Victor Pan

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Areas of Research Specialization:

- Algebraic Computation
- Numerical Computation
- Design and Analysis of Algorithms
- Computations with Dense Structured Matrices

Education:

1956-1964:	Department of Mechanics and Mathematics, Moscow University
1961:	M.S. in Mathematics
1964:	Ph.D. in Mathematics

(Thesis Advisor: A. G. Vitushkin)

Employment:

1988 -	Visiting Professor, Professor, and Distinguished Professor (since 2000) Department of Mathematics and Computer Science Lehman College, CUNY, and Graduate Center of CUNY, Ph.D. Programs in Computer Science and (since 1999) in Mathematics
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
1979-80, 1981-1991	Professor Computer Science Department State University of New York at Albany
January 1991, July-August 1992 and August 1993	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
April- June 1981	Visiting Professor Computer Science Department Stanford University, Stanford, California
1980-81	Visiting Member of the Institute for Advanced Study, Princeton, New Jersey
1977-79 and August 1980	Visiting Scientist IBM Research Center, Yorktown Heights, N.Y.
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

Consulting:

- AT&T Bell Laboratories, Murray Hill, New Jersey, 1991-1993
- General Electric Research and Development Center, Schenectady, New York, 1980

Research and Publications:

- 3 research monographs, 15 book chapters and survey articles, and over 250 refereed publications in journals and conference proceedings (see the List of Publications, Research Highlights, and Research Areas)

Advising of Ph.D. Students:

- 20 Ph.D. Defenses (see the List of Ph.D. Defenses)

Editing:

Associated Editor of

- Computers and Mathematics (with Applications), (1980-2011)
- Theoretical Computer Science (since 1985)
- Calcolo (since 1999)
- Corresponding Guest Editor of the Special Issues:

Special Issue on Algebraic and Numerical Algorithms
(I.Z. Emiris, B. Mourrain, V. Y. Pan, editors),
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. Kostserias, B. Mourrain, V. Y. Pan, editors),
Theoretical Computer Science, 412, 16, 1443-1543,

2011.

Special Issue on Algebraic and Numerical Algorithms
(II. Kostserias, B. Mourrain, V. Y. Pan, L. Zhi, editors),
Theoretical Computer Science, in preparation, 2012.

Membership in Professional Societies:

- American Math. Society
- Society for Industrial and Applied Math.
- Association for Computing Machinery
- European Association for Theoretical Computer Science

Program Committee Member for:

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 4th International Workshop on Symbolic-Numeric Computation (SNC 2007), San Jose, California, June 2011,

International Conferences on Polynomial Computer Algebra, St. Petersburg, Russia,
April 2008, 2009, 2010, 2011 and 2012.

International Symposium on Linear Algebra
(ILAS-2013), Member of the Scientific Committee.

Other Professional Activities:

- Organization of Conferences and Conference Sessions
- 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 List of Publications and Talks at the Conferences)
- Colloquium Lectures at Universities and Research Centers
- **Membership in the CUNY's Committees:**

the Distinguished Professor Selection Committee,
the Leadership Committee of the PhD Program in Computer Science

Awards and Grants:

- NSF Grants: $1,483,057, 1980-2004, 2011-2014.
- 23 PSC-CUNY Awards: $105,080, 1989-2013
- CUNY Institute for Software Design and Development Grants: $8,000, 2001-2002
- Best Paper Award 2000, Journal of Complexity: $3,000 (shared)
- 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

Languages:

- English
- Russian
- French
- Italian

Personal Data:

- Immigrated to the U.S. in 1977
- U.S. Citizen since 1982
- Married
- Hobbies: Russian Poetry, History, Mountaineering, Swimming, Skiing and Cross-country Skiing

List of the Ph.D. Students at CUNY supervised and mentored by Victor Pan

STUDENT NAME	DISSERTATION 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
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
Yu, Y.	April 1998	June 1998	Computer Science
Zheng, A.	October 16, 1997	January 1998	Mathematics

A. Atinkpahoun, O. Dias, S. Providence, A. Sadikou, A. Serme, and I. Sobze are African-American. H. Celecioglu, O. Dias and Y. Lin are female. In all the listed defenses, Victor Pan has served as the mentor, the advisor and the chair of the Examination Committees at all the defenses.

RESEARCH HIGHLIGHTS

The results of my research have been published in 4 books and over 240 research and survey articles in journals and refereed proceedings of conferences and have been surveyed in my 18 surveys in journals and book chapters. In the description below I use some abbreviations listed at the end.

