Polynomials and a Program for Automatic Preconditioning", *Zhurnal Vychislitel'noy Matematiki i Matematicheskoy Fiziki* (in Russian), 2, 1, 133–140 (1962). (Transl. from *USSR Computational Mathematics and Mathematical Physics*, 1, 137–146 (1963).)
7. "Methods for Computing Polynomials" (in Russian), Ph.D. thesis, Dept. of Mechanics and Mathematics, Moscow State University (1964).
8. "The Evaluation of Polynomials of the Fifth and Seventh Degrees with Real Coefficients", *Zhurnal Vychislitel'noy Matematiki i Matematicheskoy Fiziki* (in Russian), 5, 1, 116–118 (1965). (Transl. *USSR Computational Mathematics and Mathematical Physics*, 5, 1, 159–161 (1965).)
9. "On Simultaneous Evaluation of Several Polynomials of Low Degree (Two to Five)", *Zhurnal Vychislitel'noy Matematiki i Matematicheskoy Fiziki* (in Russian), 6, 2, 352–357 (1966). (Transl. *USSR Computational Mathematics and Mathematical Physics*, 6, 2, 222–227 (1966).)
10. "On Methods of Computing the Values of Polynomials", *Uspekhi Matematicheskikh Nauk* (in Russian), 21, 1 (127), 103–134 (1966). (Transl. *Russian Mathematical Surveys*, 21, 1 (127), 105–137 (1966).)
11. "Calculus of Rational Costs Based on Modern Economic Information" (by V. Belkin, A. Kronrod, Y. Nazarov and V. Y. Pan), *Ekonomika i Matematicheskie Metody* (in Russian), *Akademiya Nauk SSSR*, 1, 5, 699–717 (1965).
12. "A Linear Model and Algorithm for Optimizing Foreign Trade", *Tezisy Dokladov i Vystupleniy na Simpoziume po Modelirovaniyu Narodnogo Khozyaistva, Institut Ekonomiki AN SSSR* (Proceedings of the Symposium on Models of Public Economy, Institute of Economics, Academy of Sciences of USSR), (in Russian), Moscow, 29–37 (1970).
13. "On Solving a Distribution Problem with Upper Bounds on the Variables and a Simplified Criterion for Optimizing Foreign Trade", *Trudy 4-oy Zimney Schkoly po Matematicheskomu Programirovaniyu i Smezhnym Voprosam* (in Russian), (Transactions of the 4-th Winter School on Mathematical Programming and Adjacent Problems), (edited by S. I. Zukhovitskiy), Iss. 5, 26–49, Drogobych (1972).
14. "On Schemes for the Evaluation of Products and Inverses of Matrices", *Uspekhi Matematicheskikh Nauk* (in Russian), 27, 5 (167), 249–250 (1972).
15. "Models for Planning Costs with Optimization of Foreign Trade of Several Countries under the Economic Integration", *Primenenie Ekonomiko-Matematicheskikh Modeley*

i EVM pri Planirovanii i Prognozirovanii Tsen (in Russian), 5 (1973).

16. "A Model for the Optimization of Foreign Economic Relations Under the Economic Integration of the Socialist Countries", *Ekonomika i Matematicheskie Metody* (in Russian), *Akademiya Nauk SSSR*, 10, 2, 255–266 (1974). (Transl. *USSR Trade and Services*, 755, 1–16 (1974).)

17. "A Model for the Dynamics of Costs and Expenditures", *Trudy Mezhdunarodnoy Konferentsii "Modelirovanie Ekonomicheskikh Protsessov"* (Transactions of the International Conference, "Models of Economic Processes"), (in Russian), Erevan, 166–174 (1974).

18. "A Modification of a Balanced Model of Income–Commodities into an Equilibrium Model" (by V. Belkin, V. Ivanter, N. Konstantinov and V. Pan), *Ekonomika i Matematicheskie Methody*, *Akademiya Nauk SSSR* (in Russian), 11, 6, 1037–1049 (1975).

19. "Computational Complexity of Computing Polynomials over the Fields of Real and Complex Numbers", *Proceedings of the Tenth Annual ACM Symposium on Theory of Computing (STOC'78)*, 162–172, ACM Press, New York (1978).

20. "Strassen's Algorithm Is Not Optimal. Trilinear Technique of Aggregating, Uniting and Canceling for Constructing Fast Algorithms for Matrix Multiplication", *Proceedings of the 19th Annual IEEE Symposium on Foundations of Computer Science (FOCS'78)*, 166–176, IEEE Computer Society Press, Long Beach, California (1978).

21. "Fields Extension and Trilinear Aggregating, Uniting and Canceling for the Acceleration of Matrix Multiplication", *Proceedings of the 20th Annual IEEE Symposium on Foundations of Computer Science (FOCS'79)*, 28–38, IEEE Computer Society Press, Long Beach, California (1979).

22. "Methods of Aggregations" (by W. L. Miranker and V. Y. Pan), *Linear Algebra and Its Applications*, 29, 231–257 (1980).

23. "New Fast Algorithms for Matrix Operations", *SIAM J. on Computing*, 9, 2, 321–342 (1980).

24. "Convolution of Vectors over the Real Field of Constants", *Journal of Algorithms*, 1, 297–300 (1980).

25. "New Combinations of Methods for the Acceleration of Matrix Multiplications", *Computers and Mathematics (with Applications)*, 7, 73–125 (1981).

26. "The Bit Complexity of Arithmetic Algorithms", *Journal of Algorithms*, 2, 144–163 (1981).

27. "A Unified Approach to the Analysis of Bilinear Algorithms", *Journal of Algorithms*, 2, 301–310 (1981).

28. "The Bit Operation Complexity of Matrix Multiplication and All Pair Shortest Path Problem", *Computers and Mathematics (with Applications)*, 7, 5, 431–438 (1981).

29. "The Lower Bounds on the Additive Complexity of Bilinear Problems in Terms of Some Algebraic Quantities", *Information Processing Letters*, 13, 2, 71–72 (1981).

30. "Trilinear Aggregating with Implicit Canceling for a New Acceleration of Matrix Multiplication", *Computers and Mathematics (with Applications)*, 8, 1, 23–34 (1982).

31. "The Bit Operation Complexity of Approximate Evaluation of Matrix and Polynomial Products Using Modular Arithmetic", *Computers and Mathematics (with Applications)*, 8, 2, 137–140 (1982).

32. "Fast Matrix Multiplication without APA–Algorithms", *Computers and Mathematics (with Applications)*, 8, 5, 343–366 (1982).

33. "Trilinear Aggregating is the Basis for the Asymptotically Fastest Known Algorithms for Matrix Multiplication", *Conference Record, Second Conference on Foundations*

of Software Technology and Theoretical Computer Science (FST and TCS'82), 321–337, Indian Institute of Technology, Bangalore, India (December 1982).

34. "The Additive and Logical Complexities of Linear and Bilinear Algorithms", *J. of Algorithms*, 4, 1–34 (1983).

35. "The Projective Power Method for the Algebraic Eigenvalue Problem", *Computers and Mathematics (with Applications)*, 9, 6, 735–745 (1983).

36. "Trilinear Aggregating Is the Basis for the Asymptotically Fastest Known Algorithms for Matrix Multiplication" (extended abstract), *Methods of Operations Research*, 45, 493–494 (1983).

37. "Trilinear Aggregating and the Recent Progress in the Asymptotic Acceleration of Matrix Operations", *Theoretical Computer Science*, 33, 117–138 (1984).

38. "How Fast Can We Solve a System of Linear Inequalities in the Worst and in the Average Case?", *Methods of Operations Research*, 51, 107–118 (1984).

39. "Fast Finite Methods for a System of Linear Inequalities", *Computers and Mathematics (with Applications)*, 11, 4, 355–394 (1985).

40. "The Bit Complexity of Matrix Multiplication and of the Related Computations in Linear Algebra. The Segmented λ -algorithms", *Computers and Mathematics (with Applications)*, 11, 9, 919–928 (1985).

41. "On Application of Some Recent Techniques of the Design of Algebraic Algorithms to the Sequential and Parallel Evaluation of the Roots of a Polynomial and to Some Other Numerical Problems", *Computers and Mathematics (with Applications)*, 11, 9, 911–917 (1985).

42. "Fast Parallel Polynomial Division via Reduction to Polynomial Inversion Modulo a Power" (by D. Bini and V. Y. Pan), *Information Processing Letters*, 21, 79–81 (1985).

43. "On the Complexity of a Pivot Step of the Revised Simplex Algorithm", *Computers and Mathematics (with Applications)*, 11, 11, 1127–1140 (1985).

44. "Efficient Parallel Solution of Linear Systems" (by V. Y. Pan and J. Reif), *Proc. 17th Annual ACM Symposium on Theory of Computing (STOC'85)*, 143–152, ACM Press, New York (1985).

45. "Improved Processor Bounds for Algebraic and Combinatorial Problems in RNC" (by Z. Galil and V. Y. Pan), *Proc. 26th Annual IEEE Symposium on Foundations of Computer Science (FOCS'85)*, 490–495, IEEE Computer Society Press, Los Angeles, California (1985).

46. "Fast and Efficient Algorithms for Sequential and Parallel Evaluation of Polynomial Zeros and of Matrix Polynomials," *Proc. 26th Annual IEEE Symposium on Foundations of Computer Science (FOCS'85)*, 522–531, IEEE Computer Society Press, Los Angeles, California (1985).

47. "Fast and Efficient Parallel Algorithms for the Exact Inversion of Integer Matrices", *Proc. Fifth Conference on Foundations of Software Technology and Theoretical Computer Science (FST and TCS'85)*, (edited by K. V. Nori), *Lecture Notes in Computer Science*, 206, 504–521, Springer, Berlin (1985).

48. "Algorithms for Polynomial Division" (by D. Bini and V. Y. Pan), *Proc. European Conference on Computer Algebra, Linz, Austria, Lecture Notes in Computer Science*, 204, 1–3, Springer (1985).

49. "The Trade-off Between the Additive Complexity and Asynchronicity of Linear and Bilinear Algorithms", *Information Processing Letters*, 22, 11–14 (1986).

50. "Fast and Efficient Parallel Linear Programming and Least Squares Computations" (by V. Y. Pan and J. Reif), *VLSI Algorithms and Architectures, Lecture Notes in Computer*

Science, 227, 283–295, Springer, Berlin (1986).

51. "A Logarithmic Boolean Time Algorithm for Parallel Polynomial Division" (by D. Bini and V. Y. Pan), VLSI Algorithms and Architectures, Lecture Notes in Computer Science, 227, 246–251, Springer, Berlin (1986).

52. "Polynomial Division and Its Computational Complexity" (by D. Bini and V. Y. Pan), Journal of Complexity, 2, 179–203 (1986).

53. "Fast Parallel Algorithms for Polynomial Division over Arbitrary Field of Constants" (by D. Bini and V. Y. Pan), Computers and Mathematics (with Applications), 12A, 11, 1105–1118 (1986).

54. "Extension of the Parallel Nested Dissection Algorithm to the Path Algebra Problems" (by V. Y. Pan and J. Reif), Proc. Sixth Conference on Foundations of Software Technology and Theoretical Computer Science (FST and TCS'86), (New Delhi, India), Lecture Notes in Computer Science, 241, 470–487, Springer, Berlin (1986).

55. "Fast and Efficient Linear Programming and Linear Least-Squares Computations" (by V. Y. Pan and J. Reif), Computers and Mathematics (with Applications), 12A, 12, 1217–1227 (1986).

56. "Parallel Nested Dissection for Path Algebra Computations" (by V. Y. Pan and J. Reif), Operations Research Letters, 5, 4, 177–184 (1986).

57. "Efficient Parallel Linear Programming" (by V. Y. Pan and J. Reif), Operations Research Letters, 5, 3, 127–135 (1986).

58. "A Logarithmic Boolean Time Algorithm for Parallel Polynomial Division" (by D. Bini and V. Y. Pan), Information Processing Letters, 24, 233–237 (1987).

59. "Algebraic Complexity of Computing Polynomial Zeros", Computers and Mathematics (with Applications), 14, 4, 285–304 (1987).

60. "Complexity of Parallel Matrix Computations", Theoretical Computer Science, 54, 65–85 (1987).

61. "Sequential and Parallel Complexity of Approximate Evaluation of Polynomial Zeros", Computers and Mathematics (with Applications), 14, 8, 591–622 (1987).

62. "Some Polynomial and Toeplitz Matrix Computations" (by V. Y. Pan and J. Reif), Proc. 28th Annual IEEE Symposium on Foundations of Computer Science (FOCS'87), 173–184, IEEE Computer Society Press, Los Angeles, California (1987).

63. "Improved Processor Bounds for Combinatorial Problems in RNC" (by Z. Galil and V. Y. Pan), Combinatorica, 8, 2, 189–200 (1988).

64. "Efficient Algorithms for the Evaluation of the Eigenvalues of (Block) Banded Toeplitz Matrices" (by D. Bini and V. Y. Pan), Mathematics of Computation, 50, 182, 431–448 (1988).

65. "Computing the Determinant and the Characteristic Polynomial of a Matrix via Solving Linear Systems of Equations", Information Processing Letters, 28, 2, 71–75 (1988).

66. "Fast and Efficient Solution of Path Algebra Problems" (by V. Y. Pan and J. Reif), Journal of Computer and Systems Sciences, 38, 3, 494–510 (1989).

67. "Parallel Evaluation of the Determinant and of the Inverse of a Matrix" (by Z. Galil and V. Y. Pan), Information Processing Letters, 30, 41–45 (1989).

68. "Fast and Efficient Parallel Evaluation of the Zeros of a Polynomial Having Only Real Zeros", Computers and Mathematics (with Applications), 17, 11, 1475–1480 (1989).

69. "Fast and Efficient Parallel Solution of Dense Linear Systems" (by V. Y. Pan and J. Reif), Computers and Mathematics (with Applications), 17, 11, 1481–1491 (1989).

70. "Fast Evaluation and Interpolation at the Chebyshev Sets of Points", Applied Mathematics Letters, 2, 3, 255–258 (1989).

