BIBLIOGRAPHY

- [AA86] A. C. Antoulas and B. D. O. Anderson, On the scalar rational interpolation problem, IMA J. Math. Control Inform., 3, pp. 61-88, 1986.
- [AAK71] V. M. ADAMJAN, D. Z. AROV, AND M. G. KREĬN, Analytic properties of Schmidt pairs for a Hankel operator and the generalized Schur-Takagi problem, Math. USSR Sbornik, 15, pp. 31-73, 1971 (transl. of Iz. Akad. Nauk Armjan. SSR Ser. Mat., 6 (1971)).
- [AB84] O. AXELSSON AND V. BARKER, Finite Element Solution of Boundary Value Problems, Theory and Computation, Academic Press, Orlando, FL, 1984.
- [Ack91] R. ACKNER, Fast Algorithms for Indefinite Matrices and Meromorphic Functions, Ph.D. dissertation, Stanford University, Stanford, CA, 1991.
- [AD86] D. Alpay and H. Dym, On applications of reproducing kernel spaces to the Schur algorithm and rational J-unitary factorization, Oper. Theory: Adv. Appl., 18, pp. 89–159, Birkhäuser, Boston, 1986.
- [AD92] D. Alpay and H. Dym, On a new class of reproducing kernel spaces and a new generalization of Iohvidov laws, Linear Algebra Appl., 178, pp. 109-183, 1992.
- [ADD89] D. ALPAY, P. DEWILDE, AND H. DYM, On the existence and construction of solutions to the partial lossless inverse scattering problem, with applications to estimation theory, IEEE Trans. Inform. Theory, 35, pp. 1184–1205, 1989.
- [AE87] J. ABBISS AND P. EARWICKER, Compact operator equations, regularization and superresolution, in Mathematics in Signal Processing, T. Durrani, J. Abbiss, T. Durrani, J. Hudson, R. Madan, J. McWriter, and T. Moore, eds., Clarendon Press, Oxford, UK, 1987.
- [AG88] G. S. AMMAR AND W. B. GRAGG, Superfast solution of real positive definite Toeplitz systems, SIAM J. Matrix Anal. Appl., 9, pp. 61-76, 1988.
- [AG89] G. S. AMMAR AND P. GADER, New decomposition of the inverse of a Toeplitz matrix, Proc. Int. Symp. MTNS, vol. III, pp. 421–428, Birkhäuser, Boston, 1989.
- [Akl89] S. Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, Englewood Cliffs, NJ, 1989.
- [AL86] O. AXELSSON AND G. LINDSKOG, The rate of convergence of the conjugate gradient method, Numer. Math., 48, pp. 499-523, 1986.
- [ALM97] G. ANASTASI, L. LENZINI, AND B. MEINI, Performance evaluation of a worst case model of the MetaRing MAC protocol with global fairness, Performance Evaluation, 29, pp. 127–151, 1997.
- [AM79] B. D. O. Anderson and J. B. Moore, *Optimal Filtering*, Prentice-Hall, Englewood Cliffs, NJ, 1979.
- [APP88] S. T. ALEXANDER, C.-T. PAN, AND R. J. PLEMMONS, Analysis of a recursive least-squares hyperbolic rotation algorithm for signal processing, Linear Algebra Appl., 98, pp. 3-40, 1988.

- [AS99] N. AL-DHAHIR AND A. H. SAYED, A computationally efficient FIR MMSE-DFE for multi-user communications, in Proc. Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, 1999, to appear.
- [Atk78] K. E. ATKINSON, An Introduction to Numerical Analysis, John Wiley, New York, 1978.
- [Avr88] F. Avram, On bilinear forms on Gaussian random variables and Toeplitz matrices, Probab. Theory Related Fields, 79, pp. 37-45, 1988.
- [Bar69] E. H. BAREISS, Numerical solution of linear equations with Toeplitz and vector Toeplitz matrices, Numer. Math., 13, pp. 404-424, 1969.
- [BBDH87] A. W. BOJANCZYK, R. P. BRENT, P. VAN DOOREN, AND F. R. DE HOOG, A note on downdating the Cholesky factorization, SIAM J. Sci. Statist. Comput., 8, pp. 210-220, 1987.
- [BBH86] A. W. BOJANCZYK, R. P. BRENT, AND F. R. DE HOOG, QR factorization of Toeplitz matrices, Numer. Math., 49, pp. 81-94, 1986.
- [BBH95] A. W. BOJANCZYK, R. P. BRENT, AND F. R. DE HOOG, Stability analysis of a general Toeplitz systems solver, Numer. Algorithms, 10, pp. 225-244, 1995.
- [BBHS95] A. W. BOJANCZYK, R. P. BRENT, F. R. DE HOOG, AND D. R. SWEET, On the stability of the Bareiss and related Toeplitz factorization algorithms, SIAM J. Matrix Anal. Appl., 16, pp. 40-57, 1995.
- [BC83] D. BINI AND M. CAPOVANI, Spectral and computational properties of band symmetric Toeplitz matrices, Linear Algebra Appl., 52, pp. 99-126, 1983.
- [BCK88] A. M. Bruckstein, T. K. Citron, and T. Kailath, On inverse scattering and partial realizations, Internat. J. Control, 48, pp. 1537-1550, 1988.
- [BD90] D. BINI AND F. DI BENEDETTO, A new preconditioner for the parallel solution of positive definite Toeplitz systems, in Proc. Second ACM Symp. on Parallel Algorithms and Architectures, Crete, Greece, pp. 220–223, 1990.