1. Polynomial evaluation 1959-1966.

a) In 1962 I introduced the active operation/linear substitution method to prove the optimality of Horner's classical algorithm for polynomial evaluation. This solved A.M. Ostrowski's problem of 1955. The method was used by V. Strassen and S. Winograd for proving various other fundamental lower bounds in algebraic computing.

b) I have accelerated polynomial evaluation by using preprocessing.

The work is surveyed in my paper in Russian Math. Surveys, 1966, and in the book by D.E. Knuth, The Art of Computer Programming, volume 2, Addison-Wesley, 1998 (third edition).

2. Fast matrix multiplication (MM). In 1978 I decreased Strassen's MM exponent 2.807 of 1968-69 based on my techniques of trilinear aggregating of 1972. Decreasing the exponent was a challenge that defied a decade of worldwide effort. The effort was due to the fundamental role of MM in the theory and practice of computing. Currently the fastest known algorithms for n-by-n MM for all n from 20 to some enormous values are from my papers in SIAM Review of 1984 and (with Laderman and Sha) in LAA 1992. They rely on trilinear aggregating and have been implemented by Igor Kaporin (see his paper in TCS 2004). Trilinear aggregating is also a part of the fastest known algorithms for n-by-n MM for immense n (see JSC'90 and STOC 2012). The work (up to 1984) is surveyed in my article in SIAM Review of 1984 and my book in Springer Lecture Notes in Computer Science, volume 179, Berlin, 1984.

The current record computational complexity estimates for fast rectangular matrix multiplication were reached in my papers with X. Huang (Proc. PASCO '97 and J. of Complexity of 1998), where the estimates were also extended to similar record estimates for polynomial factoring in finite fields and parallel evaluation of the determinant of a matrix, based on my work with Z. Galil (IPL '89).

Trilinear aggregating was a novel approach to algorithm design. It begins with restating the two-dimensional matrix problem as the problem of decomposing a three-dimensional tensor. Then proper manipulation with the indices of this tensor leads to lower rank decompositions and effective algorithms. This was the first example where such a back and forth transition between matrix and tensors defined effective algorithms for some fundamental matrix computations. By now this became a highly important tool of the algorithm design in matrix computations, far beyond the area of matrix multiplication.

3. Multigrid and Algebraic multigrid methods. This popular field evolved from my paper with W. L. Miranker in LAA '80, which introduced linear aggregation/disaggregation processes. Then I left the field of multigrid methods until 1990-93 when I published four papers with J.H. Reif in Proc. SPAA'90, SIAM J. on Scientific and Stat. Computing in 1992 and in CAMWA '90 and 93, where a simple but novel acceleration technique was proposed.

4. Parallel computation.

a) Processor efficient NC and RNC algorithms for matrix computations with extensions. My paper with J. H. Reif

(Proc. STOC ‘85) on parallel solution of linear systems of equations was reviewed in the Science, Science News, and Byte magazines in 1985/86. It focused on processor efficiency of fast parallel algorithms in NC and RNC, which was an innovation in theoretical computer science. The resulting algorithm for sparse linear systems of equations (SICOMP’93) was implemented on the supercomputers of NASA and Thinking Machines. Independently, I introduced the techniques of variable diagonal, which enabled the fast and processor efficient solution of linear systems of equations and of some other fundamental problems of matrix computations with integer input (Proc. FST & TCS ‘85, TCS ‘87, IPL’89, and SICOMP ‘00). I also proposed some distinct techniques (by myself in SPAA’90, with D. Bini and L. Gemignani in ICALP’91, and with E. Kaltofen, in Proc. SPAA ’91 and Proc. FOCS ’92) for solving general and structured linear systems of equations over abstract fields; this has resolved a long standing theoretical challenge. I also extended this approach to fast and processor efficient computation of polynomial gcds, lcms and Pade approximations (TCS’96).

b) Graph algorithms. I obtained processor efficient and fast parallel algorithms for the computation of matchings and paths in graphs based on improving the known non-trivial reductions to matrix computations and on the extension of the known methods for matrix computations (Proc. FOCS ‘85 and Combinatorica of 1988 with Z. Galil, JCSS ‘89 and IPL ‘91 with J.H. Reif, my Chapter in the Handbook on Computer Science 1993, Proc. SPAA ‘92 and SICOMP ‘95 with F. P. Preparata, and Proc. SPAA ‘92 and Algorithmica of 1997 with Y. Han and J.H. Reif).

c) Polynomial division. I obtained the fastest processor efficient algorithms with D. Bini (Proc. FOCS ‘92 and SICOMP ‘93).

d) Hard theoretical problem of the NC-equivalence of the integer gcd and planar integer linear programming problems was solved by using novel techniques in Proc. SODA ‘92 (with Y. Lin-Kriz), Proc. FOCS ‘93 and SICOMP ‘98 (with D. Shallcross and Y. Lin-Kriz).