71. "On Some Computations with Dense Structured Matrices", Proc. Annual ACM-SIGSAM International Symposium on Symbolic and Algebraic Computation (ISSAC'89), 34–42, ACM Press, New York (1989).
72. "Fast and Efficient Parallel Inversion of Toeplitz and Block Toeplitz Matrices", Operator Theory: Advances and Applications, 40, 359–389, Birkhäuser, Basel, Switzerland (1989).
73. "On the Bit-Complexity of Discrete Solution of PDEs: Compact Multigrid" (by V. Y. Pan and J. Reif), Proc. 17th International Colloquium on Automata, Languages and Programming (ICALP'90), Springer's Lecture Notes in Computer Science, 443, 612–625 (1990).
74. "Parallel Least-Squares Solution of General and Toeplitz-like Linear Systems", Proc. 2nd Annual ACM Symposium on Parallel Algorithms and Architecture (SPAA'90), 244–253, ACM Press, New York (1990).
75. "Parallel Polynomial Computations by Recursive Processes" (by D. Bini and V. Y. Pan), Proc. Annual ACM International Symposium on Symbolic and Algebraic Computation (ISSAC'90), 294, ACM Press, New York (1990).
76. "On Computations with Dense Structured Matrices", Mathematics of Computation, 55, 191, 179–190 (1990).
77. "The Bit-Complexity of the Discrete Solution of PDEs: Compact Multigrid" (by V. Y. Pan and J. Reif), Computers and Mathematics (with Applications), 20, 2, 9–16 (1990).
78. "Estimating the Extremal Eigenvalues of a Symmetric Matrix", Computers and Mathematics (with Applications), 20, 2, 17–22 (1990).
79. "The Modified Barrier Function Method for Linear Programming and Its Extensions", Computers and Mathematics (with Applications), 20, 3, 1–14 (1990).
80. "Parallel Complexity of Tridiagonal Symmetric Eigenvalue Problem" (by D. Bini and V. Y. Pan), Proc. 2nd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'91), 384–393, ACM Press, New York, and SIAM Publications, Philadelphia (1991).
81. "Improved Parallel Computations with Matrices and Polynomials" (by D. Bini, L. Gemignani and V. Y. Pan), Proc. 18th Intern. Colloquium on Automata, Languages and Programming (ICALP'91), Lecture Notes in Computer Science, 510, 520–531, Springer, Berlin (1991).
82. "Processor Efficient Parallel Solution of Linear Systems over an Abstract Field" (by E. Kaltofen and V. Y. Pan), Proc. 3rd Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'91), 180–191, ACM Press, New York (1991).
83. "An Improved Newton Iteration for the Generalized Inverse of a Matrix, with Applications" (by V. Y. Pan and R. Schreiber), SIAM J. on Scientific and Statistical Computing, 12, 5, 1109–1131 (1991).
84. "On the Evaluation of the Eigenvalues of a Banded Toeplitz Block Matrix" (by D. Bini and V. Y. Pan), J. of Complexity, 7, 408–424 (1991).
85. "The Parallel Computation of the Minimum Cost Paths in Graphs by Stream Contraction" (by V. Y. Pan and J. Reif), Information Processing Letters, 40, 79–83 (1991).
86. "Univariate Polynomial Division with a Remainder by Means of Evaluation and Interpolation" (by V. Y. Pan, E. Landowne, and A. Sadikou), Proc. of 3rd IEEE Symposium on Parallel and Distributed Processing, 212–217, IEEE Computer Society Press, Los Alamitos, California (1991).
87. "Extended Concept of Significant Digits and Lower Precision Computations", Applied Mathematics Letters, 5, 2, 3–6 (1992).

88. "Parametrization of Newton's Iteration for Computations with Structured Matrices and Applications", *Computers and Mathematics (with Applications)*, 24, 3, 61–75 (1992).
89. "On Parallel Complexity of Integer Linear Programming, GCD and the Iterated Mod Function" (by Yu Lin-Kriz and V. Y. Pan), *Proc. 3rd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'92)*, 124–137, ACM Press, New York and SIAM Publications, Philadelphia (1992).
90. "Efficient Parallel Algorithms for Computing All Pair Shortest Paths in Directed Graphs" (by Y. Han, V. Y. Pan and J. Reif), *Proc. 4th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'92)*, 353–362, ACM Press, New York (1992).
91. "Supereffective Slow-down of Parallel Computations" (by V. Y. Pan and F. P. Preparata), *Proc. 4th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'92)*, 402–409, ACM Press, New York (1992).
92. "Compact Multigrid" (by V. Y. Pan and J. Reif), *SIAM J. on Scientific and Statistical Computing*, 13, 1, 119–127 (1992).
93. "Parallel Solution of Toeplitz-like Linear Systems", *J. of Complexity*, 8, 1–21 (1992).
94. "A Fast, Preconditioned Conjugate Gradient Toeplitz Solver" (by V. Y. Pan and R. Schreiber), *Computers and Mathematics (with Applications)*, 24, 7, 17–24 (1992).
95. "On Practical Algorithms for Accelerated Matrix Multiplication" (by J. Laderman, V. Y. Pan and H.-X. Sha), *Linear Algebra and Its Applications*, 162–164, 557–588 (1992).
96. "Practical Improvement of the Divide-and-Conquer Eigenvalue Algorithms" (by D. Bini and V. Y. Pan), *Computing*, 48, 109–123 (1992).
97. "Polynomial Division with a Remainder by Means of Evaluation and Interpolation" (by V. Y. Pan, E. Landowne, and A. Sadikou), *Information Processing Letters*, 44, 149–153 (1992).
98. "Improving the Solution of the Symmetric Eigenvalue Problem and an Extension", *Applied Mathematics Letters*, 5, 6, 49–50 (1992).
99. "New Resultant Inequalities and Complex Polynomial Factorization", *Proc. 1st Israel Symposium on Theory of Computing and Systems (ISTCS '92)*, *Lecture Notes in Computer Science*, 601, 122–136, Springer, Berlin (1992).
100. "Improved Parallel Computations with Toeplitz-like and Hankel-like Matrices" (by D. Bini and V. Y. Pan), *Proc. of Annual ACM-SIGSAM International Symposium on Symbolic and Algebraic Computation (ISSAC'93)*, 193–200, ACM Press, New York (1993).
101. "The Power of Combining the Techniques of Algebraic and Numerical Computing: Improved Approximate Multipoint Polynomial Evaluation and Improved Multipole Algorithms" (by V. Y. Pan, J. Reif, and S. Tate), *Proc. of 33rd Annual IEEE Symposium on Foundations of Computer Science (FOCS '92)*, 703–713, IEEE Computer Society Press, Los Alamitos, California (1992).
102. "Processor-Efficient Parallel Solution of Linear Systems II. The Positive Characteristic and Singular Cases" (by E. Kaltofen and V. Y. Pan), *Proc. of 33rd Annual IEEE Symposium on Foundations of Computer Science (FOCS'92)*, 714–723, IEEE Computer Society Press, Los Alamitos, California (1992).
103. "Improved Parallel Polynomial Division and Its Extension" (by D. Bini and V. Y. Pan), *Proc. of 33rd Annual IEEE Symposium on Foundations of Computer Science (FOCS'92)*, 131–136, IEEE Computer Society Press, Los Alamitos, California (1992).
104. "Binary Segmentation for Matrix and Vector Operations", *Computers and Mathematics (with Applications)*, 25, 3, 69–71 (1993).
105. "A New Approach to Fast Polynomial Interpolation and Multipoint Evaluation" (by V. Y. Pan, A. Sadikou, E. Landowne, and O. Tiga), *Computers and Mathematics (with*

Applications), 25, 9, 25–30 (1993).

106. "Concurrent Iterative Algorithm for Toeplitz-like Linear Systems", IEEE Trans. on Parallel and Distributed Systems, 4, 5, 592–600 (1993).

107. "Fast and Efficient Parallel Solution of Sparse Linear Systems" (by V. Y. Pan and J. Reif), SIAM J. on Computing, 22, 6, 1227–1250 (1993).

108. "Decreasing the Displacement Rank of a Matrix", SIAM J. on Matrix Analysis, 14, 1, 118–121 (1993).

109. "Generalized Compact Multigrid" (by V. Y. Pan and J. Reif), Computers and Mathematics (with Applications), 25, 9, 3–5 (1993).

110. "A New Algorithm for the Symmetric Tridiagonal Eigenvalue Problem" (by V. Y. Pan and J. Demmel), Journal of Complexity, 9, 387–405 (1993).

111. "Improved Parallel Polynomial Division" (by D. Bini and V. Y. Pan), SIAM J. on Computing, 22, 3, 617–627 (1993).

112. "Improved Parallel Computations with Toeplitz-like and Hankel-like Matrices" (by D. Bini and V. Y. Pan), Linear Algebra and Its Applications, 188, 189, 3–29 (1993).

113. "The NC-Equivalence of Planar Integer Linear Programming and Euclidean GCD" (by D. Shallcross, V. Y. Pan, and Yu Lin-Kriz), Proc. 34th Annual IEEE Symposium on Foundations of Computer Science (FOCS'93), 557–564, IEEE Computer Society Press, Los Alamitos, California (1993).

114. "New Resultant Inequalities and Complex Polynomial Factorization", SIAM Journal on Computing 23, 5, 934–950 (1994).

115. "Improved Parallel Solution of a Triangular Linear System", Computers and Mathematics (with Applications), 27, 11, 41–43 (1994).

116. "New Techniques for Approximating Complex Polynomial Zeros", Proc. 5th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'94), 260–270, ACM Press, New York, and SIAM Publications, Philadelphia (1994).

117. "Optimum Parallel Computations with Band Matrices" (by V. Y. Pan, I. Sobze and A. Atinkpahoun), Proc. 5th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'94), 649–658, ACM Press, New York, and SIAM Publications, Philadelphia (1994).

118. "Simple Multivariate Polynomial Multiplication", J. Symbolic Computation, 18, 183–186 (1994).

119. "Parallel Solution of Toeplitz and Toeplitz-like Linear Systems over Fields of Small Positive Characteristic" (by E. Kaltofen and V. Y. Pan), Proceedings of First Intern. Symposium on Parallel Symbolic Computation (PASCO'94), Linz, Austria (Sept. 1994), Lecture Notes Series in Computing, 5, 225–233, World Scientific Publishing Company, Singapore (1994).

120. "Algebraic Improvement of Numerical Algorithms: Interpolation and Economization of Taylor Series", Mathematical and Computer Modeling, 20, 1, 23–26 (1994).

121. "An Algebraic Approach to Approximate Evaluation of a Polynomial on a Set of Real Points", Advances in Computational Mathematics, 3, 41–58 (1995).

122. "Work-Preserving Speed-up of Parallel Matrix Computations" (by V. Y. Pan and F. P. Preparata), SIAM J. on Computing, 24, 4, 811–821 (1995).

123. "Parallel Computation of a Krylov Matrix for a Sparse and Structured Input", Mathematical and Computer Modeling, 21, 11, 97–99 (1995).

124. "Deterministic Improvement of Complex Polynomial Factorization Based on the Properties of the Associated Resultant", Computers and Mathematics (with Applications), 30, 2, 71–94 (1995).

125. "On Parallel Computations with Band Matrices" (by V. Y. Pan, I. Sobze, and A. Atinkpahoun), *Information and Computation*, 120, 2, 237–250 (1995).
126. "Optimal (up to Polylog Factors) Sequential and Parallel Algorithms for Approximating Complex Polynomial Zeros", *Proc. 27th Annual ACM Symposium on Theory of Computing (STOC'95)*, 741–750, ACM Press, New York (1995).
127. "Weyl's Quadtree Algorithm for Unsymmetric Eigenvalue Problem", *Applied Mathematics Letters*, 8, 5, 87–88 (1995).
128. "A Fast, Preconditioned Conjugate Gradient Toeplitz and Toeplitz-like Solver" (by V. Y. Pan, A. Zheng, O. Dias, X. Huang), *Computers and Mathematics (with Applications)*, 30, 8, 57–63 (1995).
129. "Optimal and Nearly Optimal Algorithms for Approximating Polynomial Zeros", *Computers and Mathematics (with Applications)*, 31, 12, 97–138 (1996).
130. "Computing $x^n \bmod p(x)$ and an Application to Splitting a Polynomial into Factors over a Fixed Disc", *Journal of Symbolic Computations*, 22, 377–380 (1996).
131. "A New Approach to Parallel Computation of Polynomial GCDs and to Related Parallel Computations over Fields and Integer Rings", *Proc. 7th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'96)*, 518–527, ACM Press, New York, and SIAM Publications, Philadelphia (1996).
132. "Effective Parallel Computations with Toeplitz and Toeplitz-like Matrices Filled with Integers", in *Proc. of the AMS-SIAM Workshop "Mathematics of Numerical Analysis"*, Park City, Utah, July-August 1995 (J. Renegar, M. Shub, and S. Smale, editors), *Lectures in Applied Math.*, 32, 593–641, American Mathematical Society Press, Providence, Rhode Island (1996).
133. "Parallel Computation of Polynomial GCD and Some Related Parallel Computations over Abstract Fields", *Theoretical Computer Science*, 162, 2, 173–223 (1996).
134. "On Isolation of Real and Nearly Real Zeros of a Univariate Polynomial and Its Splitting into Factors" (by V. Y. Pan, M.-h. Kim, A. Sadikou, X. Huang, and A. Zheng), *J. of Complexity*, 12, 572–594 (1996).
135. "Graeffe's, Chebyshev-like, and Cardinal's Processes for Splitting a Polynomial into Factors" (by D. Bini and V. Y. Pan), *J. of Complexity*, 12, 492–511 (1996).
136. "Multidimensional Structured Matrices and Polynomial Systems" (by B. Mourrain and V. Y. Pan), *Calcolo (Special Issue on Toeplitz Matrices: Structure, Algorithms and Applications)*, 33, 389–401 (1996).
137. "Techniques for Exploiting Structure in Matrix Formulae of the Sparse Resultant" (by I. Z. Emiris and V. Y. Pan), *Calcolo (Special Issue on Toeplitz Matrices: Structure, Algorithms and Applications)*, 33, 353–369 (1996).
138. "Efficient Parallel Algorithms for Computing All Pair Shortest Paths in Directed Graphs" (by Y. Han, V. Y. Pan and J. Reif), *Algorithmica*, 17, 399–415 (1997).
139. "Solving Special Polynomial Systems by Using Structured Matrices and Algebraic Residues" (by B. Mourrain and V. Y. Pan), *Proc. of the AMS-SIAM Conference on Foundation of Computational Mathematics (FoCM'97)*, (F. Cucker and M. Shub, editors), Rio-de-Janeiro, January 1997, 287–304, Springer (1997).
140. "Fast Multipoint Polynomial Evaluation and Interpolation via Computation with Structured Matrices" (by V. Y. Pan, A. Zheng, X. Huang, and Y. Yu), *Annals of Numerical Math.*, 4, 483–510 (1997).
141. "Newton's Iteration for Inversion of Cauchy-like and Other Structured Matrices" (by V. Y. Pan, A. Zheng, X. Huang, and O. Dias), *J. of Complexity*, 13, 108–124 (1997).

142. "Faster Solution of the Key Equation for Decoding the BCH Error-Correcting Codes", Proc. 29th ACM Symposium on Theory of Computing (STOC'97), 168–175, ACM Press, New York (1997).
143. "Computing Exact Geometric Predicates Using Modular Arithmetic with Single Precision" (by H. Brönnimann, I. Z. Emiris, V. Y. Pan and S. Pion), Proc. 13th Annual ACM Symposium on Computational Geometry, 174–182, ACM Press, New York (1997).
144. "The Structure of Sparse Resultant Matrices" (by I. Z. Emiris and V. Y. Pan), Proc. Annual ACM International Symposium on Symbolic and Algebraic Computations (ISSAC'97), 189–196, ACM Press, New York (1997).
145. "Fast Rectangular Matrix Multiplication and Improving Parallel Matrix Computations" (by X. Huang and V. Y. Pan), Proc. Annual ACM International Symposium on Parallel Algebraic and Symbolic Computation (PASCO'97), 11–23, ACM Press, New York (1997).
146. "Algebraic and Numerical Techniques for the Computation of Matrix Determinants" (by V. Y. Pan, Y. Yu, and C. Stewart), Computers and Mathematics (with Applications), 34, 1, 43–70 (1997).
147. "Efficient Parallel Algorithms for Computing All Pair Shortest Paths in Directed Graphs" (by Y. Han, V.Y. Pan and J. Reif), Algorithmica, 17, 399–415 (1997).
148. "New Fast Algorithms for Polynomial Interpolation and Evaluation on the Chebyshev Node Set", Computers and Mathematics (with Applications), 35, 3, 125–129 (1998).
149. "Approximate Polynomial Gcds, Padé Approximation, Polynomial Zeros, and Bipartite Graphs", Proc. 9th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'98), 68–77, ACM Press, New York, and SIAM Publications, Philadelphia (1998).
150. "New Transformations of Cauchy Matrices and Trummer's Problem" (by V. Y. Pan, M. Abu Tabanjeh, Z. Q. Chen, E. Landowne, and A. Sadikou), Computers and Mathematics (with Applications), 35, 12, 1–5 (1998).
151. "Asymptotic Acceleration of Solving Polynomial Systems" (by B. Mourrain and V. Y. Pan), Proc. 30th Annual ACM Symposium on Theory of Computing (STOC'98), 488–496, ACM Press, New York (1998).
152. "Planar Integer Linear Programming Is NC-equivalent to Euclidean GCD" (by D. F. Shallcross, V. Y. Pan and Y. Lin-Kriz), SIAM Journal on Computing, 27, 4, 960–971 (1998).
153. "Computing Matrix Eigenvalues and Polynomial Zeros Where the Output Is Real" (by D. Bini and V. Y. Pan), SIAM J. on Computing, 27, 4, 1099–1115 (1998).
154. "Modular Arithmetic for Linear Algebra Computations in the Real Field" (by I. Z. Emiris, V. Y. Pan and Y. Yu), J. of Symbolic Computation, 21, 1–17 (1998).
155. "Controlled Iterative Methods for Solving Polynomial Systems" (by D. Bondyfalat, B. Mourrain, and V. Y. Pan), Proc. ACM Annual Intern. Symposium on Symbolic and Algebraic Comp. (ISSAC'98), 252–259, ACM Press, New York (1998).
156. "Transformations of Cauchy Matrices for Trummer's Problem and a Cauchy-like Linear Solver" (by V. Y. Pan, M. Abu Tabanjeh, Z. Chen, S. Providence and A. Sadikou), Proc. of 5th Annual International Symposium on Solving Irregularly Structured Problems in Parallel (IREGULAR'98), (A. Ferreira, J. Rolim, H. Simon, and S.-H. Teng, editors), Lecture Notes in Computer Science, 1457, 274–284, Springer, Berlin (1998).
157. "Fast Rectangular Matrix Multiplication and Applications" (by X. Huang and V. Y. Pan), J. of Complexity, 14, 257–299 (1998).
158. "Single Precision Computation of the Sign of Algebraic Predicates", Applied Mathematics Letters, 11, 6, 49–50 (1998).