- [BD91] P. BROCKWELL AND R. DAVIS, *Time Series: Theory and Methods*, 2nd ed., Springer-Verlag, New York, 1991.
- [BF93] D. BINI AND P. FAVATI, On a matrix algebra related to the discrete Hartley transform, SIAM J. Matrix Anal. Appl., 14, pp. 500-507, 1993.
- [BG95] D. BINI AND L. GEMIGNANI, Fast parallel computation of the polynomial remainder sequence via Bezout and Hankel matrices, SIAM J. Comput., 24, pp. 63-77, 1995.
- [BG97] A. BÖTTCHER AND S. M. GRUDSKY, Estimates for the condition numbers of large Toeplitz matrices, preprint.
- [BGN70] B. L. BUZBEE, G. H. GOLUB, AND C. W. NIELSON, On direct methods for solving Poisson's equation, SIAM J. Numer. Anal., 7, pp. 627-656, 1970.
- [BGR90] J. A. Ball, I. Gohberg, and L. Rodman, Interpolation of Rational Matrix Functions, Oper. Theory Adv. Appl. 45, Birkhäuser, Boston, 1990.
- [BGY80] R. P. Brent, F. G. Gustavson, and D. Y. Y. Yun, Fast solution of Toeplitz systems of equations and computation of Padé approximants, J. Algorithms, 1, pp. 259-295, 1980.
- [Bin83] D. Bini, On a Class of Matrices Related to Toeplitz Matrices, Tech. Rep. 83-5, State University of New York, Albany, NY, 1983.
- [Bjo87] A. BJÖRCK, Stability analysis of the method of semi-normal equations for linear least squares problems, Linear Algebra Appl., 88/89, pp. 31-48, 1987.
- [Bjo91] A. BJÖRCK, Error analysis of least squares algorithms, in Numerical Linear Algebra, Digital Signal Processing and Parallel Algorithms, G. H. Golub and P. Van Dooren, eds., Springer-Verlag, Berlin, New York, pp. 41-73, 1991.
- [BK87a] A. BRUCKSTEIN AND T. KAILATH, An inverse scattering framework for several problems in signal processing, IEEE ASSP Magazine, pp. 6-20, January 1987.

- [BK87b] A. BRUCKSTEIN AND T. KAILATH, Inverse scattering for discrete transmission-line models, SIAM Rev., 29, pp. 359–389, 1987.
- [BK87c] A. BRUCKSTEIN AND T. KAILATH, On discrete Schrodinger equations and their two component wave-equation equivalents, J. Math. Phys., 28, pp. 2914-2924, 1987.
- [BK95] E. BOMAN AND I. KOLTRACHT, Fast transform based preconditioners for Toeplitz equations, SIAM J. Matrix Anal. Appl., 16, pp. 628-645, 1995.
- [BKLS98a] T. BOROS, T. KAILATH, H. LEV-ARI, AND A. H. SAYED, A generalized Schurtype algorithm for the joint factorization of a structured matrix and its inverse: Part I—Nondegenerate case, preprint.
- [BKLS98b] T. BOROS, T. KAILATH, H. LEV-ARI, AND A. H. SAYED, A generalized Schur-type algorithm for the joint factorization of a structured matrix and its inverse: Part II—General case, preprint.
- [Bla84] R. E. BLAHUT, Fast Algorithms for Digital Signal Processing, Addison-Wesley, Reading, MA, 1984.
- [BM96a] D. BINI AND B. MEINI, On cyclic reduction applied to a class of Toeplitz-like matrices arising in queueing problems, in Computations with Markov Chains, W. J. Stewart, ed., Kluwer Academic Publishers, Norwell, MA, pp. 21–38, 1996.
- [BM96b] D. BINI AND B. MEINI, On the solution of a nonlinear matrix equation arising in queueing problems, SIAM J. Matrix Anal. Appl., 17, pp. 906-926, 1996.
- [BM97a] D. BINI AND B. MEINI, Improved cyclic reduction for solving queueing problems, Numer. Algorithms, 15, pp. 57–74, 1997.
- [BM97b] D. A. BINI AND B. MEINI, Effective methods for solving banded Toeplitz systems, SIAM J. Matrix Anal. Appl., 20, pp. 700-719, 1999.
- [BM98a] D. BINI AND B. MEINI, Inverting block Toeplitz matrices in block Hessenberg form by means of displacement operators: Application to queueing problems, Linear Algebra Appl., 272, pp. 1–16, 1998.
- [BM98b] D. BINI AND B. MEINI, Using displacement structure for solving non-skip-free M/G/1 type Markov chains, in Advances in Matrix Analytic Methods, A. Alfa and S. Chakravarthy, eds., Notable Publications, Neshanic Station, NJ, 1998, pp. 17–37.
- [Boy68] C. A. Boyer, A History of Mathematics, John Wiley, New York, 1968.
- [Boz95] E. Bozzo, Algebras of higher dimension for displacement decompositions and computations with Toeplitz plus Hankel matrices, Linear Algebra Appl., 230, pp. 127-150, 1995.
- [BP86] D. BINI AND V. PAN, Polynomial division and its computational complexity, J. Complexity, 2, pp. 179–203, 1986.
- [BP93] D. BINI AND V. Y. PAN, Improved parallel computations with Toeplitz-like and Hankel matrices, Linear Algebra Appl., 188–189, pp. 3–29, 1993.
- [BP94] D. BINI AND V. Y. PAN, Matrix and Polynomial Computations, Vol. 1: Fundamental Algorithms, Birkhäuser, Boston, 1994.