5. Symbolic-Numerical Computations (SNC).

In this large and highly important area, numerical techniques are applied to problems of symbolic computation and vice versa symbolic techniques are applied to problems of numerical computation, to the benefit of both areas. In my research and survey papers since 1991 and in two books of 1994 (with D. Bini) and of 2001, I consistently demonstrated the advantages of this kind in computations with structured matrices and in their applications to polynomial computations. In this way the highly developed numerical techniques of matrix computations can be effectively applied to the problems of polynomial computations, traditionally considered symbolic. Furthermore, both numerical and symbolic techniques can be combined for computations with structured matrices. Besides the books, see my survey articles in SIAM Review 1992 and 1997, in NATO ASI Series published by Springer 1991, Academic Press 1992, and Kluwer 1998, and in electronic proceeding of IMACS/ACA 1998, also the relevant papers in parts 6-12 below.

6. Root-finding for a polynomial and a system of polynomials. Extensions to approximate polynomial gcd.

The celebrated problem of univariate polynomial root-finding was central in mathematics and applied mathematics for about four millennia. It is still highly important to computer algebra. My algorithms (Proc. STOC ‘95/CAMWA ‘96, and Proc. ISSAC ‘01/JSC ‘02) improved the record estimates for arithmetic and Boolean complexity of the solution. The improvement (by the order of magnitude) relied on combining various known methods, in particular by A. Schönhage, P. Kirrinnis, J. Renegar, C.A. Neff and J.H. Reif, with new recursive techniques of lifting/descending and exploiting Padé approximation for numerical stabilization. The algorithms yield a nearly optimal solution (with both arithmetic and Boolean time-cost within polylogarithmic factors from

the information lower bounds) and allowed processor efficient NC parallelization to run in polylogarithmic arithmetic and Boolean time. This work (up to 1997) has been surveyed in SIAM Review of 1997 and (up to 2012) in my chapter (with I.Z. Emiris and E. Tsidaridas) in Computing Handbook Set – Computer Science, Volume 1 (Teofilo Gonzales editor). In 1996, 2000, 2005, 2007, and 2010-2012 I presented my works (some with coauthors) on polynomial root-finding in J. of Complexity 1996 (two papers) and 2000 (two papers), in CAMWA 2005 (two papers),
2011 (two papers), and 2012, in the ACM Proc. of SNC'2007 and SNC'2011 and ISSAC'2010 and in the LNCS Proc. of CASC 2012 (two papers).

a) With D.A. Bini and L. Gemignani, first in CAMWA '04 and then in ETNA'04 and Numerische Mathematiks '05, I proposed a novel distinct approach based on exploiting the structure of the associated companion and generalized companion matrices. Using matrix methods enabled numerically stable solution, while keeping arithmetic cost at a nearly optimum level due to using matrix structure. This work is surveyed in my chapter (with coauthors from CUNY) in the SNC volume of 2007 (published by Birkhauser). I further extended these algorithms to solving the eigen-problem for general matrix in Proc. SODA'05 and in CAMWA'07. I extended this work in 2009 by incorporating my novel preprocessing techniques into the inverse iteration for eigen-solving applied to companion and generalized companion matrices.
b) Polynomial root-finding algorithms were combined in Proc. SODA '98 and Information and Computation of 2001 with some graph algorithms in application to computing approximate polynomial gcd; also a new approach based on using Padé approximation was proposed in these papers;
c) A series of papers with B. Mourrain and with I.Z. Emiris have introduced and developed several novel techniques and algorithms for approximating the roots of dense and sparse systems of multivariate polynomials. The algorithms exploited the structure of the associated matrices and enabled substantial improvement of the known upper bounds on the time and memory space complexity. Sources: B. Mourrain, V.Y. Pan, J. of Complexity of 2000 (awarded by this Journal as one of its two best papers for 2000); I.Z. Emiris, V.Y. Pan, JSC '02 , Proc. CASC '03, J. of Complexity '05, and the references therein.