159. “A Unified Superfast Algorithm for Boundary Rational Tangential Interpolation Problem and for Inversion and Factorization of Dense Structured Matrices” (by V. Olshevsky and V. Y. Pan), Proc. 39th Annual IEEE Symposium on Foundation of Computer Science (FOCS’98), 192–201, IEEE Computer Society Press, Los Alamitos, California (1998).
160. “Sign Determination in Residue Number Systems” (by H. Brönnimann, I. Z. Emiris, V. Y. Pan and S. Pion), Theoretical Computer Science, 210, 1, 173–197 (1999).
161. “Certified Computation of the Sign of a Matrix Determinant” (by V. Y. Pan and Y. Yu), Proc. 10th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA’99), 715–724, ACM Press, New York, and SIAM Publications, Philadelphia (1999).
162. “Approximate Real Polynomial Division via Approximate Inversion of Real Triangular Toeplitz Matrices” (by V. Y. Pan and Z. Q. Chen), Applied Mathematics Letters, 12, 1–2 (1999).
163. “Parallel Matrix Multiplication on a Linear Array with a Reconfigurable Pipelined Bus System” (by K. Li and V. Y. Pan), Proc. 13th Intern. Parallel Processing Symposium and 10th Symposium on Parallel and Distributed Computing (IPPS/SPDP 1999), 31–35, IEEE Computer Soc. Press, Los Alamitos, California (April 1999).
164. “The Complexity of the Matrix Eigenproblem” (by V. Y. Pan and Z. Chen), Proc. 31st Annual ACM Symposium on Theory of Computing (STOC’99), 507–516, ACM Press, New York (1999).
165. “Superfast Computations with Singular Structured Matrices over Abstract Fields” (by V. Y. Pan, A. Zheng, M. Abutabanjeh, Z. Chen, and S. Providence), Proc. Second Workshop on Computer Algebra in Scientific Computing (CASC’99), (V. G. Ganzha, E. W. Mayr, E. V. Vorozhtsov, Editors), 323–338, Springer (May 1999).
166. “Polynomial and Rational Interpolation and Multipoint Evaluation (with Structured Matrices)” (by V. Olshevsky and V. Y. Pan), Proc. 26th Intern. Colloquium on Automata, Languages and Programming (ICALP’99), 1644, 585–594, Springer’s Lecture Notes in Computer Science, Springer, Berlin (July 1999).
167. “A New Approach to Bisection Acceleration for the Symmetric Tridiagonal Eigenvalue Problem” (by V. Y. Pan and E. Linzer), Numerical Algorithms, 22, 13–39 (1999).
168. “Nearly Optimal Computations with Structured Matrices”, Proc. of 11th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA’2000), 953–962, ACM Press, New York, and SIAM Publications, Philadelphia (January 2000).
169. “Approximating Complex Polynomial Zeros: Modified Quadtree (Weyl’s) Construction and Improved Newton’s Iteration”, J. of Complexity, 16, 1, 213–264 (2000).
170. “Multivariate Polynomials, Duality and Structured Matrices” (by B. Mourrain and V. Y. Pan), J. of Complexity, 16, 1, 110–180 (2000).
171. “Lifting/Descending Processes for Polynomial Zeros and Applications” (by B. Mourrain and V. Y. Pan), J. of Complexity, 16, 1, 265–273 (2000).
172. “New Techniques for the Computation of Linear Recurrence Coefficients”, Finite Fields and Their Applications, 6, 93–118 (2000). Proc, version in ACM STOC 1997.
173. “Superfast Algorithms for Cauchy-like Matrix Computations and Extensions” (by V. Y. Pan and A. Zheng), Linear Algebra and Its Applications, 310, 83–108 (2000).
174. “Matrix Structure, Polynomial Arithmetic, and Erasure-Resilient Encoding and Decoding”, Proceedings of International Symposium on Symbolic and Algebraic Computations (ISSAC’2000), 266–271, ACM Press, New York (2000).
175. “Parallel Complexity of Computations with General and Toeplitz-like Matrices Filled with Integers”, SIAM J. on Computing, 30, 1080–1125 (2000).

176. “Computation of a Specified Root of a Polynomial System of Equations Using Eigenvectors” (by D. Bondyfalat, B. Mourrain, and V. Y. Pan), *Linear Algebra and Its Applications*, 319, 193–209 (2000).
177. “A New Proximity Test for Polynomial Zeros”, *Computers and Mathematics (with Applications)*, 41, 12, 1559–1560 (2001).
178. “A Homotopic Residual Correction Process”, *Proc. of the Second Conference on Numerical Analysis and Applications* (L. Vulkov, J. Wasniewsky and P. Yalamov, editors), *Lecture Notes in Computer Science*, 1988, 644–649, Springer, Berlin (2001).
179. “Newton’s Iteration for the Inversion of Structured Matrices” (by V. Y. Pan and Y. Rami), in “Structured Matrices: Recent Developments in Theory and Computation”, 79–90 (edited by D. Bini, E. Tyrtyshnikov and P. Yalamov), Nova Science Publishers, USA (2001).
180. “Certification of Numerical Computation of the Sign of the Determinant of a Matrix” (by V. Y. Pan and Y. Yu), *Algorithmica*, 30, 708–724 (2001).
181. “Parallel Matrix Multiplication on a Linear Array with a Reconfigurable Pipelined Bus System” (by K. Li and V. Y. Pan), *IEEE Transactions on Computing*, 50, 5, 519–525 (2001).
182. “Numerical Computation of a Polynomial GCD and Extensions”, *Information and Computation*, 167, 2, 71–85 (2001).
183. “Univariate Polynomials: Nearly Optimal Algorithms for Factorization and Rootfinding”, *Proc. Intern. Symposium on Symbolic Algebraic Comp. (ISSAC’01)*, 253–267, ACM Press, NY (2001).
184. “Nearly Optimal Algorithms for Univariate Polynomial Factorization and Rootfinding II: Computing a Basic Annulus for Splitting”, *Trudy of the Steklov Mathematical Institute of the Russian Academy of Science (in English)*, volume 235, pp. 211–223, Moscow (2001).
185. “Asymptotic Acceleration of the Solution of Multivariate Polynomial Systems of Equations” (by B. Mourrain, V. Y. Pan and O. Ruatta), *Proceedings of the Smalefest 2000* (F. Cucker and M. Rojas, editors), *Foundations of Computational Mathematics Series*, 267–294, World Scientific, New Jersey (2002).
186. “Nearly Optimal Algorithms for Numerical Univariate Polynomial Factorization and Rootfinding I: Splitting a Polynomial into Factors over an Annulus”, *Proceedings of the Smalefest 2000* (F. Cucker and M. Rojas, editors), *Foundations of Computational Mathematics Series*, 325–353, World Scientific, New Jersey (2002).
187. “Structured Matrices and Newton’s Iteration: Unified Approach” (by V. Y. Pan, Y. Rami and X. Wang), *Linear Algebra and Its Applications*, 343/344, 233–265 (2002).
188. “Randomized Acceleration of Fundamental Matrix Computations”, *Proc. of Symposium on Theoretical Aspects of Computer Science (STACS ’02)*, *Lecture Notes in Computer Science*, 2285, 215–226, Springer, Berlin (2002).
189. “Symbolic and Numerical Methods for Exploiting Structure in Constructing Resultant Matrices” (by I. Z. Emiris and V. Y. Pan), *Journal of Symbolic Computation*, 33, 393–413 (2002).
190. “Acceleration of Euclidean Algorithm and Extensions” (by V. Y. Pan and X. Wang), *Proc. International Symposium on Symbolic and Algebraic Computation (ISSAC ’02)*, 207–213, ACM Press, New York (2002).
191. “Univariate Polynomials: Nearly Optimal Algorithms for Numerical Factorization and Root-Finding”, *J. of Symbolic Computation*, 33, 5, 701–733 (2002).

192. “Can We Optimize Toeplitz/Hankel Computations?” in Proc. the 5th International Workshop on Computer Algebra in Scientific Computing (CASC’02), (edited by E. W. Mayr, V. G. Ganzha, and E. V. Vorozhtzov), 253–264, Technische University of München, Germany (2002).
193. “Accelerated Solution of Multivariate Polynomial Systems of Equations” (by B. Mourrain, V. Y. Pan and O. Ruatta), *SIAM J. on Computing*, 32, 2, 435–454 (2003).
194. “Inversion of Displacement Operators” (by V. Y. Pan and X. Wang), *SIAM J. on Matrix Analysis and Applications*, 24, 3, 660–677 (2003).
195. “Matrix Structure and Loss-Resilient Encoding/Decoding”, *Computers and Mathematics (with Applications)*, 46, 493–499 (2003).
196. “Acceleration of Euclidean Algorithm and Rational Number Reconstruction” (by X. Wang and V. Y. Pan), *SIAM J. of Computing*, 32, 2, 548–556 (2003).
197. “Improved Computation of Determinants and Resultants” (by I. Z. Emiris and V. Y. Pan), Proc. of the 6th Intern. Workshop on Computer Algebra in Scientific Computing (CASC ’03), (edited by E.W. Mayr, V.G. Ganzha, and E.V. Vorozhtzov), 81–94, Technische University of München (2003).
198. “Inverse Power and Durand-Kerner Iteration for Univariate Polynomial Root-Finding” (by D. A. Bini, L. Gemignani and V. Y. Pan), *Computers and Mathematics (with Applications)*, 47, 2/3, 447–459 (2004).
199. “On Rational Number Reconstruction and Approximation” (by V. Y. Pan and X. Wang), *SIAM J. on Computing*, 33, 2, 502–503 (2004).
200. “Iterative Inversion of Structured Matrices” (by V. Y. Pan, M. Van Barel, X. Wang and G. Codevico), *Theoretical Computer Science*, 315, 2–3, 581–592 (2004).
201. “The Least-Squares Compression Policy for Newton-like Iteration for Structured Matrices” (by G. Codevico, V. Y. Pan, M. Van Barel, X. Wang, and A.-L. Zheng) in Proceedings of the 6th International Mathematica Symposium (IMS 2004), (edited by C. Jacob and P. Mitic), Banff, Alberta, Canada (August 2004).
202. “Improved Initialization of the Accelerated and Robust QR-like Polynomial Root-finding” (by D. A. Bini, L. Gemignani, and V. Y. Pan), *Electronic Transactions on Numerical Analysis*, 17, 195–205 (2004). (Proc. version in Proceedings of the 7th International Workshop on Computer Algebra in Scientific Computing (CASC’04), St. Petersburg, Russia (2004), (edited by E. W. Mayr, V. G. Ganzha, and E. V. Vorozhtzov), 39-50, Technische Univ. Mnchen, Germany (2004).)
203. “An Efficient Solution for Cauchy-like Systems of Linear Equations” (by Z. Chen and V. Y. Pan), *Computers and Mathematics with Applications*, 48, 529–537 (2004).
204. “Newton-like Iteration Based on Cubic Polynomials for Structured Matrices” (by G. Codevico, V. Y. Pan, and M. Van Barel), *Numerical Algorithms*, 36, 365–380 (2004).
205. “On Theoretical and Practical Acceleration of Randomized Computation of the Determinant of an Integer Matrix”, *Zapiski Nauchnykh Seminarov POMI (in English)*, Vol. 316, 163–187, St. Petersburg, Russia (2004).
206. “Can the TPR1 Structure Help Us to Solve the Algebraic Eigenproblem?”, in Proc. of the 16th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA’05), 1069–1078, ACM Press, New York, and SIAM Publications, Philadelphia (2005).
207. “Fast and Stable QR Eigenvalue Algorithms for Generalized Semiseparable Matrices and Secular Equation” (by D. A. Bini, L. Gemignani and V. Y. Pan), *Numerische Mathematik*, 3, 373–408 (2005).
208. “Improved Algorithms for Computing Determinants and Resultants” (by I. Z. Emiris and V. Y. Pan), *J. of Complexity*, 21, 1, 43–71 (2005).

209. “Coefficient-free Adaptation of Polynomial Root-finders”, *Computers and Mathematics with Applications*, 50, 263–269 (2005).
210. “Amended DSeSC Power Method for Polynomial Root-finding”, *Computers and Mathematics with Applications*, 49, 9–10, 1515–1524 (2005).
211. “Homotopic Residual Correction Algorithms for General and Structures Matrices” (by V. Y. Pan, M. Kunin, R. Rosholt, and H. Kodai), *Mathematics of Computation*, 75, 345–368 (2006).
212. “Linking the TPR1, DPR1 and Arrow-head Matrix Structures” (by V. Y. Pan, B. Murphy, R. E. Rosholt, Y. Tang, X. Yan, and W. Cao), *Computers and Mathematics with Applications*, 52, 10-11, 1603–1608 (2006).
213. “Real Root-finding” (by V. Y. Pan, G. Qian, B. Murphy, R. E. Rosholt, and Y. Tang), *Proceedings of the Third International Workshop on Symbolic-Numeric Computation (SNC 2007)*, July 2007, London, Ontario, Canada (Jan Verschelde and Stephen Watt, editors), 161–169, ACM Press, New York (2007).
214. “Null Space and Eigenspace Computation with Additive Preconditioning” (by V. Y. Pan and X. Yan), *Proceedings of the Third International Workshop on Symbolic-Numeric Computation (SNC’2007)*, July 2007, London, Ontario, Canada (Jan Verschelde and Stephen Watt, editors), 170–179, ACM Press, New York (2007).
215. “The Schur Aggregation for Solving Linear Systems of Equations” (by V. Y. Pan, B. Murphy, R. E. Rosholt, and M. Tabanjeh), *Proceedings of the Third International Workshop on Symbolic-Numeric Computation (SNC’2007)*, July 2007, London, Ontario, Canada (Jan Verschelde and Stephen Watt, editors), 180–188, ACM Press, New York (2007).
216. “New Homotopic/Factorization and Symmetrization Techniques for Newton’s and Newton’s Structured Iteration”, *Computers Mathematics with Applications*, 54, 721–729 (2007).
217. “Additive Preconditioning and Aggregation in Matrix Computations” (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, I. Taj-Eddin, Y. Tang, and X. Yan), *Computers and Mathematics with Applications*, 55, 8, 1870–1886 (2008).
218. “Eigen-solving via Reduction to DPR1 Matrices” (by V. Y. Pan, B. Murphy, R. Rosholt, Y. Tang, X. Wang, and A. Zheng), *Computers and Mathematics with Applications*, 56, 166–171 (2008).
219. “Additive Preconditioning for Matrix Computations” (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, and X. Yan), in *Proc. of the Third International Computer Science Symposium in Russia (CSR’2008)*, *Lecture Notes in Computer Science (LNCS)*, 5010, 372–383 (2008).
220. “Degeneration of Integer Matrices Modulo an Integer” (by V. Y. Pan and X. Wang), *Linear Algebra and Its Applications*, 429, 2113–2130 (2008).
221. “Schur Aggregation for Linear Systems and Determinants” (by V. Y. Pan, D. Grady, B. Murphy, G. Qian, R. E. Rosholt, and A. Ruslanov), *Theoretical Computer Science, Special Issue on Symbolic-Numerical Algorithms* (D.A. Bini, V. Y. Pan, and J. Verschelde, editors), 409, pp. 255–268 (2008).
222. “Fast Rectangular Matrix Multiplication and Some Applications” (by S. Ke, B. Zeng, W. Han, V. Y. Pan), *Science in China, Series A: Mathematics*, 51, 3, 389–406, 2008.
223. “Additive Preconditioning, Eigenspaces, and the Inverse Iteration” (by V. Y. Pan and X. Yan), *Linear Algebra and Its Applications*, 430, 186–203 (2009).
224. “A New Error-free Floating-Point Summation Algorithm” (by V. Y. Pan, B. Murphy, G. Qian, and R. E. Rosholt), *Computers and Mathematics with Applications*, 57, 560–564 (2009).