- [Bre91] R. P. Brent, Parallel algorithms for Toeplitz systems, in Numerical Linear Algebra, Digital Signal Processing and Parallel Algorithms, G. H. Golub and P. Van Dooren, eds., Springer-Verlag, Berlin, New York, pp. 75–92, 1991.
- [Bre78] J. W. Brewer, Kronecker products and matrix calculus in system theory, IEEE Trans. Circuits Systems, 25, pp. 772–781, 1978.
- [Bre97] R. P. Brent, Numerical stability of some fast algorithms for structured matrices, in Proc. Workshop on Scientific Computing, Hong Kong, March 1997, Springer-Verlag, Berlin, New York, 1998.
- [BS88] A. W. BOJANCZYK AND A. O. STEINHARDT, Matrix downdating techniques for signal processing, Proc. SPIE Conference on Advanced Algorithms and Architectures for Signal Processing, San Diego, 975, pp. 68-75, 1988.

- [BS91] A. W. BOJANCZYK AND A. O. STEINHARDT, Stability analysis of a Householder-based algorithm for downdating the Cholesky factorization, SIAM J. Sci. Statist. Comput., 12, pp. 1255–1265, 1991.
- [BSK94] T. Boros, A. H. Sayed, and T. Kailath, Structured matrices and unconstrained rational interpolation, Linear Algebra Appl., 203-204, pp. 155-188, 1994.
- [BSK99] T. Boros, A. H. Sayed, and T. Kailath, A recursive method for solving unconstrained tangential interpolation problems, IEEE Trans. Automat. Control, 44, pp. 454-470, 1999.
- [BSLK96] T. Boros, A. H. SAYED, H. LEV-ARI, AND T. KAILATH, A generalized Schur-type algorithm for the joint factorization of a structured matrix and its inverse, Calcolo, 33, pp. 131–145, 1996.
- [BS90] A. BÖTTCHER AND B. SILBERMANN, Analysis of Toeplitz Operators, Springer-Verlag, Berlin, New York, 1990.
- [BT89] D. BERTSEKAS AND J. TSITSIKLIS, Parallel and Distributed Computation: Numerical Methods, Prentice-Hall, Englewood Cliffs, NJ, 1989.
- [Bun85] J. Bunch, Stability of methods for solving Toeplitz systems of equations, SIAM J. Sci. Statist. Comput., 6, pp. 349-364, 1985.
- [Bun87] J. Bunch, The weak and strong stability of algorithms in numerical linear algebra, Linear Algebra Appl., 88/89, pp. 49-66, 1987.
- [Bun92] J. Bunch, Matrix properties of the Levinson and Schur algorithms, J. Numer. Linear Algebra Appl., 1, pp. 183–198, 1992.
- [Bur75] J. P. Burg, Maximum Entropy Spectral Analysis, Ph.D. thesis, Stanford University, Stanford, CA, 1975.
- [Car90] J. CARDOSO, Eigen-structure of the fourth-order cumulant tensor with application to the blind source separation problem, in Proc. ICASSP, Albuquerque, NM, 1990, pp. 2655–2658.
- [Car95] J. CARDOSO, A tetradic decomposition of 4th-order tensors: Application to the source separation problem, in SVD and Signal Processing, III, M. Moonen and B. D. Moor, eds., Elsevier Science Publishers, Amsterdam, 1995.
- [CC82] C. Chui and A. Chan, Application of approximation theory methods to recursive digital filter design, IEEE Trans. Acoustics, Speech Signal Process., 30, pp. 18–24, 1982.
- [CC92] R. CHAN AND T. CHAN, Circulant preconditioners for elliptic problems, Numer. Linear Algebra Appl., 1, pp. 77–101, 1992.
- [CC96a] J. CARDOSO AND P. COMON, Independent component analysis, a survey of some algebraic methods, in Proc. ISCAS, 1996.
- [CC96b] R. CHAN AND W. CHING, Toeplitz-circulant preconditioners for Toeplitz systems and their applications to queueing networks with batch arrivals, SIAM J. Sci. Comput., 17, pp. 762-772, 1996.
- [CCW95] R. CHAN, T. CHAN, AND C. WONG, Cosine transform based preconditioners for total variation minimization problems in image processing, in Iterative Methods in Linear Algebra, II, 3, S. Margenov and P. Vassilevski, eds., IMACS Series in Computational and Applied Mathematics, Proc. Second IMACS International Symposium on Iterative Methods in Linear Algebra, Bulgaria, pp. 311-329, 1995.
- [CCW96] R. CHAN, W. CHING, AND C. WONG, Optimal trigonometric preconditioners for elliptic problems and queueing problems, SEA Bull. Math., 20, pp. 110–117, 1996.
- [CCZ97] W. CHING, R. CHAN, AND X. ZHOU, Circulant preconditioners for Markov modulated Poisson processes and their applications to manufacturing systems, SIAM J. Matrix. Anal. Appl., 18, pp. 464-481, 1997.

- [CDH97] R. CHAN, T. DELILLO, AND M. HORN, The numerical solution of the biharmonic equation by conformal mapping, SIAM J. Sci. Comput., 18, pp. 1571-1582, 1997.
- [CDH98] R. CHAN, T. DELILLO, AND M. HORN, Superlinear convergence estimates for a conjugate gradient method for the biharmonic equation, SIAM J. Sci. Comput., 19, pp. 139–147, 1998.
- [CH92a] T. F. CHAN AND P. C. HANSEN, A look-ahead Levinson algorithm for indefinite Toeplitz systems, SIAM J. Matrix Anal. Appl. 13, pp. 490-506, 1992.