7. Algorithms for structured matrices. This is a highly important area for both theory and practice of computations for sciences, engineering, and signal and image processing. The subject was studied already in the 19th century and with increased intensity in the recent years. Here is a partial list of my contributions (also see the Reference below, the bibliography therein, and the list of my publications).

a) My general method of displacement transformation (Proc. ISSAC '89 and MC '90) readily extends successful algorithms from one class of structured matrices to many other classes (e.g., the extension is readily obtained in all directions among Cauchy-like, Toeplitz-like, and Vandermonde-like matrices). In particular a matrix of each of the three classes is readily expressed through its displacement defined by a pair of operator matrices of diagonal scaling and/or shift. Multiplications of a matrix by proper Vandermonde matrices and/or by the transpose of such matrices transforms the pair of operator matrices and thus transform the associated type of structure. Consequently one can readily extend every successful algorithm for matrices of one class to the matrices of the two other classes. In particular his method was the basis of the GKO celebrated algorithm by Gohberg, Kailath and Olshevsky (MC '95), which employs the multiplication by the matrix of discrete Fourier transform (which is just a special case of Vandermonde matrix) and by its transpose to reduce Toeplitz and Toeplitz-like linear systems to Cauchy-like ones. This turns out to be the critical step, and GKO and a number of successive works have produced highly effective numerical algorithms for Toeplitz and Toeplitz-like linear systems.

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b) I supported Newton-structured matrix iteration and other structured residual correction methods with nontrivial

techniques of recursive compression (also called recompression) of structured matrices (see part d below) and novel initialization techniques. The resulting superfast algorithms, allowing effective parallelization, have been unified over various classes of structured matrices.

c) With V. Olshevsky in Proc. FOCS '98, I proposed a "superfast" (that is running in nearly linear time) divide-and-conquer algorithm that was unified over various classes of structured matrices (also see my book of 2001 and the references therein)

d) Effective algorithms for compression of the displacements of structured matrices were presented in CAMWA'92, SIMAX'93, and Section 4.6 of the book of 2001. These algorithms are required to supports fast algorithms for the compression of the displacements to their rank level. This operation is required in parts b) and c).

e) New, improved algorithms for various fundamental computations with structured matrices (solving linear systems of equations and the eigenproblem, computing the rank, a basis for the null space, and the characteristic and minimum polynomials).

f) The extension of successful methods for computations with structured matrices to some fundamental polynomial and rational computations.

g) Inversion of displacement operators (with X. Wang) as a basis for decompression of structured matrices from their displacements.

5. **References:** V.Y. Pan, Structured Matrices and Polynomials: Unified Superfast Algorithms, Birkhäuser/Springer, Boston/New York, 2001, and the bibliography therein. On Newton's iteration, also see my coauthored papers in LAA'02, TCS'04, Numerical Algorithms '04, and MC '06, and my Paper of 2010 in MATRIX METHODS: THEORY, ALGORITHMS AND APPLICATIONS and the bibliography therein. See part 6 above on using matrix structure on root-finding for polynomials and systems of polynomials. See CAMWA'93 and Annals of Numerical Math. 1997 on application to polynomial evaluation.

8, Computation of the sign and the value of the determinant of a matrix. (Also see part 9 below.) The problem is important for geometric computations.

a) Two novel algorithms appeared in Proc. ACM Annual Conference on Computational Geometry of 199 and TCS '99 (with M. Bronnimann, I.Z. Emiris and S. Pion) and in Proc. SODA '99 and Algorithmica of 2001 (with Y. Yu). They perform with single or double precision (algebraically in TCS and numerically in Algorithmica), use small arithmetic time, and certify the output. The TCS paper also proposes some output sensitive technique and randomization to accelerate the computations.

b) My algorithms in TCS'87 (Appendix) and IPL'88 reduce the computation of the determinant to the solution of linear systems of equations and then apply p-adic lifting to yield the solution rapidly. These techniques have eventually evolved into one of the fastest practical symbolic algorithms for the computation of the determinant of a matrix (see J. Abbott, M. Bronstein, T. Mulders in Proc. ISSAC'99 and W. Eberly, M. Giesbrecht, G. Villard in Proc. FOCS '00).

9. p-adic lifting for linear systems and determinants. I proposed and analyzed nearly optimal exact solution algorithms for sparse and structured (e.g., Toeplitz and Toeplitz-like) systems of linear equations with integer coefficients. My approach relies on p-adic lifting combined with the divide-and-conquer algorithms (Proc. ISSAC '02 and CASC '02). I further extended these algorithms to rings instead of fields to initialize lifting modulo a power of two instead of modulo a random prime. This allowed more effective implementation. In SNC'09 I initialized Lifting by using numerical iterative refinement.