225. “Preconditioning, Randomization, Solving Linear Systems, Eigen-Solving, and Root-Finding” (by V. Y. Pan, G. Qian, and A.-L. Zheng), Proc. International Symposium on Symbolic- Numerical Computations (SNC’2009), Kyoto, Japan, August 2009, (edited by Hiroshi Kai and Hiroshi Sekigawa), pp. 5–6, ACM Press, New York(2009).
226. “Nearly Optimal Symbolic-Numerical Algorithms for Structured Integer Matrices and Polynomials” (by V. Y. Pan, B. Murphy, and R. E. Rosholt), Proc. Intern. Symposium Symbolic-Numerical Comp. (SNC’2009), Kyoto, Japan, August 2009, (edited by Hiroshi Kai and Hiroshi Sekigawa), 105–113, ACM Press, New York (2009).
227. “Root Squaring with DPR1 Matrices”, in Zapiski Nauchnykh Seminarov POMI (in English), volume 373 (edited by N. N. Vasiliev and A. M. Vershik), pp. 189–193 (2009).
228. “Solving Homogeneous Linear Systems with Randomized Preprocessing” (by V. Y. Pan and G. Qian), Linear Algebra and Its Applications, 432, 3272–3318 (2010).
229. “Unified Nearly Optimal Algorithms for Structured Matrices” (by V. Y. Pan, B. Murphy, and R. E. Rosholt), Operator Theory: Advances and Applications, 199, 359–375, Birkhäuser, Basel (2010).
230. “Additive Preconditioning for Matrix Computations” (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, and X. Yan), Linear Algebra and Its Applications, 432, 1070–1089 (2010).
231. “Newton’s Iteration for Matrix Inversion, Advances and Extensions”, pp. 364–381, in MATRIX METHODS: THEORY, ALGORITHMS AND APPLICATIONS (dedicated to the Memory of Gene Golub, edited by Vadim Olshevsky and Eugene Tyrtyshnikov), World Scientific Publishing, New Jersey, ISBN-13 978-981-283-601-4, ISBN-10-981-283-601-2 (2010).
232. “Advancing Matrix Computations with Randomized Preprocessing” (by V. Y. Pan, G. Qian, and A.-L. Zheng), in Proc. of the Fifth International Computer Science Symposium in Russia (CSR’2010), Kazan, Russia, June 2010 (Farid Ablav and Ernst W. Mayr, editors), Lecture Notes in Computer Science (LNCS), pages 303–314, Springer, Berlin (2010).
233. “Real and Complex Polynomial Root-Finding with Eigen-Solving and Preprocessing” (by V. Y. Pan and A.-L. Zheng), (edited by Stephen Watt), in Proc. International Symposium on Symbolic and Algebraic Computation (ISSAC’2010), pages 219–226, ACM Press, New York (July 2010).
234. “Matrix Computations and Polynomial Root-finding with Preprocessing” (by V. Y. Pan, G. Qian, A.-L. Zheng, and Z. Chen), Linear Algebra and Its Applications, 434, 854–879 (2011).
235. “New Progress in Real and Complex Polynomial Root-Finding” (by V. Y. Pan and A.-L. Zheng), Computers and Mathematics (with Applications), 61, 1305–1334 (2011).
236. “Univariate Polynomial Root-Finding by Arming with Constraints”, in Proc. International Symposium on Symbolic-Numerical Computations (SNC’2011), San Jose, California, 2011 (edited by Marc Moreno Masa), 112–121, ACM Press, New York (2011).
237. “Randomized Preconditioning of the MBA Algorithm” (by V. Y. Pan, G. Qian, and A.-L. Zheng), in Proc. International Symposium on Symbolic and Algebraic Computation (ISSAC’2011), San Jose, California, June 2011 (edited by Anton Leykin), 281–288, ACM Press, New York (2011).
238. “Nearly Optimal Solution of Rational Linear Systems of Equations with Symbolic Lifting and Numerical Initialization”, Computers and Mathematics with Applications, 62, 1685–1706 (2011).

239. “Root-finding by Expansion with Independent Constraints” (by V. Y. Pan and A.-L. Zheng), *Computers and Mathematics with Applications*, 62, 3164–3182 (2011).
240. “A Note on the Paper by Murat Cenk and Ferruh Ozbudak “Multiplication of Polynomials Modulo x^n ”, *Theoretical Computer Science*, 412 (2011) 3451–3462”, *T, Theoretical Computer Science*, 428, page 91 (2012).
241. “Efficient Polynomial Root-refiners: A Survey and New Record Efficiency Estimate” (by J. M. McNamee and V. Y. Pan), *Computers and Mathematics with Applications*, 63, 239–254 (2012).
242. “Root-refining for a Polynomial Equation”, *Proceedings of the 14th International Workshop on Computer Algebra in Scientific Computing (CASC’2012)*, (V. P. Gerdt, V. Koepf, E. W. Mayr, and E. V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 7442, 271–282, Springer, Heidelberg (2012).
243. “Real and Complex Polynomial Root-finding via Eigen-solving and Randomization” (by V. Y. Pan, G. Qian, and A.-L. Zheng), *Proceedings of the 14th International Workshop on Computer Algebra in Scientific Computing (CASC’2012)*, (V. P. Gerdt, V. Koepf, E. W. Mayr, and E. V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 7442, 283–293, Springer, Heidelberg (2012).
244. “Solving Linear Systems of Equations with Randomization, Augmentation and Aggregation” (by V. Y. Pan and G. Qian), *Linear Algebra and Its Applications*, 437, 2851–2876 (2012).
245. “Randomized Preconditioning versus Pivoting” (by V. Y. Pan, G. Qian, and A.-L. Zheng), *Linear Algebra and Its Applications*, 438, 4, 1883–1889 (2013).
246. “On the Boolean Complexity of the Real Root Refinement” (by V. Y. Pan and E. P. Tsigaridas), in *Proc. International Symposium on Symbolic and Algebraic Computations (ISSAC’2013)*, Boston, Massachusetts, June 2013 (M. Kauers, editor), 299–306, ACM Press, New York (2013).
247. “Polynomial Evaluation and Interpolation and Transformations of Matrix Structures”, *Proceedings of the 15th International Workshop on Computer Algebra in Scientific Computing (CASC’2013)*, (V. P. Gerdt, V. Koepf, E. W. Mayr, and E. V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 8136, 273–287, Springer, Heidelberg (2013).
248. “Fast Approximate Computations with Cauchy Matrices, Polynomials and Rational Functions”, *Proc. of the Ninth International Computer Science Symposium in Russia (CSR’2014)*, (E. A. Hirsch et al., editors), Moscow, Russia, June 2014, *Lecture Notes in Computer Science (LNCS)*, 8476, pp. 287–300, Springer International Publishing, Switzerland (2014).
249. “Nearly Optimal Computations with Structured Matrices” (by Victor Y. Pan and Elias Tsigaridas), *Proc. of the International Conference on Symbolic-Numeric Computation (SNC 2014)*, (edited by S. Watt and J. Verschelde), 21–30, ACM Press, New York, 2014.
250. “Accelerated Approximation of the Complex Roots of a Univariate Polynomial” (by Victor Y. Pan and Elias Tsigaridas), *Proc. of the International Conference on Symbolic Numeric Computation (SNC 2014)*, (edited by S. Watt and J. Verschelde), pages 132–134, ACM Press, New York, 2014.
251. “Global Newton Iteration over Archimedean and non-Archimedean Fields” (by Jonathan D. Hauenstein, Victor Pan, Agnes Szanto), *Proceedings of the 16th International Workshop on Computer Algebra in Scientific Computing (CASC’2014)*, (V.P. Gerdt, V. Koepf, W.M. Zeiler, and E.V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 8660, 202–217, Springer, Cham (2014). Also April 17, 2014, arXiv:1404.5525 [math.NA]
252. “Real Polynomial Root-finding by Means of Matrix and Polynomial Iterations”,

Proceedings of the 16th International Workshop on Computer Algebra in Scientific Computing (CASC'2014), (V.P. Gerdt, V. Koepf, W.M. Zeiler, and E.V. Vorozhtsov, editors), Lecture Notes in Computer Science, 8660, 335–349, Springer, Cham (2014).

253. “Transformations of Matrix Structures Work Again”, *Linear Algebra and Its Applications*, 465, 1-32 (2015).

254. “Estimating the Norms of Circulant and Toeplitz Random Matrices and Their Inverses” (by V. Y. Pan, J. Svadlenka, and L. Zhao), *Linear Algebra and Its Applications*, 468, 197–210 (2015)

255. “Random Multipliers Numerically Stabilize Gaussian and Block Gaussian Elimination: Proofs and an Extension to Low-rank Approximation” (by V. Y. Pan, G. Qian, and X. Yan), *Linear Algebra and Its Applications*, 481, 202–234 (2015).

256. “Real Root Isolation by Means of Root Radii Approximation” (by V. Y. Pan and L. Zhao), *Proceedings of the 17th International Workshop on Computer Algebra in Scientific Computing (CASC'2015)*, (V. P. Gerdt, V. Koepf, and E. V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 9301, 347–358, Springer, Heidelberg (2015), (also in arXiv:1501.05386 [math.NA] (36 pages, 12 tables), 22 January 2015, revised October 21, 2015.).

257. “Randomized Circulant and Gaussian Preprocessing” (by V. Y. Pan and L. Zhao), *Proceedings of the 17th International Workshop on Computer Algebra in Scientific Computing (CASC'2015)*, (V. P. Gerdt, V. Koepf, and E. V. Vorozhtsov, editors), *Lecture Notes in Computer Science*, 9301, 359–373, Springer, Heidelberg (2015).

258. “Nearly Optimal Refinement of Real Roots of a Univariate Polynomial” (by V. Y. Pan and E. P. Tsigaridas), *J. of Symbolic Computation*, 74, 181–204 (2016)

259. “How Bad Are Vandermonde Matrices?”, *SIAM Journal of Matrix Analysis*, 37 (2016), no. 2, 676–694.

260. “Low-rank Approximation of a Matrix: Novel Insights, New Progress, and Extensions” (by Victor Y. Pan and Liang Zhao), *Proc. of the Eleventh International Computer Science Symposium in Russia (CSR'2016)*, (Alexander Kulikov and Gerhard Woeginger, editors), St. Petersburg, Russia, June 2016, *Lecture Notes in Computer Science (LNCS)*, Volume 9691, 352–366, Springer International Publishing, Switzerland (2016).

261. “Real Polynomial Root-finding by Means of Matrix and Polynomial Iterations” (by Victor Y. Pan and Liang Zhao), *Theoretical Computer Science, Special Issue on Symbolic-Numerical Algorithms* (Stephen Watt, Jan Verschelde, and Lihong Zhi, editors), 681, 101-116 (2017), <http://dx.doi.org/10.1016/j.tcs.2017.03.032>.

262. “Accelerated Approximation of the Complex Roots and Factors of a Univariate Polynomial” (by V. Y. Pan and E. P. Tsigaridas), *Theoretical Computer Science, Special Issue on Symbolic-Numerical Algorithms* (Stephen Watt, Jan Verschelde, and Lihong Zhi, editors), 681, 138–145 (2017). <http://dx.doi.org/10.1016/j.tcs.2017.03.030>.

263. “Nearly Optimal Computations with Structured Matrices” (by V. Y. Pan and E. P. Tsigaridas), *Theoretical Computer Science, Special Issue on Symbolic-Numerical Algorithms* (Stephen Watt, Jan Verschelde, and Lihong Zhi, editors), 681, 117–137, 2017. <http://dx.doi.org/10.1016/j.tcs.2017.03.031>.

264. “Simple and Nearly Optimal Polynomial Root-Finding by Means of Root Radii Approximation”, Springer International Publishing (I.S. Kotsireas and E. Martinez- Moro, editors), *Applications of Computer Algebra*, Springer, Chapter 23, *Proceedings in Mathematics and Statistics*, 198 AG (2017). Chapter DOI.10.1007/978-3-319-56932-1_23

265. “New Studies of Randomized Augmentation and Additive Preprocessing” (by Victor Y. Pan and Liang Zhao), *Linear Algebra and Its Applications*, 512, 256–305 (2017).

Available at <http://dx.doi.org/10.1016/j.laa.2016.09.035>.

266. "Numerically Safe Gaussian Elimination with No Pivoting" (by Victor Y. Pan and Liang Zhao), *Linear Algebra and Its Applications*, 527, 349–383 (2017).

<http://dx.doi.org/10.1016/j.laa.2017.04.007>

267. "Fast approximate computations with Cauchy matrices and polynomials", *Mathematics of Computation*, in print. arXiv:1506.02285 [math.NA] (31 pages, 7 figures, 9 tables)

268. "An Efficient Computation of Generalized Inverse of a Matrix" (by V.Y. Pan, F. Soleymani and L. Zhao), *Applied Mathematics and Computation*, 316, 89–101, 2018.

<http://dx.doi.org/10.1016/j.amc.2017.08.010>

10 TALKS AND PRESENTATIONS AT PROFESSIONAL MEETINGS SINCE 1991

1991

2nd Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'91), San Francisco, California, January 1991. Refereed paper was accepted by Program Committee.

Fifth Biennial Copper Mountain Conference on Multigrid Methods, Copper Mountain, Colorado, April 1991. Refereed paper was accepted by Program Committee.

18th International Colloquium on Automata, Languages and Programming (ICALP'91), Madrid, Spain, July 1991. Refereed paper was accepted by Program Committee.

3rd Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'91), Hilton Head, South Carolina, July 1991. Refereed paper was accepted by Program Committee.

4th SIAM Conference on Applied Linear Algebra, Minneapolis, Minnesota, September 1991. Two talks at mini-symposia.

3rd IEEE Symposium on Parallel and Distributed Algorithms, Dallas, Texas, December 1991. Refereed paper was accepted by Program Committee.

1992

3rd Annual ACM-SIAM Symposium on Discrete Algorithms, Orlando, Florida, January 1992. Refereed paper was accepted by Program Committee.

Israel Symposium on the Theory of Computing and Systems (ISTCS'92), Haifa, Israel, May 1992. Refereed paper was accepted by Program Committee.