- [CH92b] T. F. CHAN AND P. C. HANSEN, A look-ahead Levinson algorithm for general Toeplitz systems, IEEE Trans. Signal Process., 40, pp. 1079–1090, 1992.
- [Cha88] T. CHAN, An optimal circulant preconditioner for Toeplitz systems, SIAM J. Sci. Statist. Comput., 9, pp. 766-771, 1988.
- [Cha89a] R. CHAN, Circulant preconditioners for Hermitian Toeplitz systems, SIAM J. Matrix Anal. Appl., 10, pp. 542-550, 1989.
- [Cha89b] R. Chan, The spectrum of a family of circulant preconditioned Toeplitz systems, SIAM J. Numer. Anal., 26, pp. 503-506, 1989.
- [Cha91] R. Chan, Toeplitz preconditioners for Toeplitz systems with nonnegative generating functions, IMA J. Numer. Anal., 11, pp. 333-345, 1991.
- [Chu89] J. CHUN, Fast Array Algorithms for Structured Matrices, Ph.D. dissertation, Stanford University, Stanford, CA, 1989.
- [CJY91a] R. CHAN, X. JIN, AND M. YEUNG, The circulant operator in the Banach algebra of matrices, Linear Algebra Appl., 149, pp. 41-53, 1991.
- [CJY91b] R. CHAN, X. JIN, AND M. YEUNG, The spectra of super-optimal circulant preconditioned Toeplitz systems, SIAM J. Numer. Anal., 28, pp. 871-879, 1991.
- [CK91a] J. CHUN AND T. KAILATH, Divide-and-conquer solutions of least-squares problems for matrices with displacement structure, SIAM J. Matrix Anal. Appl., 12, pp. 128-145, 1991.
- [CK91b] J. CHUN AND T. KAILATH, Displacement structure for Hankel, Vandermonde, and related (derived) matrices, Linear Algebra Appl., 151, pp. 199-227, 1991.
- [CKL87] J. CHUN, T. KAILATH, AND H. LEV-ARI, Fast parallel algorithms for QR and triangular factorization, SIAM J. Sci. Statist. Comput., 8, pp. 899-913, 1987.
- [CKM82] G. CARAYANNIS, N. KALOUPTSIDIS, AND D. MANOLAKIS, Fast recursive algorithms for a class of linear equations, IEEE Trans. Acoustics Speech Signal Process., 30, pp. 227–239, 1982.
- [CM96] P. COMON AND B. MOURRAIN, Decomposition of quantics in sums of powers of linear forms, Signal Process., 53, pp. 93-107, 1996.
- [CN93a] R. CHAN AND M. NG, Fast iterative solvers for Toeplitz-plus-band systems, SIAM J. Sci. Comput., 14, pp. 1013-1019, 1993.
- [CN93b] R. Chan and M. Ng, Toeplitz preconditioners for Hermitian Toeplitz systems, Linear Algebra Appl., 190, pp. 181–208, 1993.
- [CN96] R. CHAN AND M. NG, Conjugate gradient methods for Toeplitz systems, SIAM Rev., 38, pp. 427-482, 1996.
- [CNP93] R. CHAN, J. NAGY, AND R. PLEMMONS, FFT-based preconditioners for Toeplitz-block least squares problems, SIAM J. Numer. Anal., 30, pp. 1740-1768, 1993.
- [CNP94a] R. CHAN, J. NAGY, AND R. PLEMMONS, Circulant preconditioned Toeplitz least squares iterations, SIAM J. Matrix Anal. Appl., 15, pp. 80-97, 1994.
- [CNP94b] R. CHAN, J. NAGY, AND R. PLEMMONS, Displacement preconditioner for Toeplitz least squares iterations, Electron. Trans. Numer. Anal., 2, pp. 44-56, 1994.

- [CNP96] R. CHAN, M. NG, AND R. PLEMMONS, Generalization of Strang's preconditioner with applications to Toeplitz least squares problems, Numer. Linear Algebra Appl., 3, pp. 45-64, 1996.
- [CNW96] R. CHAN, M. NG, AND C. WONG, Sine transform based preconditioners for symmetric Toeplitz systems, Linear Algebra Appl., 232, pp. 237-259, 1996.
- [CO94] T. CHAN AND J. OLKIN, Circulant preconditioners for Toeplitz-block matrices, Numer. Algorithms, 6, pp. 89-101, 1994.
- [Col60] L. Collatz, The Numerical Treatment of Differential Equations, 3rd ed., Springer-Verlag, Berlin, New York, 1960.
- [Con73] J. Conway, Functions of One Complex Variable, Springer-Verlag, Berlin, 1973.
- [Con96] T. CONSTANTINESCU, Schur Parameters, Factorization and Dilation Problems, Birkhäuser, Basel, 1996.
- [Coo72] R. COOPER, Introduction to Queueing Theory, 2nd ed., Macmillan, New York, 1972.
- [CS89] R. CHAN AND G. STRANG, Toeplitz equations by conjugate gradients with circulant preconditioner, SIAM J. Sci. Statist. Comput., 10, pp. 104-119, 1989.
- [CS96] S. CHANDRASEKARAN AND A. H. SAYED, Stabilizing the generalized Schur algorithm, SIAM J. Matrix Anal. Appl., 17, pp. 950-983, 1996.
- [CS98] S. CHANDRASEKARAN AND A. H. SAYED, A fast stable solver for nonsymmetric Toeplitz and quasi-Toeplitz systems of linear equations, SIAM J. Matrix Anal. Appl., 19, pp. 107–139, 1998.