I also applied p-adic lifting to accelerate the bottleneck stage of block Hankel computations in the bloc Wiedemann algorithm for computing determinants. See Zapiski Nauchnykh Seminarov POMI 2004 (in English) and my papers (some with coauthors) in the ACM Proc. of SNC 2009, Journal of Operator Theory (2010) and CAMWA (2011).

10. **Error-free Computations via Floating-Point Operations.** In CAMWA'09, with coauthors from CUNY, I contributed to the error-free computations performed with floating-point operations. I proposed a novel summation algorithm of this class based on modular reduction of finite and infinite binary numbers. The latter idea came from the algorithms in my technical report in ICSI '92, further refined and tested with I.Z. Emiris and Y.Yu and with B. Murphy, G. Qian and R. E. Rosholt (see JSC'98 and CAMWA'09).

11. The symmetric tridiagonal eigenproblem and real polynomial roots. The first algorithm that computed all eigenvalues of a real symmetric tridiagonal matrix using nearly linear arithmetic time was proposed and elaborated upon in 1990 (with D. Bini) and published in some detail in January 1991 in Proc. SODA'91. It has journal versions in Computing 1992 and SICOMP '98. In SICOMP'98 the algorithm was also extended to nearly optimal root-finding for polynomials with only real roots.

12. Randomized preprocessing. Together with polynomial root-finding, this was my main subject since 2005. Multiplicative preconditioning is an important, popular and highly developed tool for solving linear systems of equations, but only for special classes of input matrices readily factorized or having certain properties of their singular values. I proposed novel techniques of randomized preprocessing that largely relax this restriction. The techniques handle both degeneracy and ill conditioning, enable numerically safe Gaussian elimination with no pivoting, and have led me to devising new effective algorithms for computing vectors in the null space of a matrix, approximating a matrix by a nearby matrix having a small rank or a small displacement rank, 2-by-2 block triangulation of such matrices, and approximation of their singular spaces, with further applications to root-finding for polynomial and secular equations and to solving linear systems of equations. According to extensive analysis and experiments, the approach substantially accelerate some most fundamental computations with matrices and polynomials. In the case of structured (e.g., Toeplitz) input the acceleration is dramatic both in terms of estimated arithmetic time and observed CPU time. This work has been presented in my papers in LAA of 2009, 2010 (two papers), 2011, in two papers accepted by LAA and one just submitted there, in CAMWA 2009, in TCS 2008 and in the Proc.of ACM SNC 2007 (two papers) and 2010 (invited) and ISSAC 2011 as well as in the Springer LNCS Proc. of CSR 2008 and 2010.

Abbreviations.

CACS – Conference on Applications of Computer Algebra

CAMWA – Computers & Mathematics (with Applications)

CSR – Computer Science in Russia

FOCS – **IEEE** Symposium on Foundations of Computer Science

FST & TCS – Symposium on Foundations of Software Technology and Theoretical Computer Science

ICALP – International Colloquium on Automata Languages and Programming

ICSI – International Computer Science Institute (Berkeley, California)

IPL – Information Processing Letters

ISSAC – ACM International Symposium on Symbolic and Algebraic Computation

JCSS – Journal of Computer and System Sciences

JSC – Journal of Symbolic Computation

LAA – Linear Algebra and Its Applications

LNCS – Lecture Notes in Computer Science

MC – Mathematics of Computation

MM –Matrix Multiplication

PASCO – Symposium on Parallel Algebraic and Symbolic Computations

Proc. – Proceedings of

SICOMP – SIAM Journal on Computing

SIMAX – SIAM Journal on Matrix Analysis and Applications

SNC –Symbolic-Numerical Computations

SODA – ACM-SIAM Symposium on Discrete Algorithms

SPAA – ACM Symposium on Parallel Algorithms and Architecture

STOC – ACM Symposium on Theory of Computing

TCS – Theoretical Computer Science

PAPERS CLASSIFIED BY RESEARCH SUBJECTS

THE BOOKS, SURVEYS AND BOOKS CHAPTERS, AND RESEARCH PAPERS HAVE BEEN ENUMERATED BELOW ACCORDING TO THE PUBLICATION LIST

1. REAL AND COMPLEX FUNCTIONS: papers 1, 3.

2. MATHEMATICAL ECONOMICS: papers 11-13, 15-18

3. LOWER BOUNDS IN ALGEBRAIC COMPUTATIONS: papers 7, 10, 29, 49.

4. FUNDAMENTAL POLYNOMIAL OPERATIONS.
a) EVALUATION: paper 10 covers the work up to 1966. Later work is covered in papers 19, 62, 70, 101, 105, 121, 140, 148, 167.
b) INTERPOLATION: papers 62, 70, 105, 120, 140, 148, 159, 167.
c) MULTIPLICATION (multivariate case): paper 118.
d) DIVISION: papers 42, 48, 51-53, 58, 75, 86, 97, 103, 111, 162.