4th Annual ACM Symposium on Parallel Algorithms and Architectures (SPAA'92), San Diego, California, June-July 1992. Two refereed papers were accepted by Program Committee.

33rd Annual IEEE Conference on Foundations of Computer Science (FOCS'92), Pittsburgh, Pennsylvania, October 1992. Three refereed papers were accepted by Program Committee.

Second Biennial Copper Mountain Conference on Iterative Methods, Copper Mountain, Colorado, April 1992. Refereed paper was accepted by Program Committee.

1993

Panamerican Workshop for Applied and Computational Mathematics, Caracas, Venezuela, January 1993. Three refereed papers were accepted by Program Committee.

Workshop on Applicable Algebra, Obervolfach, Germany, February 1992. Invited talk (30 minutes).

Annual ACM International Symposium on Symbolic and Algebraic Computations (IS-SAC'93), Kiev, Ukraine, July 1993. Refereed paper was accepted by Program Committee.

3rd SIAM Conference on Linear Algebra, Seattle, Washington, August 1993. Invited talk at mini-symposium (30 minutes).

884th Meeting of the American Mathematical Society, Syracuse, New York, September 1993. Invited talk (30 minutes).

34th Annual IEEE Conference on Foundations of Computer Science, Palo Alto, California, November 1993. Refereed paper was accepted by Program Committee.

Workshop on Parallel Algorithms, DIMACS, Rutgers University, New Jersey, November 1993. Invited talk (30 minutes).

1994

5th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'94). Two refereed papers were accepted by Program Committee.

Third Biennial Colorado Conference on Iterative Methods (CCIM'94), Breckenridge, Colorado, April 1994. Refereed paper was accepted by Program Committee.

5th SIAM Conference on Applied Linear Algebra, Snowbird, Utah, June 1994. Three refereed papers were accepted by Program Committee.

First International Symposium on Parallel Algebraic and Symbolic Computation (PASCO'94), Linz, Austria, September 1994. Refereed paper was accepted by Program Committee.

35th Annual IEEE Conference on Foundation of Computer Science (FOCS'94), Santa Fe, New Mexico, November 1994. Refereed paper was accepted by Program Committee.

1995

Annual ACM Symposium on Theory of Computing (STOC'95), Las Vegas, Arizona, May 1995. Refereed paper was accepted by Program Committee.

25th AMS-SIAM Summer Seminar on Mathematics of Numerical Analysis, Park City, Utah, July-August 1995. Invited plenary talk (1 hour).

Seminar on Real Computation and Complexity, Schloss Dagstuhl, Germany, November 1995. Invited talk (45 minutes).

1996

7th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'96), Atlanta, Georgia, January 1996. Refereed paper was accepted by Program Committee.

Fourth Biennial Copper Mountain Conference on Iterative Methods, Copper Mountain, Colorado, April 1996. Refereed paper was accepted by Program Committee.

NATO Advanced Study Workshop on Algorithms for Sparse Large Scale Linear Systems, Las Palmas de Grand Canaria, Spain, June 1996. Invited Talk (1 hour).

Workshop on Symbolic - Numeric Algebra for Polynomials (SNAP'96), INRIA Sophia Antipolis, France, July 1996. Invited talk (45 minutes).

International Conference on Structured Matrices, Cortona, Italy, September 1996. Two refereed papers were accepted by Program Committee.

1997

International Conference on Foundation of Computational Mathematics (FoCM), Rio de Janeiro, Brazil, January 1997. Invited semi-plenary talk (50 minutes) and invited talk (30 minutes).

FRISCO Open Workshop 97, INRIA Sophia Antipoles, France, March 1997. Invited talk (20 minutes).

The 29th Annual ACM Symposium of Theory of Computing (STOC'97), El Paso, Texas, May 1997. Refereed paper was accepted by Program Committee.

The 13th Annual ACM Symposium on Computational Geometry, Nice, France, June 1997. Refereed paper was accepted by Program Committee.

Faddeev Memorial International Algebraic Conference, St. Petersburg, Russia, June 1997. Invited talk (45 minutes).

Annual ACM International Symposium on Symbolic and Algebraic Computation (IS-SAC'97), Maui, Hawaii, August 1997. Refereed paper was accepted by Program Committee.

Second ACM International Symposium on Parallel Symbolic Computation (PASCQ'97), Maui, Hawaii, August 1997. Refereed paper was accepted by Program Committee.

1998

9th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'98), January 1998, San Francisco, California. Refereed paper was accepted by Program Committee.

Fifth Biennial Copper Mountain Conference on Iterative Methods, March 1998. Copper Mountain, Colorado. Refereed paper was accepted by Program Committee.

933rd AMS Meeting, April 1998, Philadelphia. Invited talk at mini-symposium.

30th Annual ACM Symposium on Theory of Computing (STOC'98), May 1998, Dallas, Texas. Refereed paper was accepted by Program Committee.

Kurosh Memorial Algebraic Conference, June 1998, Moscow, Russia. Invited talk at mini-symposium.

International Seminar on Real Computation and Complexity, June 1998, Dagstuhl, Germany. Invited talk (45 minutes).

SIAM Annual Meeting, July 1998, Toronto, Canada. Invited talk at mini-symposium.

Annual International Conference IMACS on Application of Computer Algebra (ACA), August 1998, Praha, Czech Republic. Two invited talks at two mini-symposia.

Annual ACM International Symposium on Symbolic and Algebraic Computations (IS-SAC'98), August 1998, Rostock, Germany. Refereed paper was accepted by Program Committee.

5th International Symposium on Solving Irregularly Structured Problems Parallel (IR-REGULAR'98), August 1998, Berkeley, California. Refereed paper was accepted by Program Committee.

MSRI Workshop on Solving Systems of Equations, September 1998, Berkeley, California. Invited talk (30 minutes).

39th Annual IEEE Conference on Foundations of Computer Science (FOCS'98), October 1998, Palo Alto, California. Refereed paper was accepted by Program Committee.

1999

10th Annual ACM-SIAM Symposium on Discrete Algorithms (SODA'99), January 1999, Baltimore, Maryland. Refereed paper was accepted by Program Committee.

13th International Parallel Processing Symposium and 10th Symposium on Parallel and Distributed Computing (IPPS/SPDP'99), San Juan, Puerto Rico, April 1999. Refereed paper was accepted by Program Committee.

31st Annual ACM Symposium on Theory of Computing (STOC'99), May 1999, Atlanta, Georgia. Refereed paper was accepted by Program Committee.

2nd International Workshop on Computer Algebra in Scientific Computing (CASC'99), June 1999, Munich, Germany. Invited lecture (45 minutes).

Annual International Conference IMACS on Application of Computer Algebra (ACA), June 1999, El Escorial, Madrid, Spain. Two invited lectures at two mini-symposia.

1999 AMS-IMS-SIAM Summer Research Conference on Structured Matrices in Operator Theory, Numerical Analysis, Control, Signal and Image Processing, June-July 1999, Boulder, Colorado. Invited lecture (45 minutes).

Annual Intern. Colloquium of Automata, Languages, and Programming (ICALP'99), July 1999, Praha, Czech Republic. Refereed paper was accepted by Program Committee.

International Symposium on Foundations of Computational Mathematics (FoCM'99), July 1999, Oxford, England. Four invited talks at three mini-symposia.

2000

11th Annual ACM-SIAM Symposium on Discrete Algorithm (SODA'2000), January 2000, San Francisco. Refereed paper was accepted by Program Committee.

Sixth Biennial Copper Mountain Conference on Iterative Methods (Copper'2000), April 2000, Copper Mountain, Colorado. Refereed paper was accepted by Program Committee.

2nd Conference on Numerical Analysis and Applications (NAA'2000), June 2000, Rousse, Bulgaria. Invited plenary talk (1 hour).

Annual International Conference IMACS on Application of Computer Algebra (ACA), June 2000, St. Petersburg, Russia. Invited plenary talk (50 minutes) and invited talk at mini-symposium.

14th International Symposium on Mathematical Theory of Network and Systems (MTNS'2000), June 2000, Perpignan, France. Invited talk at mini-symposium.

The Smalefest Conference in Hong Kong, July 2000. Two papers were refereed and accepted for the proceedings.

Annual ACM International Symposium on Symbolic and Algebraic Computation (IS-SAC'2000), August 2000, St. Andrew's, Scotland. Refereed paper was accepted by Program Committee.

2001

International Conference on Complex Analysis and Applications. Moscow, Russia, June 2001. Invited talk (45 minutes) and a refereed paper accepted for the proceedings.

SIAM Annual Meeting, San Diego, California, July 2001. Invited talk at mini-symposium.

Annual ACM International Symposium on Symbolic and Algebraic Computations (IS-SAC'2001), London, Ontario, Canada, July 2001. Refereed paper was accepted by the Program Committee.

2001 AMS-IMS-SIAM Summer Research Conference on Fast Algorithms in Mathematics, Computer Science, and Engineering. S. Hadley, Massachusetts, August 2001. Invited Lecture (45 minutes).

2002

Annual International Symposium on Theoretical Aspects of Computer Science (STACS). March 2002, Juan Les Pins, France. Refereed paper was accepted by the Program Committee.

Seventh Biennial Copper Mountain Conference on Iterative Methods (Copper'2002), March-April 2002, Copper Mountain, Colorado. Refereed paper was accepted by the Program Committee.

International Conference on Structured Matrices, May-June 2002, Hong Kong, China. Invited talk at a mini-symposium.

First Joint Meeting of the American Mathematical Society and Unione Matematica Italiana (AMS/UMI'2002), Pisa, Italy, June 2002. Invited talks at a session.

Annual International Conference IMACS on Application of Computer Algebra (ACA), Volos, Greece, June 2002. Two invited talks at two mini-symposia.

Annual ACM Intern. Symposium Symbolic and Algebraic Computation (ISSAC'2002), Lille, France, July 2002. Refereed paper was accepted by the Program Committee.

International Symposium on Foundations of Computational Mathematics (FoCM'2002), Minneapolis, Minnesota, August 2002. Two invited talks at a mini-symposium.

5th Annual Conference on Computer Algebra in Scientific Computing (CASC'2002), Yalta, Crimea, Ukraine, September 2002. Refereed paper was accepted by the Program Committee.

2003

International Seminar on Matrix Methods and Operator Equations, Moscow, Russia, June 2003. Invited talk.

Workshop on Nonlinear Approximation in Numerical Analysis, Moscow, Russia, June 2003. Invited talk.

SIAM Conference on Linear Algebra (LA'03), Williamsburg, Virginia, July 2003. Invited talk at a mini-symposium and a contributed talk.

9th Annual International Conference on Applications of Computer Algebra (ACA'2003), Raleigh, North Carolina, July 2003. An invited talk at mini-symposium.

6th Annual Conference on Computer Algebra in Scientific Computing (CASC'2003), Passau, Germany, September 2003. Refereed paper was accepted by the Program Committee.

2004

Eighth Biennial Copper Mountain Conference on Iterative Methods (Copper'2004), March-April 2004, Copper Mountain, Colorado. Refereed paper was accepted by the Program Committee.

Mathematics of Computer Algebra and Analysis (MOCAA'2004). A talk by invitation by Program Committee.

16th International Symposium on Mathematical Theory of Network and Systems (MTNS'2004), July 2004, Leuven, Belgium. Refereed paper was accepted by the Program Committee.

6th Annual Conference on Computer Algebra in Scientific Computing (CASC'2003), July 2004, St. Petersburg, Russia. Refereed paper was accepted by the Program Committee.

6th International Mathematica Symposium (IMS 2004), August 2004, Banff, Canada, Refereed paper was accepted by the Program Committee.

2nd International Conference on Structured Numerical Linear Algebra Problems: Algorithms and Applications (Cortona 2004), September 2004, Cortona, Italy. Invited talk (30 minutes).

2005

International Conference on Matrix Methods and Operator Equations, Moscow, Russia, June 2005. Invited talk (30 minutes).

16th Annual ACM-SIAM Symposium on Discrete Algorithm (SODA'2005), January 2005, Vancouver, Canada. Refereed paper was accepted by Program Committee.

International Conference on Foundation of Computational Mathematics (FoCM'2005), July 2005, Santander, Spain. Two invited talks (50 minutes and 25 minutes) at two mini-symposia.

International Workshop on Symbolic-Numeric Computation, July 2005, Xi'an, China. Invited plenary talk (one hour).

Conference on Applications of Computer Algebra, July-August 2005, Nara, Japan. Invited talk at mini-symposium.

2006

Nineth Biennial Copper Mountain Conference on Iterative Methods (CMCIM'06), April 2006, Copper Mountain, Colorado. Refereed paper was accepted by the Program Committee.

International Conference on Algebraic Computational Geometry, Nice, France, June 2006. Invited talk (30 minutes).

Conference on Applications of Computer Algebra, Varna, Bulgaria, June 2006. Two invited talks at a mini-symposium.

SIAM Annual Meeting, Boston, Massachusetts, July 2006. Refereed paper was accepted by the Program Committee.

2007

The 6th International Congress on Industrial and Applied Mathematics (ICIAM'2007), Zurich, Switzerland, July 2007. Invited talk at a mini-symposium.

2nd International Conference on Matrix Methods and Operator Equations, Moscow, Russia, July 2007. Invited talk (30 minutes).

International Workshop on Symbolic-Numerical Computations (SNC'2007), London, Ontario, Canada, July 2007. Three refereed papers were accepted by the Program Committee.

2008

Tenth Biennial Copper Mountain Conference on Iterative Methods (CMCIM'06), April 2008, Copper Mountain, Colorado. Refereed paper was accepted by the Program Committee.

Third International Computer Science Symposium in Russia (CSR'2008), June 2008, Moscow, Russia. Refereed paper was accepted by the Program Committee.

The XIX International Workshop on Operator Theory and its Applications, July 2008, Williamsburg, Virginia. Invited talk at a mini-symposium.

Structured Linear Algebra Problems: Analysis, Algorithms, and Applications, Cortona, Italy, September, 2008. Invited talk, 30 minutes.

2009

International Conference on Polynomial Computer Algebra, St. Petersburg, Russia, April 2009. Invited Speaker.

The 3rd International Workshop on Symbolic-Numeric Computation (SNC 2009), Kyoto, Japan, August 2009. Invited talk (1 hour) and a refereed paper was accepted by the Program Committee.

SIAM Conference on Applied Linear Algebra, Oct. 26-29, Seaside, California, Oct. 26-29. Two invited talks at two mini-symposia.

2010

International Conference on Polynomial Computer Algebra, St. Petersburg, Russia, April 2010. Invited Speaker.

The Fifth International Computer Science Symposium in Russia (CSR'2010), June 2010, Kazan, Russia. Refereed paper was accepted by the Program Committee.

The 16-th ILAS Conference, Pisa, Italy, June 2010. Invited talk, 30 minutes.

Annual ACM International Symposium on Symbolic and Algebraic Computation (ISAAC'2001), Munich, Germany, July 2010. Refereed paper was accepted by the Program Committee.

2011

Annual ACM SIGSAM International Symposium on Symbolic and Algebraic Computation (ISAAC'2011), San Jose, CA, June 8-11, 2011. Refereed paper was accepted by the Program Committee.

The 4th International Workshop on Symbolic-Numeric Computation (SNC'2011), San Jose, CA, June 7-9, 2011. Refereed paper was accepted by the Program Committee.

3rd International Conference on Matrix Methods in Mathematics and Applications, Moscow, Russia, June 22-25, 2011. Plenary talk (1 hour) and invited talk (30 minutes).

The 7th International Congress on Industrial and Applied Mathematics (ICIAM'2011), Vancouver, British Columbia, Canada, July 18-22, 2011. Invited talk at a mini-symposium (30 minutes).