- [CSK94] T. CONSTANTINESCU, A. H. SAYED, AND T. KAILATH, A recursive Schur-based approach to the four-block problem, IEEE Trans. Automat. Control, 39, pp. 1476-1481, 1994.
- [CSK95] T. CONSTANTINESCU, A. H. SAYED, AND T. KAILATH, Displacement structure and completion problems, SIAM J. Matrix Anal. Appl., 16, pp. 58-78, 1995.
- [CSK99] T. CONSTANTINESCU, A. H. SAYED, AND T. KAILATH, Displacement structure and H_{∞} problems, in Advances in System Theory, T. Djaferis, ed., Kluwer Academic Publishers, Norwell, MA, 1999, to appear.
- [CT65] J. COOLEY AND J. TUKEY, An algorithm for the machine calculation of complex Fourier series, Math. Comp., 19, pp. 297–301, 1965.
- [CT94] R. CHAN AND P. TANG, Fast band-Toeplitz preconditioners for Hermitian Toeplitz systems, SIAM J. Sci. Comput., 15, pp. 164-171, 1994.
- [CXT94] Y. M. CHO, G. XU, AND T. KAILATH, Fast identification of state-space models via exploitation of displacement structure, IEEE Trans. Automat. Control, 39, pp. 2004–2017, 1994.
- [CY92] R. CHAN AND M. YEUNG, Circulant preconditioners constructed from kernels, SIAM J. Numer. Anal., 29, pp. 1093-1103, 1992.
- [CY93] R. CHAN AND M. YEUNG, Circulant preconditioners for complex Toeplitz matrices, SIAM J. Numer. Anal., 30, pp. 1193-1207, 1993.
- [Cyb80] G. Cybenko, The numerical stability of the Levinson-Durbin algorithm for Toeplitz systems of equations, SIAM J. Sci. Statist. Comput., 1, pp. 303-319, 1980.
- [Cyb83] G. Cybenko, A general orthogonalization technique with applications to time series analysis and signal processing, Math. Comp., 40, pp. 323-336, 1983.
- [Cyb87] G. Cybenko, Fast Toeplitz orthogonalization using inner products, SIAM J. Sci. Statist. Comput., 8, pp. 734-740, 1987.
- [Dan67] J. DANIEL, The conjugate gradient method for linear and nonlinear operator equations, SIAM J. Numer. Anal., 4, pp. 10-26, 1967.
- [Dav79] P. DAVIS, Circulant Matrices, John Wiley, New York, 1979.

- [DD84] P. DEWILDE AND H. DYM, Lossless inverse scattering, digital filters, and estimation theory, IEEE Trans. Inform. Theory, 30, pp. 644-662, 1984.
- [Del82] J.-M. DELOSME, Algorithms and Implementations for Linear Least-Squares Estimation, Ph.D. dissertation, Stanford University, Stanford, CA, 1982.
- [DFS93] F. DI BENEDETTO, G. FIORENTINO, AND S. SERRA, C.G. preconditioning for Toeplitz matrices, Comput. Math. Appl., 25, pp. 35-45, 1993.
- [DGK85] P. DELSARTE, Y. V. GENIN, AND Y. G. KAMP, A generalisation of the Levinson algorithm for Hermitian Toeplitz matrices with any rank profile, IEEE Trans. Acoustics Speech Signal Process., 33, pp. 964-971, 1985.
- [DI86] J.-M. DELOSME AND I. C. F. IPSEN, Parallel solution of symmetric positive definite systems with hyperbolic rotations, Linear Algebra Appl., 77, pp. 75–111, 1986.
- [DiB95] F. DI BENEDETTO, Analysis of preconditioning techniques for ill-conditioned Toeplitz matrices, SIAM J. Sci. Comput., 16, pp. 682-697, 1995.
- [DM85] L. DELVES AND J. MOHAMED, Computational Methods for Integral Equations, Cambridge University Press, Cambridge, UK, 1985.
- [DMV99] L. DELATHAUWER, B. DEMOOR, AND J. VANDEWALLE, A multilinear singular value decomposition, SIAM J. Matrix Anal. Appl., to appear.
- [Dur59] J. Durbin, The fitting of time-series models, Rev. Int. Stat. Inst., 28, pp. 229-249, 1959.
- [DV93] P. M. DEWILDE AND A. J. VAN DER VEEN, On the Hankel-norm approximation of upper-triangular operators and matrices, Integral Equations Operator Theory, 17, pp. 1-45, 1993.
- [DV98] P. DEWILDE AND A. J. VAN DER VEEN, Time-Varying Systems and Computations, Kluwer Academic Publishers, Boston, MA, 1998.
- [DVK78] P. DEWILDE, A. C. VIEIRA, AND T. KAILATH, On a generalized Szegő-Levinson realization algorithm for optimal linear predictors based on a network synthesis approach, IEEE Trans. Circuits Systems, 25, pp. 663-675, 1978.
- [Dym89a] H. DYM, J-Contractive Matrix Functions, Reproducing Kernel Hilbert Spaces, and Interpolation, CBMS Regional Conf. Ser. in Math. 71, AMS, Providence, RI, 1989.
- [Dym89b] H. DYM, On reproducing kernel spaces, J-unitary matrix functions, interpolation and displacement rank, Oper. Theory Adv. Appl. 41, pp. 173-239, Birkhäuser, Basel, 1989.
- [Edw82] R. E. EDWARDS, Fourier Series, Vols. 1 and 2, 2nd ed., Springer-Verlag, Berlin, New York, 1982.
- [ER82] D. F. ELLIOTT AND K. R. RAO, Fast Transform Algorithms, Analyses, Applications, Academic Press, New York, 1982.