5. MATH PROGRAMMING.
a) LINEAR PROGRAMMING: papers13, 39, 43, 50, 55-57.
b) INTEGER LINEAR PROGRAMMING: papers 89, 113, 152.
c) NONLINEAR PROGRAMMING: paper 79.

6. FAST MATRIX MULTIPLICATION. The work is covered in book 1 and survey paper 2 (up to 1984) and in papers 95, 145, 157.

7. MULTIGRID ALGORITHMS.
a) ALGEBRAIC MULTIGRID: paper 22.
b) COMPACT MULTIGRID: papers 73, 77, 81, 109.

8. PARALLEL COMPUTATIONS (ALSO SEE RELEVANT ITEMS IN PARTS 7-12 and 14).
a) PROCESSOR EFFICIENT ALGORITHMS IN NC: book 2 (chapter 4) and papers 45-47, 50-58, 60, 61, 63, 64, 66-69, 72, 74, 75, 80-82, 85, 90, 93, 100, 102, 103, 107, 111, 112, 117, 119, 123, 125, 126, 129, 131-133, 138, 147, 164, 176.
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) and papers 44, 69, 83, 176, 179, 212, 217, 226, 231.
b) RANDOMIZED ALGORITHMS: papers 215, 216, 218, 220-223, 225, 228, 220-223, 225, 228, 230, 232, 234, 236, 238, 245.
c) OTHER METHODS: books 2 and 3 and papers 44, 45, 47, 60, 67, 74, 81, 82, 91, 122, 176, 239.

11. LINEAR SYSTEMS OF EQUATIONS AND MATRIX INVERSION (TRIANGULAR. BANDED OR SPARSE INPUT): item 6 in the list of book chapters and papers 44, 107, 115, 117, 125.

12. LINEAR SYSTEMS OF EQUATIONS AND MATRIX INVERSION (STRUCTIRED INPUT).
a) METHOD OF DISPLACEMENT TRANSFORMATION (WITH APPLICATIONS TO POLYNOMIAL EVALUATION AND INTERPOLATION): book 3 and papers 71, 76, 105, 140, 150, 156, 204.
b) NEWTON'S ITERATION AND RESIDUAL CORRECTION PROCESSES: book 3 and papers 72, 88, 93, 106, 132, 141, 163, 176, 179, 180, 188, 201, 202, 205, 212, 217, 223, 231.
c) COMPRESSION OF DISPLACEMENTS: book 3 and papers 88, 93, 106, 108, 141, 163, 166, 176, 188, 212.
d) HOMOTOPIC/CONTINUATION TECHNIQUES: book 3 (chapter 6) and papers 93, 106, 179, 188, 201, 202, 212, 217, 231.
d) INVERSION OF DISPLACEMENT OPERATORS: book 3 and paper 195.
e) SOLUTION WITH LIFTING TECHNIQUES: papers 191, 193, 226, 239.
f) SOLUTION WITH PRECONDITIONED CONJUGATE GRADIENT METHOD: papers 94, 128.
g) UNIFICATION OF SUPERFAST ALGORITHMS: book 3 and papers 71, 76, 105, 140, 150, 156, 159, 169.
h) OTHER METHODS: book 2 and 3 and papers 62, 72, 74, 81, 102, 131-133, 166.
i) APPLICATIONS TO POLYNOMIAL GCD AND RATIONAL INTERPOLATION: papers 133, 149, 159, 167, 183.