2012

SIAM International Conference on Linear Algebra, Valencia, Spain, June 18-22, 2012. Invited talk at a mini-symposium (30 minutes).

14th Annual Conference on Computer Algebra in Scientific Computing (CASC'2012), September 3-6, 2012, Maribor, Slovenia. Two refereed papers were accepted by the Program Committee.

2nd International Conference on Structured Numerical Linear Algebra Problems: Algorithms and Applications (Leuven 2012), September 10-14, 2012, Leuven, Belgium. Invited talk (30 minutes).

2013

The 17-th ILAS Conference, Providence, R.I., June 3-7, 2013. Four invited talks at three mini-symposia (30 minutes each).

Annual ACM SIGSAM International Symposium on Symbolic and Algebraic Computation (ISAAC'2013), Boston, Massachusetts, June 23-26, 2013. Refereed paper was accepted by the Program Committee.

15th Annual Conference on Computer Algebra in Scientific Computing (CASC'2013), September 9-13, 2013, Berlin, Germany. A refereed paper was accepted by the Program Committee.

2014

The Ninth International Computer Science Symposium in Russia (CSR'2014), June 2014, Moscow, Russia. Refereed paper was accepted by the Program Committee.

The 5th International Workshop on Symbolic-Numeric Computation (SNC'2014), July 2014, Shanghai, China. Two refereed paper were accepted by the Program Committee.

16th Annual Conference on Computer Algebra in Scientific Computing (CASC'2014), September 8-12, 2014, Warsaw, Poland. Two refereed papers have been accepted by the Program Committee.

3rd International Conference on Structured Numerical Linear Algebra Problems: Algorithms and Applications, September 8-12, 2012, Kalamata, Greece. Invited talk (30 minutes).

2015

The 26th International Workshop on Operator Theory and its Applications, July 6–10, 2015, Tbilisi, Georgia. Invited talk at a mini-symposium (30 minutes).

Conference on Applications of Computer Algebra, Kalamata, Greece, July 20-23, 2016. Invited talk at a mini-symposium (30 minutes).

17th Annual Conference on Computer Algebra in Scientific Computing (CASC'2014), September 10–14, 2015, Aachen, Germany. Two refereed papers have been accepted by the Program Committee.

4th International Conference on Matrix Methods in Mathematics and Applications (MMMA-2015), August 24–28, 2015, Skolkovo/Moscow, Russia. Invited talk at a mini-symposium (30 minutes).

2015 SIAM Conference on Applied Linear Algebra, October 26–30, 2015, Atlanta, Georgia, USA. Invited talk at a mini-symposium (30 minutes).

2016

The Eleventh International Computer Science Symposium in Russia (CSR'2016), June 2016, Moscow, Russia. Refereed paper was accepted by the Program Committee.

Milestones in Computer Algebra (MICA 2016), July 16–18, 2016, University of Waterloo, Canada. Invited talk at a mini-symposium (30 minutes).

Workshop on Fast Direct Solvers, November 12–13, 2016, Purdue University, West Lafayette, Indiana. Invited talk (50 minutes).

2017

SIAM Conference on Computational Science and Engineering, February–March 2017, Atlanta, Georgia, USA. Invited talk at a mini-symposium (30 minutes).

INdAM Meeting –Structured Matrices in Numerical Linear Algebra: Analysis, Algorithms and Applications, Cortona, Italy, September 4-8, 2017. Invited talk (30 minutes).

11 MANIFESTO – MY RESEARCH

I have been working in Mathematics, Computational Mathematics, and Computer Science for more than five decades, facing research challenges and seeking new insights and novel methods. I was thrilled whenever I discovered new keys that opened challenging scientific locks, particularly when *a single key opened a number of locks*, as this was the case with my techniques of active operation/linear substitution, trilinear aggregation, and transformation of matrix structures.

My work has contributed to the creation of the fields of the *Complexity of Algebraic Computations* and *Algebraic Multigrid* and to significantly advancing some other research

areas such as, *fast and processor-efficient parallel algorithms, computations with structured matrices* and *Symbolic-Numerical Computations*. My techniques, insights, concepts and definitions are commonly used, sometimes as folklore.

My research has revealed a number of important but hidden links among apparently distant subjects and helped bring together research in various areas of computing such as symbolic computations, numerical computations, theoretical computer science and applied linear algebra, achieving synergy by combining the techniques from distinct areas.

I am grateful for recognition and support of my research by leading experts, foundations (I received from National Science Foundation (NSF) over \$2,500,000 for 1980-2020 and over \$1,000,000 of them for 2016-2020), journals, professional societies, research centers and universities (over \$130,000 came from the City University of New York (CUNY) in 1989–2018). Enthusiastic reviews and citations of my work appeared in books, journals, and magazines. In 2013 I was designated a Fellow of American Mathematical Society “*For Contributions to the Mathematical Theory of Computation*”.

According to Google Scholar and DBLP, I published four books (1623+LXXIV pages overall), over 20 surveys in journals and book chapters, over 170 research articles in journals and over 90 in refereed conference proceedings. Almost all my publications are in *Computer Science* and *Computational and Applied Mathematics*. I have also disseminated my research findings through research reports, lectures at the universities, research centers and professional conferences worldwide, the Internet, and personal communication.

I published dozens of papers jointly with my current and former students; some of them continued joint research with me for more than a decade after the defense.

12 MY RESEARCH JOURNEY

12.1 Education and research areas

Next I will comment on my education and then on my research in ten major subject areas of Computer Science and Computational Mathematics. I will not cover my work of 1965–75 in Economics in the USSR and a number of my more sporadic research excursions into other areas. I will use the *acronyms* listed in Section 12.16 and followed by the list of the references cited in this section, and I will also refer to my works cited in the section PUBLICATIONS (COMPLETE LIST).

My scientific destiny was decided in the 59th high school in Moscow, Russia, celebrated for having excellent teachers in mathematics. I was among many of its graduates who went to the famous MechMat Department of Moscow State University (MGU), headed by *Andrey Nikolaevich Kolmogorov*. He was one of the greatest mathematician of his time, and so was his student Vladimir Igorevich Arnold, also a graduate from the 59th school in Moscow.

My adviser *Anatoli Georgievich Vitushkin*, a world leading expert in the theory of functions of real and complex variables and a member of the Russian Academy of Sciences, was among Kolmogorov’s distinguished disciples. He has also worked with a versatile scientist Alexander Semenovich Kronrod and like Kolmogorov and Kronrod had broad scientific interests.

From 1956 to 1961 I enjoyed learning mathematics in MechMat of MGU. My first journal paper appeared in 1958 and was on the real function theory, but at that time Vitushkin guided me into *research in Computational Mathematics*, and from 1959 to 1964 almost all my publications as well as my PhD Thesis were in that field.

Having defended that thesis in 1964, I had been making living by working and publishing in Economics rather than mathematics because job market in the USSR was quite restricted for people of Jewish ethnicity, like myself. In 1976 I emigrated to the USA and since 1977 have been working entirely in Computer Science and Computational Mathematics (see my employment history).

12.2 My first scientific breakthrough: polynomial evaluation

In 1962, by introducing a novel technique of active operation/linear substitution, I proved *optimality of the classical algorithm for polynomial evaluation*, commonly called Horner's. This gave positive answer to a question asked by Alexander Markowich Ostrowsky in 1955. Volker Strassen and Shmuel Winograd adopted my technique for proving the optimality of classical algorithms for some fundamental matrix computations (see Section 2.3 of [BM75]).

In that period I also accelerated polynomial evaluation by means of pre-processing.

My work has been surveyed in my paper [P66] and in the most fundamental Computer Science book [K81/97] by Donald E. Knuth, which cites my work and that of R.P. Brent most extensively among all its cited authors. The paper [P66] has made considerable impact in the West, leading to the emergence of the field of *Complexity of Algebraic Computations*.

I have become known in the West as "*polynomial Pan*".

12.3 My second scientific breakthrough: fast matrix multiplication by means of trilinear decomposition and aggregation

Matrix multiplication (hereafter referred to as MM) is one of the central subjects of the theory and practice of computing, and the scientific world was tremendously impressed in 1969, when Strassen decreased the classical exponent 3 of MM to $\log_2 7 \approx 2.808$, that is, performed MM by using less than cubic time. In my book and review article in SIAM Review in 1984, both much cited at that time, I praised his discovery as well as his subsequent extensive work on algebraic computations, while he himself has been attracted to this field by my paper [P66] and has paid tribute to my work in his chapters, both called "*Pan's method*", in [S72] and [S74].

Further progress toward performing MM in quadratic time was expected to come shortly, but all attempts to decrease the exponent 2.808 defied worldwide effort for almost a decade, until I decreased it in 1978.

My work was most widely recognized as a long-awaited breakthrough. The following excerpt from a letter by Donald E. Knuth is quoted here with his permission.

"I am convinced that his research on matrix multiplication was the most outstanding event in all of theoretical computer science during 1978. The problem he solved, to multiply $n \times n$ matrices with less than $O(n^{\log_2 7})$ operations, was not only a famous unsolved problem for many years, it also was worked on by all of the leading researchers in the field, worldwide. Pan's breakthrough was based on combination of brilliant ideas, and there is no telling what new avenues this will open."

Indeed my techniques prompted fast new progress in the field, with my participation. I have become widely known as "*matrix Pan*" and to the experts as "*matrix and polynomial Pan*".

I devised my fast MM algorithms by means of

(i) reducing the bilinear problem of matrix multiplication to the equivalent problem of trilinear (tensor) decomposition and

(ii) nontrivially exploiting its cyclic symmetry in the case of matrix multiplication.

My combination of the two techniques, called *trilinear aggregation* in [P78], was not new in 1978, however, – it was introduced in my paper [P72] (in Russian). Its implementation in [P72] only supported an exponent below 2.85, but a better implementation in [P82] yielded an exponent below 2.7734. The paper [P72] was translated into English only in 2014, in arXiv:1411.1972, and was little known in the West until 1978.

Actually my trilinear aggregation technique of 1972 was a historic landmark on a wider scale. *It produced the first nontrivial decomposition of a tensor and the associated trilinear form that defined a new efficient algorithm for matrix computations.* Subsequently tensor decomposition has become a popular tool for devising highly efficient matrix algorithms in many areas of scientific computing. Says E.E. Tyrtysnikov, a renowned expert in tensor decomposition:

“We should be especially thankful to Victor Pan for the link between the bilinear algorithms and trilinear tensor decompositions. Although it looks simple and even might be regarded as a folklore by now, this observation still has its creator, and by all means and for all I know it is due to the work of Victor Pan written in the Soviet period of his life.”

Since 1978 my trilinear aggregation has been routinely employed by myself and my successors for devising new fast MM algorithms. After the stalemate from 1969 to 1978 the MM exponent was decreased several times in 1979–1981, then again twice in 1986, reaching the record value 2.376 in [CW86/90]. It was decreased again in 2010–2014, but only nominally. Every decrease relied on amazing novel techniques built on the top of the previous ones, always employing the reduction of the MM problem to trilinear aggregation, as has been pointed out on page 255 of the celebrated paper [CW86/90].

As Arnold Schönhage has written at the end of the introduction of his seminal paper [S81], however, *all these exponents of MM have been just “of theoretical interest”.* *They hold only for inputs “beyond any practical size”, and “Pan’s estimates of 1978 for moderate” input sizes were “still unbeaten”.* Actually in [P79], [P80], [P81] and [P82], I successively decreased my record exponent for feasible MM (that is, for MM of moderate sizes $n \times n$, say, up to $n \leq 1,000,000,000$). My exponent of [P82], below 2.7734, still remains the record by the end of 2017. All smaller exponents have been obtained by ignoring the *curse of recursion*, that is, by means of applying long recursive processes, each squaring the input size. The resulting algorithms beat the classical one only for inputs of immense sizes.

My algorithms promise to be highly efficient in practice: the implementations by Igor Kaporin of an algorithm from [P84a] in [K99] and of that of [LPS92] in [K04] use substantially smaller computer memory and are more stable numerically than Strassen’s algorithm.

I surveyed the progress up to the date in a book [P84b] and long papers [P84a] and [P17]. In 1984 I focused on the decrease of the exponent of MM because this was the focus of the research community, but in 2017 I paid much more attention to the acceleration of feasible MM.

In [HP98], jointly with my student Xiaohan Huang, I accelerated rectangular MM, which implied new record complexity estimates for the computations of the composition and factorization of univariate polynomials over finite fields.

12.4 Hierarchical aggregation as a springboard for the Algebraic Multigrid (1980). Compact Multigrid (1990–1993)

In [MP80], jointly with Miranker, I introduced hierarchical aggregation/disaggregation processes, substantially responsible for the emergence of the popular field of *Algebraic Multigrid*.

Jointly with Reif, in SPAA 1990, SIAM J. of Scientific and Statistical Computing 1992 and CAMWA 1990 and 1993, I proposed a simple but novel acceleration technique of *Compact Multigrid*.

12.5 Parallel algebraic and graph algorithms (1985–2001)

Throughout the years of 1985–2001, prompted by high recognition of my joint paper with John H. Reif at STOC 1985, I proposed, both with coauthors and by myself, a variety of new efficient parallel algorithms and in particular a number of fast and processor-efficient parallel algorithms for computations with matrices, polynomials, and graphs. They relied on our novel nontrivial techniques, and I regularly presented them at the most competitive conferences in this field such as ACM STOC, IEEE FOCS, ICALP and ACM-SIAM SODA and published them in leading journals such as SICOMP, JCSS, Algorithmica and Information and Computation.

a) *Fast and processor efficient algorithms for matrix and polynomial computations.* In STOC 1985, jointly with Reif I introduced fast and processor efficient parallel algorithms for the solution of dense and sparse linear systems of equations. The study of processor efficiency of fast parallel algorithms was a novelty at that time. In 1985–86 this work was covered in the magazines *Science*, *Science News*, and *Byte*. The algorithm for sparse linear systems of equations has been implemented on the supercomputers of NASA and Thinking Machines Corp. By myself and jointly with coauthors I continued working on parallel matrix and polynomial computations for more than a decade. We proposed nontrivial novel techniques, extended the list of the known fast and processor efficient parallel algorithms, and improved the known complexity bounds for the following fundamental computational problems: (i) the solution of general and structured linear systems of equations with integer input (see my papers in TCS 1987, IPL 1989, and SICOMP 2000) and over abstract fields (see my paper in CAMWA 1992 and my joint papers with Bini and Gemignani in ICALP 1991 and Kaltofen in SPAA 1991 and FOCS 1992), (ii) the computation of polynomial greatest common divisors (GCDs), least common multiples, and Padé approximations (see my papers in CAMWA 1992 and TCS 1996), (iii) polynomial division (see my joint papers with Bini in J. of Complexity 1986, FOCS 1992, and SICOMP 1993), and (iv) the computation of the determinant, the characteristic polynomial, and the inverse of a matrix (see my joint papers with Galil in IPL 1989 and Huang in J. of Complexity 1998).

b) *Graph algorithms.* To obtain fast and processor efficient parallel algorithms for the computation of matchings and paths in graphs, I have extended the known nontrivial reductions to matrix computations and applied some novel techniques for these computations. I published these results in FOCS 1985 and Combinatorica 1988 jointly with Galil, in JCSS 1989, IPL 1991, and SICOMP 1993 jointly with Reif, in SICOMP 1995 jointly with Preparata, in Algorithmica of 1997 jointly with Han and Reif, and in my own chapter in the Handbook on Computer Science of 1993.

c) In my joint works with Shallcross and my student Lin-Kriz, I proved the *NC-equivalence* of the integer GCD and planar integer linear programming problems, which was a well-known theoretical challenge (see our papers in SODA 1992, FOCS 1993 and SICOMP 1998).