- [FCG79] P. FAURRE, M. CLERGET, AND F. G_RMAIN, Opérateurs Rationnels Positifs, Dunod, Paris, 1979.
- [FF90] C. FOIAS AND A. E. FRAZHO, The Commutant Lifting Approach to Interpolation Problems, Oper. Theory Adv. Appl. 44, Birkhäuser, Basel, 1990.
- [Fie85] M. FIEDLER, Hankel and Loewner matrices, Linear Algebra Appl., 58, pp. 75-95, 1985.
- [FKML78] B. FRIEDLANDER, T. KAILATH, M. MORF, AND L. LJUNG, Extended Levinson and Chandrasekhar equations for general discrete-time linear estimation problems, IEEE Trans. Automat. Control, 23, pp. 653-659, 1978.
- [FM67] G. E. FORSYTHE AND C. B. Moler, Computer Solution of Linear Algebraic Systems, Prentice-Hall, Englewood Cliffs, NJ, 1967.
- [FP81] R. E. FUNDERLIC AND R. J. PLEMMONS, LU decomposition of M-matrices by elimination without pivoting, Linear Algebra Appl., 41, pp. 99–110, 1981.

- [Fre94] R. W. FREUND, A look-ahead Bareiss algorithm for general Toeplitz matrices, Numer. Math., 68, pp. 35-69, 1994.
- [FS95] G. FIORENTINO AND S. SERRA, Tau preconditioners for (high order) elliptic problems, in Proc. 2nd IMACS Conf. on Iterative Methods in Linear Algebra, Vassilevski, ed., pp. 241–252, Blagoevgrad, Bulgaria, 1995.
- [FZ93a] R. W. FREUND AND H. ZHA, Formally biorthogonal polynomials and a look-ahead Levinson algorithm for general Toeplitz systems, Linear Algebra Appl., 188/189, pp. 255-303, 1993.
- [FZ93b] R. W. FREUND AND H. ZHA, A look-ahead algorithm for the solution of general Hankel systems, Numer. Math., 64, pp. 295–321, 1993.
- [Gem97] L. GEMIGNANI, Schur complement of Bezoutians with applications to the inversion of block Hankel and block Toeplitz matrices, Linear Algebra Appl., 253, pp. 39-59, 1997.
- [Gen73] M. GENTLEMAN, Least squares computations by Givens transformations, J. Inst. Math. Appl., 12, pp. 329–336, 1973.
- [Ger54] L. Y. GERONIMUS, Polynomials orthogonal on a circle and their applications, Amer. Math. Soc. Transl., 3, pp. 1-78, 1954 (in Russian, 1948).
- [GF74] I. GOHBERG AND I. FEL'DMAN, Convolution equations and projection methods for their solution, Transl. Math. Monogr., 41, AMS, Providence, RI, 1974.
- [GGM92] A. GREENBAUM, L. GREENGARD, AND A. MAYO, On the numerical solution of the biharmonic equation in the plane, Physica D, 60, pp. 216-225, 1992.
- [GH93a] M. H. GUTKNECHT AND M. HOCHBRUCK, Look-ahead Levinson and Schur algorithms for non-Hermitian Toeplitz Systems, IPS Research Report 93-11, ETH, Zürich, 1993.
- [GH93b] M. H. GUTKNECHT AND M. HOCHBRUCK, The stability of inversion formulas for Toeplitz matrices, IPS Research Report 93-13, ETH, Zürich, 1993.
- [GHKT94] H. R. GAIL, S. L. HANTLER, A. G. KONHEIM, AND B. A. TAYLOR, An analysis of a class of telecommunications models, Performance Evaluation, 21, pp. 151-161, 1994.
- [GHT97] H. R. GAIL, S. L. HANTLER, AND B. A. TAYLOR, Non-skip-free M/G/1 and G/M/1 type Markov chains, Adv. Appl. Probab., 29, pp. 733-758, 1997.
- [Gia90] G. G. GIANNAKIS, On the identifiability of non-Gaussian models using cumulants, IEEE Trans. Automat. Control, 35, pp. 18-26, 1990.
- [GK93] I. GOHBERG AND I. KOLTRACHT, Mixed, componentwise and structured condition numbers, SIAM J. Matrix Anal. Appl., 14, pp. 688-704, 1993.
- [GKO95] I. GOHBERG, T. KAILATH, AND V. OLSHEVSKY, Fast Gaussian elimination with partial pivoting for matrices with displacement structure, Math. Comp., 64, pp. 1557–1576, 1995.
- [GKX94] I. GOHBERG, I. KOLTRACHT, AND D. XIAO, Condition and accuracy of algorithms for computing Schur coefficients of Toeplitz matrices, SIAM J. Matrix Anal. Appl., 15, pp. 1290– 1309, 1994.
- [GL55] I. GELFAND AND B. LEVITAN, On the determination of a differential equation from its spectral function, Amer. Math. Soc. Transl., 1, pp. 253-304, 1955.
- [Glo84] K. GLOVER, All optimal Hankel-norm approximations to linear multivariable systems and their L^{∞} -error bounds, Internat. J. Control, 39, pp. 1115–1193, 1984.
- [GM89] G. G. GIANNAKIS AND J. M. MENDEL, Identification of nonminimum phase systems using higher order statistics, IEEE Trans. Acoustics Speech Signal Process., 37, pp. 360–377, 1989.
- [GO92] I. GOHBERG AND V. OLSHEVSKY, Circulant displacements and decomposition of matrices, Integral Equations Operator Theory, 15, pp. 730–743, 1992.