13. DETERMINANT AND CHARACTERISTIC POLYNOMIAL: papers 60, 65, 67, 143, 160, 161,181, 189,198, 206, 209, 222.

14. ROOT-FINDING FOR POLYNOMIALS.
a) SURVEYS: items 8, 9, 14, 17 and 20 in the list of survey articles and book chapters.
b) NEARLY OPTIMAL DIVIDE-AND-CONQUER ALGORITHMS: papers 126, 127, 129,170, 184, 185, 187, 192 and book 4 (chapter 15).
c) STRUCTURED MATRIX METHODS: papers 199, 203, 208, 211, 214, 233, 235, 237, 240, 244.
d) REAL POLYNOMIAL ROOT-FINDERS: PAPERS 214, 235, 244.
e) OTHER ROOT-FINDING ALGORITHMS: papers 41, 46, 59, 61, 68, 99, 114, 116, 124, 130,

134, 135, 172, 215, 233, 237, 240, 243.
f) APPLICATION TO APPROXIMATE POLYNOMIAL GCD: papers 149, 183.

15. ROOT-FINDING FOR SYSTEMS OF POLYNOMIALS: papers 136, 137, 139, 144, 151, 155, 171, 177, 186, 190, 194, 198, 209.

16. EIGEN-SOLVING: papers 64, 78, 80, 84, 96, 98, 110, 153, 165, 168, 207, 208, 213, 219, 223.

17. SYMBOLIC-NUMERICAL COMPUTATIONS (ALSO SEE PARTS 8, 12-15, and 19).
a) BOOKS AND SURVEYS: books 2 and 3 and items 4, 5, 8-11, 14-17,19, 20 in the list of PAN'S SURVEY ARTICLES AND BOOK CHAPTERS.
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c) NUMERCAL COMPUTATION OF DETERMINANTS: papers 161, 181, 222.
d) RECOVERY OF A RATIONAL NUMBER FROM ITS NUMERICAL APPROXIMATION: paper 197.
e) NUMERICAL COMPUTATIONS WITH ERROR-FREE OUTPUT: papers 154, 224.

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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", Theoret. Comput. Sci. 412 (2011) 3451–3462", Theoret. Comput. Sci. 428, page 91 (2012).

241. Efficient Polynomial Root-refiners: A Survey and New Record Efficiency Estimate" (by J. M. Mc Namee and V.Y. Pan), Computers and Mathematics with Applications, 63, 239-254 (2012).

242. Root-refining for a Polynomial Equation, Proceedings of CASC 2012 (V. P. Gerdt et al. 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 CASC 2012 (V. P. Gerdt et al. 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, A.-L. Zheng), Linear Algebra and Its Applications, 438, 4, 1883-1889, 2013.

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, A.-L. Zheng), in Proc. International Symp. 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", Theoret. Comput. Sci. 412 (2011) 3451–3462", Theoret. Comput. Sci. 428, page 91 (2012).

241. Efficient Polynomial Root-refiners: A Survey and New Record Efficiency Estimate" (by J. M. Mc Namee and V.Y. Pan), Computers and Mathematics with Applications, 63, 239-254 (2012).

242. Root-refining for a Polynomial Equation, Proceedings of CASC 2012 (V. P. Gerdt et al. 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 CASC 2012 (V. P. Gerdt et al. 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, A.-L. Zheng), Linear Algebra and Its Applications, 438, 4, 1883-1889, 2013.

Reports and Manuscripts

1. "The Complexity of the Algebraic Eigenproblem" (by V.Y. Pan, Z. Chen and A. Zheng), MSRI Preprint 1998-71, Mathematical Sciences Research Institute, Berkeley, California (1998).

2. "New Deterministic Parallel Algorithms for the Characteristic Polynomial of a Matrix over Abstract Fields", MSRI Preprint 1999-011, Mathematical Sciences Research

Institute, Berkeley, California (1999).

3. "Computations with Structured Matrices" (by V. Y. Pan, B. Murphy, and R. Rosholt), MSRI Preprint 1999-021, Mathematical Sciences Research Institute, Berkeley, California (1999).

4. "A Unified Superfast Divide-and-Conquer Algorithm for Structured Matrices", MSRI Preprint 1999-033, Mathematical Sciences Research Institute, Berkeley, California (1999).

5 "Residual Correction Algorithms for General and Structures Matrices" (by V.Y. Pan, M. Kunin, R. Rosholt, and H. Cebecioglu), Technical Report 2002020, Ph.D. Program in Computer Science, The Graduate Center of the City University of New York (2002).

6. "Nearly Optimal Toeplitz/Hankel Computations" (by V. Y. Pan, B. Murphy, R. E. Rosholt, X. Wang), Technical Reports 2002001, 200217, and 2004013, Ph.D. Program in Computer Science, The Graduate Center of the City University of New York (2002 and 2004).