12.6 Univariate polynomial root-finding (1985–2017). Nearly optimal solution of a four millennia old problem

Univariate polynomial root-finding has been central in mathematics and applied mathematics for four millennia. It was studied already on Sumerian clay tablets and Egyptian papyrus scrolls but has modern applications to signal processing, financial mathematics, control theory, computational algebraic geometry and geometric modeling.

Hundreds of efficient algorithms have been proposed for its solution. Two-part book published with Elsevier, by J.M. McNamee in 2007 (354 pages) and jointly by J.M. McNamee and myself in 2013 (728 pages), covers nearly all of them up to the date, in a *unique comprehensive coverage of this popular subject area*.

Since 1985 I have been doing research in that area and in the related areas of computation of approximate polynomial GCDs, matrix eigenvalues and eigenvectors, and the solution of a system of multivariate polynomial equations. Next I briefly outline some of my results referring the reader for further information to my papers cited below in parts (a)–(g) and the papers (individual and joint with my students) in FOCS 1985 and 1987, CAMWA 1985, 1987, 1995, 1996, 2011 (two papers), and 2012 (two papers, one of them joint with McNamee), SICOMP 1994, J. of Complexity 1996 and 2000 (four papers), JSC 1996, ISSAC 2010 and 2011, and SNC 2011 and 2014 (two papers).

a) In STOC 1995 (and also in CAMWA 1996, ISSAC 2001, and JSC 2002) I combined the advanced techniques by Schönhage and by Neff and Reif with my novelties in exploiting the geometry of the complex plane, precision control by using Padé approximation, and recursive lifting and descending. As a result I have substantially accelerated the known algorithms. My resulting divide-and-conquer algorithms of STOC 1995 approximate all roots of a univariate polynomial nearly as fast as one can access the input coefficients, in *optimal* (up to a polylogarithmic factor) *Boolean time*. I have surveyed my work up to the date in SIAM Review 1997 and more informally in American Scientist 1998. I cover it in more detail in JSC 2002 and Chapter 15 of my book of 2013, joint with McNamee and already cited.

(b) Hermann Weyl’s Quad-tree construction of 1924 enables the solution of a univariate polynomial equation in roughly quartic arithmetic time. James Renegar decreased the time bound to cubic in 1987, and I reached quadratic arithmetic time bound in J. of Complexity 2000. Most of the computations of my algorithm require low precision, and this suggested that *nearly optimal Boolean time can be also reached* based on extension or refinement of this algorithm. I have not pursued that goal, but very recently Ruben Becker, Michael Sagraloff, Vikram Sharma and Chee Yap achieved this (see [BSSY18]). Their work boosted interest to that direction because the approach promises to be practically more efficient than the divide-and-conquer method.

c) *Approximation of the real roots* of a polynomial is an important goal because in many applications, e.g., to algebraic optimization, only r real roots are of interest and because frequently they are much less numerous than all n complex roots. My algorithms (joint with my students) in SNC 2007, CAMWA 2011, CASC 2012 and 2014, TCS 2017 accelerate the known algorithms for this problem by a factor of n/r .

d) My algorithm in ISSAC 2013 and JCS 2016 (joint with Elias P. Tsigaridas) is nearly optimal for a more narrow goal of real *polynomial root-refining*, rather than root-finding. Likewise my algorithm (also joint with Elias P. Tsigaridas) at SNC 2014 and TCS 2017 refines all complex roots at a nearly optimal Boolean complexity bound.

d) Together with Bini in J. of Complexity 1996, with Bini and Gemignani in CAMWA

2004, ETNA 2004 and Numerische Mathematik 2005, with McNamee in CAMWA 2012, by myself in CAMWA 2005, and jointly with my present and former students in ISSAC 2010, CAMWA 2011, LAA 2011, CASC 2012, SNC 2014, TCS 2017 and a chapter in the SNC volume of 2007, published by Birkhäuser, I proposed *novel matrix methods for polynomial root-finding*. Unlike many previous companion matrix methods, we preserve and exploit the structure of the associated companion and generalized companion matrices, and yield numerically stable solution, while keeping the arithmetic cost at a low level.

I further extended these algorithms to the solution of the eigenproblem for a general matrix in SODA 2005 and CAMWA 2006 and 2008.

e) Jointly with Bini, I proposed and elaborated upon an algorithm that *approximates all eigenvalues of a real symmetric tridiagonal matrix by using nearly optimal Boolean time*. This is a popular and important problem of matrix computations. We proposed the first algorithm of this kind, presented in some detail in SODA 1991 and then in Computing 1992 and SICOMP 1998.

f) Computation of *approximate polynomial GCDs* has important applications in control and signal processing. My papers in SODA 1998 and Information and Computation of 2001 yielded a new insight into this computational problem by exploiting its links to polynomial root-finding, matching in a graph, and Padé approximation.

12.7 A system of multivariate polynomial equations (1996-2005). Best Paper Award

My joint papers with Bernard Mourrain in Calcolo 1996, STOC 1998 and J. of Complexity (*Best Paper Award for 2000*), with Didier Bondifalat and Bernard Mourrain in ISSAC 1998 and LAA 2000, with Bernard Mourrain and Olivier Ruatta in SICOMP 2003, and with Ioannis Z. Emiris in ISSAC 1997, JSC 2002, CASC 2003, and J. of Complexity 2005, and in the references therein, introduced and analyzed a number of novel and now popular techniques and algorithms for the approximation of the roots of dense and sparse *systems of multivariate polynomials*. The algorithms exploits the structure of the associated matrices.

12.8 Matrix structures: unification of structures, benefits (1987–2017)

This area is highly important for both theory and practice of computing. It was studied already in the 19th century and with increased intensity in the recent decades because of importance of this work for handling big data.

My contributions can be traced back to 1987 and include the results in the following directions, besides the applications to polynomial root-finding, already cited.

a) *Unification of structured matrix computations by using their displacement representation and the transformation of matrix structures*. The four most popular matrix structures of Toeplitz, Hankel, Vandermonde, and Cauchy types have different features, which allow different computational benefits. In particular, the Cauchy matrix structure, unlike the three other ones, is invariant in both row and column interchange and allows approximation by rank structured matrices, which can be highly efficiently handled by means of the Fast Multipole Method.

The matrices of all four classes share, however, an important feature: they can be represented in compressed form through their displacements of small rank. Every matrix M can be expressed via its displacements $AM - MB$ and $M - AMB$ under mild restriction on operator matrices A and B , and for each of the four classes of structured matrices and a

proper pair of operators of shift and/or diagonal scaling the displacement has small rank and thus can be represented with fewer parameters (typically with $O(n)$ parameters for an $n \times n$) structured matrix, having n^2 entries. By using advanced techniques one should extend this representation to yield dramatic saving of computer memory and time for computations with such matrices.

The approach was proposed in [KKM79] by Kailath, Kung and Morf, who demonstrated its power by multiplying by a vector an $n \times n$ Toeplitz-like matrix (having structure of Toeplitz type) by using $O(n)$ memory and $Q(n \log n)$ flops (arithmetic operations). The MBA divide-and-conquer algorithm of 1980 of Morf and of Bitmead and Anderson has extended this KKM 1979 progress to the inversion of Toeplitz-like matrices and the solution of Toeplitz-like linear system of equations, and the natural challenge was the extension to computations with the important matrix classes having other structures.

I contributed to further progress with my two books – of 1994 (with Bini) and 2001 – and dozens of papers by myself and joint with coauthors.

In ISSAC 1989 and MC 1990, I unified fast computations with the four listed matrix classes in a rather unexpected way. Namely, I observed that one can transform matrix structure at will by transforming the associated operator matrices, and moreover can do this by multiplying a given structured matrix by Hankel and Vandermonde matrices and their transposes. By applying such transformations of matrix structures one can *extend any successful algorithm for the inversion of the structured matrices of any of the four classes to the inversion of the matrices of the three other classes, and similarly for solving linear systems of equations.*

One can always use the simple reversion matrix as a Hankel multiplier and frequently can use the matrix of the discrete Fourier transform or its Hermitian transpose as a Vandermonde multiplier. In some cases such transformations enable dramatic improvement of the known algorithms.

For example, by 1989 cubic time was required for the inversion of Cauchy-like matrices and likewise for the Nevanlinna–Pick fundamental problem of rational approximation, closely linked to this task. *My transformations immediately decreased the known cubic upper bounds on the time-complexity of these highly important computational problems to nearly linear.*

Unlike the multiplication algorithm of [KKM79], the MBA inversion algorithm is numerically unstable, however, and this limits applications of the latter recipe. Later, however, *my approach has become basic for a stream of highly efficient practical numerical algorithms* for Toeplitz linear systems of equations: the algorithms begin computations with the converse reduction to the Cauchy-like case and then exploit either the invariance of Cauchy structure in row and column interchange (cf. [GKO95]) or the link of this structure to the *rank structure* of matrices and consequently to the Fast Multipole Method (cf. [CGS07], [MRT05], [XXG12]). In view of of such a link one is challenged to extend my approach to unification of computations with matrices having displacement and rank structures, which could be highly important for both theory and practice of matrix computations. Very recent progress towards meeting this unification challenge was reported in [BT17].

In 2013–2017 I extended my method to Vandermonde and Cauchy matrix-by-vector multiplication, the solution of Vandermonde and Cauchy linear systems of equations, and polynomial and rational interpolation and multipoint evaluation. For all these classical problems, the known numerical algorithms, running with bounded precision (e.g., the IEEE standard double precision), required quadratic arithmetic time, and I decreased it to nearly linear (see my papers in CASC 2013, LAA 2015 and MC, in press).

For another application of my techniques, in [P16] I formally supported empirical observation of many researchers (which *remained with no proof for decades*) that a Vandermonde matrix is ill-conditioned (that is, close to singular) unless it is close (up to scaling) to the matrix of discrete Fourier transform, whose knots are nearly equally spaced on or near the unit circle centered in the origin.

b) For *alternative and more direct unification* of computations with structured matrices of the four classes, one can express them in terms of operations with the displacements. The MBA algorithm of 1980 does this for Toeplitz-like matrices. I extend it to Cauchy-like matrices first jointly with my student Ai-Long Zheng in LAA 2000 (submitted in 1996) and then jointly with Vadim Olshevsky in FOCS 1998. In SODA 2000 and in chapter 5 of my book of 2001 I extended the MBA algorithm in a unified way for computations with various structured matrices.

c) *Efficient algorithms for structured matrices and links to polynomial and rational computations*. In SIAM Review 1992, CAMWA 1992, 1993 (jointly with my students), TCS 1996, and Annals of Numerical Mathematics 1997 (by myself), and ICALP 1999, jointly with Vadim Olshevsky, I presented new efficient algorithms for various fundamental computations with structured matrices such as computing their ranks, characteristic and minimum polynomials, bases for their null spaces, and the solutions of structured linear systems of equations. Furthermore I have also extended successful methods for computations with structured matrices to some fundamental computations with polynomials and rational functions. Conversely, in SNC 2014 and TCS 2017, jointly with Elias P. Tsigaridas, I deduced nearly optimal estimates for the Boolean complexity of some fundamental computations with Vandermonde and Cauchy matrices by reducing these computations to the ones for polynomials and modifying the known fast algorithms for the latter problems.

12.9 Newton's iteration for general and structured matrix inversion

Newton's iteration reduces matrix inversion to matrix multiplications, and this is valuable for various reasons, in particular for parallel computations. My paper with R. Schreiber in SISSC 1991 works out nontrivial initialization policies as well as some variations of the iteration that enhance performance. In Chapter 6 of my book of 2001 and in my paper with my students in MC 2006 I further improved performance by applying *homotopy continuation* techniques.

The iteration is attractive for the inversion of structured matrices, provided that the structure is preserved in iterative process. In J. of Complexity 1992, IEEE Transaction on Parallel and Distributed Systems 1993, and SIMAX 1993 I achieved this by means of *recursive re-compression*, that is, by recursively compressing displacements. This enabled *superfast solution algorithms*, running in nearly linear arithmetic time. The resulting algorithms allow processor efficient parallel implementation, and I have unified them over various classes of structured matrices. I presented these results in Chapter 6 of my book of 2001, my paper of 2010 in Matrix Methods: Theory, Algorithms and Applications, and with coauthors in LAA 2002, TCS 2004, Numerical Algorithms 2004, and MC 2006.

12.10 Computation of the determinant of a matrix

This classical problem has important applications in modern computing, e.g., to the computation of *convex hulls* and *resultants*, with further link to the solution of multivariate polynomial systems of equations.

a) In TCS 1987 (Appendix) and IPL 1988 I reduced the computation of the determinant of a matrix to the solution of linear systems of equations and then applied *p-adic lifting* to yield the solution efficiently. By extending this approach John Abbott, Manuel Bronstein and Thom Manders in ISSAC 1999, Wayne Eberly, Mark Giesbrecht and Gilles Villard in FOCS 2000, and myself jointly with Ioannis Z. Emiris in JSC 2003 obtained some of the most efficient known symbolic algorithms for the computation of the determinant of a matrix and the resultant of a polynomial system.

b) I published novel algorithms for computing determinants in TCS 1999, jointly with three coauthors from INRIA, France, and in *Algorithmica* of 2001, jointly with my student Yanqiang Yu. The algorithms perform computations with single or double IEEE standard precision, based on algebraic techniques (in the TCS paper) and on numerical techniques (in the *Algorithmica* paper), use small arithmetic time, and certify the output. The TCS paper has accelerated the computations by means of output sensitive and randomization methods, novel in this context.

12.11 Synergy of symbolic and numerical computations

Numerical and symbolic algorithms are the backbone of modern computations for Sciences, Engineering, and Signal and Image Processing, but historically these two subject areas have been developed quite independently of one another. Combination of their techniques can be highly beneficial.

Since the early 1990s I have been promoting such benefits as an organizer of conferences, as a member of their Program Committees and as the Managing Editor of four Special Issues of the *Theoretical Computer Science (TCS)* on this subject in 2004, 2008, 2011 and 2013. Perhaps even stronger impact into this direction was from my books of 1994 (joint with Dario Bini), 2001 (by myself), and 2013 (joint with John M. McNamee), and from my surveys in *SIAM Review* 1992 and 1997, in *NATO ASI Series* published by Springer 1991, *Academic Press* 1992, and *Kluwer* 1998, in the electronic proceeding of *IMACS/ACA* 1998, and in my chapters (with co-authors) in four *Handbooks* of 1999, 2004, 2009 and 2014, as well as from dozens of my research papers. For example, I have not edited a Special Issue of *TCS* on *Symbolic-Numerical Algorithms* in 2017, but the Issue published my two joint papers with Elias P. Tsigaridas and my joint paper with my student Liang Zhao, out of my four my joint papers submitted and 13 papers overall in the Issue.

12.12 Randomized preprocessing (2007–2017). Addition of chaos stabilizes fundamental numerical matrix computations

Since 2007 I have been working on randomized pre-processing of matrix computations. I have contributed a new direction, new insight, and novel techniques to the popular area of randomized matrix computations. See my papers (some joint with my students) in *SNC* 2007 (two papers) and 2009, *CSR* 2008, 2010, and 2016, *TCS* 2008, *CAMWA* 2009, *LAA* of 2009, 2010 (two papers), 2011, 2012, 2013, 2015 and 2017 (two papers), *ISSAC* 2011, *CASC* 2015, and report in arXiv: 1611.01391.

I have advanced the known numerical algorithms for both nonsingular and homogeneous singular linear systems of equations. In particular I proved that, with a probability near one, randomized multiplicative preprocessing numerically stabilizes Gaussian elimination with no pivoting (GENP) and block Gaussian elimination, and I obtained similar results for any nonsingular and well-conditioned (possibly sparse and structured) multiplicative

pre-processors and for the average input. This should embolden the search for new efficient sparse and structured multipliers, and I proposed some new classes of them. My work on this subject with my students appeared in TCS 2008, LAA 2012, LAA 2013, LAA 2015 and LAA 2017. GENP with randomized pre-processing should be practically valuable because pivoting (row/column interchange) is communication intensive and because Gaussian elimination is most used algorithm in matrix computations. Some implementation of GENP applied to an input pre-processed with ad hoc random multipliers appeared in a series of papers by Mark Baboulin et al. beginning in 2012. My study should help refine such implementations and provide formal support for this approach.