- [GO94c] I. GOHBERG AND V. OLSHEVSKY, Complexity of multiplication with vectors for structured matrices, Linear Algebra Appl., 202, pp. 163–192, 1994.

- [Goh86] I. GOHBERG, ED., I. Schur Methods in Operator Theory and Signal Processing, Oper. Theory Adv. Appl. 18, Birkhäuser, Basel, 1986.
- [Gol65] G. H. GOLUB, Numerical methods for solving linear least squares problems, Numer. Math., 7, pp. 206-216, 1965.
- [Gou91] N. GOULD, On growth in Gaussian elimination with complete pivoting, SIAM J. Matrix Anal. Appl., 12, pp. 354-361, 1991.
- [GR70] G. H. GOLUB AND C. REINSCH, Singular value decomposition and least squares solutions, Numer. Math., 14, pp. 403-420, 1970.
- [Gri96] V. S. GRIGORASCU, Tenseurs Structurés, Produits d'Ordre Supérieur et Cumulants, Ph.D. dissertation, University of Paris, Orsay, 1996.
- [Gro84] C. GROETSCH, The Theory of Tikhonov Regularization for Fredholm Equations of the First Kind, Pitman Publishing, London, 1984.
- [GS84] U. Grenander and G. Szegő, *Toeplitz Forms and Their Applications*, 2nd ed., Chelsea Publishing, New York, 1984.
- [GS90] G. G. GIANNAKIS AND A. M. SWAMY, On estimating noncausal nonminimum phase ARMA models of non-Guassian processes, IEEE Trans. Acoustics Speech Signal Process., 38, pp. 478-495, 1990.
- [GS94] I. GOHBERG AND L. A. SAKHNOVICH, ED., Matrix and Operator-Valued Functions— V. P. Potapov Memorial Volume, Oper. Theory Adv. Appl. 72, Birkhäuser, Basel, 1994.
- [GT83] D. GILBARG AND N. S. TRUDINGER, Elliptic Partial Differential Equations of Second Order, 2nd ed., Springer-Verlag, Berlin, New York, 1983.
- [GTH85] W. K. GRASSMAN, M. I. TAKSAR, AND D. P. HEYMAN, Regenerative analysis and steady state distribution for Markov chains, Oper. Res., 33, pp. 1107-1116, 1985.
- [Gu95a] M. Gu, Stable and efficient algorithms for structured systems of linear equations, SIAM J. Matrix Anal. Appl., 19, pp. 279-306, 1998.
- [Gu95b] M. Gu, New Fast Algorithms for Structured Least Squares Problems, Tech. Rep. LBL-37878, Lawrence Berkeley Laboratory, 1995.
- [Gut93] M. H. GUTKNECHT, Stable row recurrences for the Padé table and generically superfast lookahead solvers for non-Hermitian Toeplitz systems, Linear Algebra Appl., 188/189, pp. 351–422, 1993.
- [GV96] G. GOLUB AND C. VAN LOAN, *Matrix Computations*, 3rd ed., The Johns Hopkins University Press, Baltimore, MD, 1996.
- [GW66] G. H. GOLUB AND J. H. WILKINSON, Note on iterative refinement of least squares solution, Numer. Math., 9, pp. 139-148, 1966.
- [Hay96] S. HAYKIN, Adaptive Filter Theory, 3rd ed., Prentice-Hall, Englewood Cliffs, NJ, 1996.
- [Hei95] G. Heinig, Inversion of generalized Cauchy matrices and other classes of structured matrices, Linear Algebra Signal Process., IMA Vol. Math. Appl. 69, pp. 95-114, 1995.
- [Hel87] J. W. HELTON, Operator Theory, Analytic Functions, Matrices and Electrical Engineering, Conference Board of the Mathematical Sciences, AMS, Providence, RI, 1987.
- [HG93] P. C. HANSEN AND H. GESMAR, Fast orthogonal decomposition of rank deficient Toeplitz matrices, Numer. Algorithms, 4, pp. 151-166, 1993.
- [HH77] L. L. HIRSCHMAN AND D. E. HUGHES, Extreme Eigen Values of Toeplitz Operators, Lecture Notes in Math., Springer-Verlag, Heidelberg, 1977.
- [HH89] N. J. HIGHAM AND D. J. HIGHAM, Large growth factors in Gaussian elimination with pivoting, SIAM J. Matrix Anal. Appl., 10, pp. 155-164, 1989.
- [HH92] D. J. HIGHAM AND N. J. HIGHAM, Backward error and condition of structured linear systems, SIAM J. Matrix Anal. Appl., 13, pp. 162-175, 1992.

- [Hig96] N. J. Higham, Accuracy and Stability of Numerical Algorithms, SIAM, Philadelphia, 1996.
- [Hil94] D. HILBERT, Ein Beitrag zur Theorie des Legendre'schen Polynoms, Acta Math., 18, pp. 155-160, 1894.
- [HJ85] R. A. HORN AND C. R. JOHNSON, Matrix Analysis, Cambridge University Press, Cambridge, UK, 1985.
- [HN94] M. HANKE AND J. NAGY, Toeplitz approximate inverse preconditioner for banded Toeplitz matrices, Numer. Algorithms, 7, pp. 183-199, 1994.
- [HR84] G. Heinig and K. Rost, Algebraic Methods for Toeplitz-like Matrices and Operators, Akademie-Verlag, Berlin, Birkhäuser, Boston, 1984.
- [HS52] M. HESTENES AND E. STIEFEL, Methods of conjugate gradients for solving linear systems, J. Res. National Bureau of Standards, Sec. B, 49, pp. 409-436, 1952.