7. "Superfast Algorithms for Singular Integer Toeplitz/Hankel-like Matrices", Technical Reports 2002002 and 2003004, Ph.D. Program in Computer Science, The Graduate Center of the City University of New York (2002 and 2003).

8. “Additive Preconditioning in Matrix Computations” (by V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, X. Yan), Technical Reports 2005009, 2006006, and 2007002, CUNY Ph.D. Program in Computer Science, Graduate Center, City University of New York (2005-2007).

9 "Additive Preconditioning for Matrix Computations”, (V. Y. Pan, D. Ivolgin, B. Murphy, R. E. Rosholt, Y. Tang, X. Yan,) Technical Report TR 2007 003, CUNY Ph.D. Program in Computer Science, Graduate Center, City University of New York (2007).

10. Null Aggregation and Extensions” , Technical Report TR 2007009, CUNY Ph.D. Program in Computer Science, Graduate Center, City University of New York (2007).

11. “Numerical Computation of Determinants with Additive Preconditioning” (by V. Y. Pan, B. Murphy, G. Qian, R. E. Rosholt, I. Taj-Eddin), Technical Report TR 2007011, CUNY Ph.D. Program in Computer Science, Graduate Center, City University of New York (2007).

12. "Additive Preconditioning and Aggregation in Matrix Computations" (by V. Y. Pan, B. Murphy, R. E. Rosholt, D. Ivolgin, G. Qian, I. Taj-Eddin, Y. Tang, and X. Yan), PAMM (a Journal of GAMM), vol. 7, issue 1, pages 1021201-1021202, Wiley VCH Verlag (2008).

Talks at Symposia/Conferences/Workshops/Colloquia/Meetings

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. 2 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. 2 refereed papers were accepted by Program Committee.

33rd Annual IEEE Conference on Foundations of Computer Science (FOCS '92), Pittsburgh, Pennsylvania, October 1992. 3 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. 3 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 (ISSAC '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 Math. 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). 2 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. 3 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-SJAM 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. 2 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, LNRIA 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 (ISSAC '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 (Copper '98), March 1998. Copper Mountain, Colorado. Refereed paper was accepted by Program Committee.

933rd AMS Meeting, April 1998, Philadelphia, Pennsylvania. 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 '98), August 1998, Praha, Czech Republic. 2 invited talks at mini-symposium.

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

5th International Symposium on Solving Irregularly Structured Problems Parallel (IRREGULAR '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.

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 '99), June 1999, El Escorial, Madrid, Spain. 2 invited lectures at mini-symposium.

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 International 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. 4 invited talks at 3 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 '2000), June 2000, St. Petersburg, Russia. Invited plenary talk (50 minutes) and invited talk at mini-symposium.

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

The Smalefest Conference in Hong Kong, July 2000. 2 papers were refereed and accepted for the proceedings.

Annual ACM International Symposium on Symbolic and Algebraic Computation, (ISSAC '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 (ISSAC ‘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 Math. Computer Science, and Engineering. S. Hadley, Massachusetts, August 2001. Invited Lecture (45 minutes).

2002

Annual International Symposium on Theoretical Aspects of Computer Science, (STACS ‘2002). 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 mini-symposium.

First Joint Meeting of the American Math. 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 ‘2002), Volos, Greece, June 2002. 2 invited talks at 2 mini-symposia.

Annual ACM International Symposium on 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 (F0CM 2002), Minneapolis, Minnesota, August 2002. 2 invited talks at mini-symposium.

5th Annual Conference on Computer Algebra in Scientific Computing (CASC ‘2002), Yalta, Crimea, Ukrain, 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 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 contributed talk by invitation by Program Committee.

16th International Symposium on Math. 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.

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), July 2005, Santander, Spain. 2 invited talks (50 minutes and 25 minutes) at 2 mini-symposia.

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

Conference on Applications of Computer Algebra July-August, Nara, Japan, 1 invited talk at mini-symposium.

2006

Nineth Biennial Copper Mountain Conference on Iterative Methods (CMCIM06), 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, 2 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, an 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, 3 refereed papers were accepted by the Program Committee.

2008

Tenth Biennial Copper Mountain Conference on Iterative Methods (CMCIM06), 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 XIXth 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

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

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

The16-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, an invited talk at a mini-symposium (30 minutes).

2012

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

14th Annual Conference on Computer Algebra in Scientific Computing (CASC '2003), September 3-6, 2012, Maribor, Slovenia. 2 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

The17-th ILAS Conference, Providence, R.I., June 2013, Invited talk, 30 minutes

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