12.13 Superfast and accurate low rank approximation

By extending my randomization techniques I obtained substantial progress in the highly popular area of low rank approximation (hereafter referred to as *LRA*) of a matrix. This is one of the central problems of modern computing because of its highly important applications to numerical linear algebra, machine learning, neural networks, and data mining and analysis. In CSR 2016 (jointly with my student Liang Zhao) I proposed a new insight into this subject, provided formal support for the empirical power of various known sparse and structured multipliers and defined some new classes of efficient multipliers.

In arXiv:1611.01391 of November 2016, jointly with my students, I studied computation of LRA by using much fewer flops and memory cells than the input matrix has entries. I call such algorithms *superfast* assuming by default that they are also superefficient in using memory.

We first showed that any superfast algorithm fails to compute accurate LRA of the worst case input. Then, however, we proved that with a high probability the well-known cross-approximation algorithms (as well as some even more primitive algorithms) compute accurate LRAs (i) of a random input matrix allowing LRA, (ii) of the average input matrices allowing LRA and (iii) even of any input matrix allowing LRA and pre-processed with a Gaussian random multiplier. We proved our results in various ways, providing insights from different angles and allowing various error and probability estimates.

Since we proved that superfast LRAs fail for the worst case input, our pre-processing cannot be superfast, but empirically in our tests with benchmark inputs coming from discretized PDEs and some other real world input data, superfast pre-processing with our sparse and structured multipliers was consistently as efficient as with Gaussian random multipliers.

In our study we introduced various new insights and novel techniques for LRA and *achieved synergy* by combining some LRA techniques developed by two groups of researchers in Numerical Linear Algebra and Computer Science independently of one another.

12.14 Dramatic acceleration of celebrated matrix algorithms

In arXiv:1611.01391 we presented two surprising applications of low-rank approximation – we *dramatically accelerated the Conjugate Gradient (CG) algorithms* and the bottleneck stage of computing generators for applications of *Fast Multipoint Methods (FMM)*. In some applications these generators are given from outside, but more they typically must be computed, e.g., they must be computed superfast in order to support our acceleration of CG algorithms. Both FMM and CG algorithms are celebrated for being among the most important algorithms of the 20th century (see [C00] and [GL13]).

12.15 Concluding remarks

Throughout my career my work has advanced the state of the art of various fundamental subjects of Computational Mathematics and Computer Science such as computations with general and structured matrices, polynomials, integers and graphs, for example, polynomial evaluation, interpolation, division, factorization, and root-finding, solution of general and structured linear systems of equations, computation of linear recurrences, matching and paths in graphs, the sign and the value of the determinant of a matrix.

While devising new efficient algorithms, I proposed novel techniques and new insights and revealed hidden links among various subject areas and computational problems, e.g., (i) between matrix multiplication and tensor decomposition, (ii) among matrices with various structures, and (iii) between Fast Multipole method and Conjugate Gradient algorithms. This list can be readily extended.

My novel ideas and techniques have been well recognized, but sometimes not immediately: each of my trilinear aggregation of 1972 and my transformation of matrix structures of 1989 waited for six years before they became widely known and appreciated, the value of my contribution of 2000 to the quadtree root-finding is only now becoming recognized, and similar story may very well occur with my novel insights into and techniques for low-rank approximation as well. In such cases the contributions are appreciated and praised more than their author, who is rewarded just by witnessing the resulting progress in the field.

I have been partly responsible for the creation of the fields of *Algebraic Complexity of Computations*. My long survey [P66] inspired the interest of Volker Strassen, Shmuel Winograd and many other renowned researchers, which has led to creation of the former field.¹ Their work in turn attracted me to this field again. For another striking example of *cross-fertilization*, my renewed interest to this field was prompted by the concise but far-fetched and clear exposition in the cited book [BM75] by Allan Borodin and Ian Munro, which was the first book in Math in English that I have read after moving to the USA in 1977. In 1979 I learned from Borodin that his interest to the field was inspired by my paper [P66] and Strassen's [S69].

My paper with Willard L. Miranker [MP80] was the beginning of the field of the *Algebraic Multigrid*, now popular.

My survey in SIAM Review in 1992 and my book with Dario Bini, published by Birkhäuser in 1994 as well as dozens of my research papers (individual and joint with Dario Bini and later with my students) have demonstrated various benefits of combining Symbolic and Numerical techniques, achieving synergy and contributing to the emerging field of *Symbolic and Numerical Computations*.²

My book with Dario Bini (1994) is called "*Polynomial and Matrix Computations*" and includes a number of new research results by the authors. It covers its title subjects both thoroughly and comprehensively according to its reviews (see some excerpts below) and was frequently cited, as well as my three other books (also devoted to polynomial and

¹The next and seminal paper [W67] in this subject area begins with: "Introduction.-In reference [1], V. Ya. Pan summarized the results about the minimum number of multiplications and additions required to compute a polynomial. In particular, Pan proved that the minimum number of multiplications/divisions required to compute $P_n(x) = a_0 + a_1x + \dots + a_nx^n$ is n . The theorem of this note includes this result of Pan's as a special case, and also shows that the minimum number of multiplications/divisions required to compute the product of an $n \times n$ matrix by a vector is $m \cdot n$."

²Besides consistently producing papers on the subjects of this field (the latest three in the TCS 2017), I was the Corresponding and Managing Guest Editor of four special issues of the TCS on its subjects in 2004, 2008, 2011, and 2013.

matrix computations) and my surveys in SIAM Review on matrix multiplication (1984), polynomial and matrix computations (1992), and polynomial root-finding (1997).

Excerpts from *SIGACT News*, ACM Press, 26, 2, pages 26–27, June 1995: “We are now greeted with the release of a book covering the basic, foundational material of the algebraic algorithm field, written by the authors who are leading researchers in the field and are responsible for many of the current best algorithms. . . . For researchers in the field of algebraic algorithms, this is a “must-have” book, both as a reference and the review of basic material. . . . In conclusion, for researchers in the field of algebraic computing, I highly recommend this book as an essential addition to your bookshelf.”

Excerpts from *SIGSAM Bulletin*, ACM Press, 30, 3, pages 21–23, September 1996: “The book covers an impressive range of algorithmic issues in Theoretical Computer Science, Symbolic Computer Algebra and Numerical Computation, and the presence of several latest methods and results makes it exciting to read. It would be useful to a specialist in any of the above areas who wishes to undergo a rigorous study of polynomial or matrix operations for large problems using exact or approximate arithmetic. . . . The book is outstanding. . . . In conclusion, the book by Bini and Pan is an excellent companion for researchers and advanced students. Given, moreover, that it is a handy reference book, it should be present in every good library.”

12.16 Acronyms

”CACS” stands for ”Proceedings of Conference on Applications of Computer Algebra”

”CAMWA” stands for ”Computers and Mathematics (with Applications)”

”CSR” stands for ”Proceedings of Computer Science in Russia”

”FOCS” stands for ”Proceedings of IEEE Symposium on Foundations of Computer Science”

”ICALP” stands for ”Proceedings of International Colloquium on Automata Languages and Programming”

”IPL” stands for ”Information Processing Letters”

”ISSAC” stands for ”Proceedings of ACM International Symposium on Symbolic and Algebraic Computation”

”JCSS” stands for ”Journal of Computer and System Sciences”

”JSC” stands for ”Journal of Symbolic Computation”

”LAA” stands for ”Linear Algebra and Its Applications”

”LNCS” stands for ”Lecture Notes in Computer Science”

”MC” stands for ”Mathematics of Computation”

”SICOMP” stands for ”SIAM Journal on Computing”

”SIMAX” stands for ”SIAM Journal on Matrix Analysis and Applications”

”SNC” stands for ”Symbolic-Numerical Computations or Proceedings of Workshop on SNC”

”SODA” stands for ”Proceedings of ACM-SIAM Symposium on Discrete Algorithms”

”SPAA” stands for ”Proceedings of ACM Symposium on Parallel Algorithms and Architecture”

”STOC” stands for ”Proceedings of ACM Symposium on Theory of Computing”

”TCS” stands for ”Theoretical Computer Science”

References

- [BM75] Allan Borodin and Ian Munro, *The Computational Complexity of Algebraic and Numeric Problems*, American Elsevier, NY, 1975.
- [BSSY18] Ruben Becker, Michael Sagraloff, Vikram Sharma and Chee Yap, A Near-Optimal Subdivision Algorithm for Complex Root Isolation based on the Pellet Test and Newton Iteration, *Journal of Symbolic Computation*, 86, 51–96, May–June 2018.
- [BT17] Bernhard Beckermann and Alex Townsend, *On the singular values of matrices with displacement structure*, *SIAM J. on Matrix Analysis and Applications*, 2017.
- [C00] Barry A. Cipra, The Best of the 20th Century: Editors Name Top 10 Algorithms, *SIAM News*, 33, 4, 2, May 16, 2000.
- [CGS07] S. Chandrasekaran, M. Gu, X. Sun, J. Xia, J. Zhu, A Superfast Algorithm for Toeplitz Systems of Linear Equations, *SIAM. J. on Matrix Analysis and Applications*, 29, 4, 1247–1266, 2007.
- [CW90/86] Don Coppersmith, Shmuel Winograd, Matrix Multiplicaton via Arithmetic Progressions. *J. of Symbolic Computations*, 9, 3, 251–280, 1990. Proc. version in 19th ACM Symposium on Theory of Computing (STOC 1987), 1–6, ACM Press, New York, NY, 1987. Also Research Report RC 12104, IBM T.J. Watson Research Center, August 1986.
- [GKO95] Israel Gohberg, Thomas Kailath, and Vadim Olshevsky, Fast Gaussian Elimination with Partial Pivoting for Matrices with Displacement Structure, *Mathematics of Computation*, 64, 1557–1576, 1995.
- [GL13] Gene H. Golub, Cleve F. Van Loan, *Matrix Computations*, The Johns Hopkins University Press, Baltimore, Maryland, 2013 (fourth edition).
- [HP97] Xiohan Huang, Victor Y. Pan, Fast Rectangular Matrix Multiplication and Applications. *Journal of Complexity*, 14, 2, 257–299, 1998. Proc. version in Proc. of ACM International Symposium on Parallel Algebraic and Symbolic Computation (PASCO’97), 11–23, ACM Press, NY, 1997.
- [K81/97] Donald E. Knuth, *The Art of Computer Programming*, volume 2, Addison-Wesley, 1981 (second edition), 1997 (third edition).
- [K99] Igor Kaporin, A Practical Algorithm for Faster Matrix Multiplication, *Numerical Linear Algebra with Applications*, 6, 8, 687–700, 1999.
- [K04] Igor Kaporin, The Aggregation and Cancellation Techniques as a Practical Tool for Faster Matrix Multiplication, *Theoretical Computer Science*, 315, 2–3, 469–510, 2004.
- [KKM78] Thomas Kailath, Sun-Yuan Kung, and Martin Morf, Displacement Ranks of Matrices and Linear Equations, *Journal of Mathematical Analysis and Applications*, 68 (1979), pp. 395–407, 1979. See also Thomas Kailath, Sun-Yuan Kung, and Martin Morf, Displacement Ranks of Matrices and Linear Equations, *American Mathematical Society (New Series)*, 1, 5, 769–773, 1979.

- [LPS92] Julian Laderman, Victor Y. Pan, Xuan-He Sha, On Practical Algorithms for Accelerated Matrix Multiplication, *Linear Algebra and Its Applications*, 162–164, 557–588, 1992.
- [MP80] Willard L. Miranker and Victor Y. Pan, Methods of Aggregations, *Linear Algebra and Its Applications*, 29, 231–257 (1980).
- [MRT05] Per Gunnar Martinsson, Vladimir Rokhlin, Marc Tygert, A Fast Algorithm for the Inversion of Toeplitz Matrices, *Computers and Mathematics with Applications*, 50, 741–752, 2005.
- [P66] Victor Y. Pan, On Methods of Computing the Values of Polynomials, *Uspekhi Matematicheskikh Nauk*, 21, 1(127), 103–134, 1966. [Transl. *Russian Mathematical Surveys*, 21, 1(127), 105–137, 1966.]
- [P72] Victor Y. Pan, On Schemes for the Evaluation of Products and Inverses of Matrices (in Russian), *Uspekhi Matematicheskikh Nauk*, 27, 5 (167), 249–250, 1972.
- [P78] Victor Y. Pan, Strassen’s Algorithm Is Not Optimal: Trilinear Technique of Aggregating for Fast Matrix Multiplication, *Proc. of the 19th Annual IEEE Symposium on Foundations of Computer Science (FOCS’78)*, 166–176, IEEE Computer Society Press, Long Beach, California, 1978.
- [P79] Victor Y. Pan, Fields Extension and Trilinear Aggregating, Uniting and Canceling for the Acceleration of Matrix Multiplication, *Proceedings of the 20th Annual IEEE Symposium on Foundations of Computer Science (FOCS’79)*, 28–38, IEEE Computer Society Press, Long Beach, California, 1979.
- [P80] Victor Y. Pan, New Fast Algorithms for Matrix Operations, *SIAM J. on Computing*, 9, 2, 321–342, 1980, and Research Report RC 7555, IBM T.J. Watson Research Center, February 1979.
- [P81] Victor Y. Pan, New Combinations of Methods for the Acceleration of Matrix Multiplications, *Computers and Mathematics (with Applications)*, 7, 1, 73–125, 1981.
- [P82] Victor Y. Pan, Trilinear Aggregating with Implicit Canceling for a New Acceleration of Matrix Multiplication, *Computers and Mathematics (with Applications)*, 8, 1, 23–34, 1982.
- [P84a] Victor Y. Pan, How Can We Speed up Matrix Multiplication? *SIAM Review*, 26, 3, 393–415, 1984.
- [P84b] Victor Y. Pan, How to Multiply Matrices Faster, *Lecture Notes in Computer Science*, 179, Springer, Berlin, 1984.
- [P16] Victor Y. Pan, How Bad Are Vandermonde Matrices? *SIAM Journal of Matrix Analysis and Applications*, 37, 2, 676–694, 2016.
- [P17] Victor Y. Pan, Fast Matrix Multiplication and Its Algebraic Neighborhood, *SB MATH (Mathematical Sbornik)*, volume 208, issue 11, 2017 (in both Russian and English). DOI:10.1070/SM8833

- [S69] Volker Strassen, Gaussian Elimination Is Not Optimal, *Numerische Mathematik*, 13, 354–356, 1969.
- [S72] Volker Strassen, Evaluation of Rational Functions, in *Analytical Complexity of Computations* (edited by R.E. Miller, J. W. Thatcher, and J. D. Bonlinger), Plenum Press, New York, pages 1–10, 1972.
- [S74] Volker Strassen, Some Results in Algebraic Complexity Theory, *Proceedings of the International Congress of Mathematicians, Vancouver, 1974* (Ralph D. James, editor), Volume 1, Canadian Mathematical Society, pages 497–501, 1974.
- [S81] Arnold Schönhage, Partial and Total Matrix Multiplication. *SIAM J. on Computing*, 10, 3, 434–455, 1981.
- [W67] Shmuel Winograd, On the Number of Multiplications Required to Compute Certain Functions, *Proc. of National Academy of Sciences*, 58, 1840–42, 1967.
- [XXG12] Jianlin Xia, Yuanzhe Xi and Ming Gu, *SIAM J. on Matrix Analysis and Applications*, 33, 837–858, 2012.