- [Huc93] T. Huckle, Some aspects of circulant preconditioners, SIAM J. Sci. Comput., 14, pp. 531-541, 1993.
- [Huc94] T. Huckle, Iterative methods for Toeplitz-like matrices, Report SCCM-94-05, Computer Science Dept., Stanford University, Stanford, CA, 1994.
- [HY93] J. HSUE AND A. YAGLE, Fast algorithms for close-to-Toeplitz-plus-Hankel systems and two-sided linear prediction, IEEE Trans. Signal Process., 41, pp. 2349-2361, 1993.
- [IK66] E. ISAACSON AND H. B. KELLER, Analysis of Numerical Methods, John Wiley, New York, 1966.
- [Ioh82] I. S. IOHVIDOV, Hankel and Toeplitz Forms: Algebraic Theory, Birkhäuser, Boston, 1982.
- [Jai89] A. JAIN, Fundamentals of Digital Image Processing, Prentice-Hall, Englewood Cliffs, NJ, 1989.
- [JK92] B. JELONNEK AND K.-D. KAMMEYER, Improved methods for blind system identification using higher order statistics, IEEE Trans. Signal Process., 40, pp. 2947–2960, 1992.
- [JW77] M. JANKOWSKI AND M. WOZNIAKOWSKI, Iterative refinement implies numerical stability, BIT, 17, pp. 303-311, 1977.
- [Kai73] T. Kailath, Some new algorithms for recursive estimation in constant linear systems, IEEE Trans. Inform. Theory, 19, pp. 750–760, 1973.
- [Kai80] T. KAILATH, Linear Systems, Prentice-Hall, Englewood Cliffs, NJ, 1980.
- [Kai85] T. KAILATH, Signal processing in the VLSI era, in VLSI and Modern Signal Processing, S. Y. Kung, H. J. Whitehouse, and T. Kailath, eds., pp. 5-24, Prentice-Hall, Englewood Cliffs, NJ, 1985.
- [Kai86] T. KAILATH, A theorem of I. Schur and its impact on modern signal processing, Oper. Theory Adv. Appl., 18, pp. 9-30, Birkhäuser, Basel, 1986.
- [Kai87] T. KAILATH, Signal processing applications of some moment problems, in Moments in Mathematics 37, H. Landau, ed., pp. 71-109, AMS, Providence, RI, 1987.
- [Kai91] T. KAILATH, Remarks on the origin of the displacement-rank concept, Appl. Math. Comput., 45, pp. 193-206, 1991.
- [Kat76] Y. KATZNELSON, An Introduction to Harmonic Analysis, 2nd ed., Dover Publications, New York, 1976.
- [KC94] T. KAILATH AND J. CHUN, Generalized displacement structure for block-Toeplitz, Toeplitz-block, and Toeplitz-derived matrices, SIAM J. Matrix Anal. Appl., 15, pp. 114–128, 1994.
- [KFA70] R. E. KALMAN, P. L. FALB, AND M. A. ARBIB, Topics in Mathematical System Theory. Int. Ser. Pure Appl. Math. McGraw-Hill, New York, 1970.

- [KH83] S. Y. Kung and Y. H. Hu, A highly concurrent algorithm and pipelined architecture for solving Toeplitz systems, IEEE Trans. Acoustics Speech Signal Process., 31, pp. 66-76, 1983.
- [KK92] T. Ku and C. Kuo, Design and analysis of Toeplitz preconditioners, IEEE Trans. Signal Process., 40, pp. 129-141, 1992.
- [KK93a] T. Ku And C. Kuo, Preconditioned iterative methods for solving Toeplitz-plus-Hankel systems, SIAM J. Numer. Anal., 30, pp. 824-845, 1993.
- [KK93b] T. KU AND C. KUO, Spectral properties of preconditioned rational Toeplitz matrices, SIAM J. Matrix Anal. Appl., 14, pp. 146-165, 1993.
- [KK93c] T. Ku and C. Kuo, Spectral properties of preconditioned rational Toeplitz matrices: The nonsymmetric case, SIAM J. Matrix Anal. Appl., 14,, pp. 521-544, 1993.
- [KKM79a] T. KAILATH, S. Y. KUNG, AND M. MORF, Displacement ranks of matrices and linear equations, J. Math. Anal. Appl., 68, pp. 395-407, 1979.
- [KKM79b] T. KAILATH, S. Y. KUNG, AND M. MORF, Displacement ranks of a matrix, Bull. Amer. Math. Soc., 1, pp. 769-773, 1979.
- [KLM78] T. KAILATH, L. LJUNG, AND M. MORF, Generalized Krein-Levinson equations for efficient calculation of Fredholm resolvents of nondisplacement kernels, in Topics in Functional Analysis, I. Gohberg and M. Kac, eds., pp. 169–184, Academic Press, New York, 1978.
- [Knu81] D. E. KNUTH, The Art of Computer Programming: Seminumerical Algorithms, 2, Addison-Wesley, Reading, MA, 1981.
- [KO95] T. KAILATH AND V. OLSHEVSKY, Displacement structure approach to Chebyshev-Vandermonde and related matrices, Integral Equations Operator Theory, 22, pp. 65-92, 1995.
- [KO96] T. KAILATH AND V. OLSHEVSKY, Displacement structure approach to discrete-trigonometric-transform based preconditioners of G. Strang type and T. Chan type, Calcolo, 33, pp. 191–208, 1996.
- [KO98] T. KAILATH AND V. OLSHEVSKY, Diagonal pivoting for partially reconstructible Cauchy-like matrices, with applications to Toeplitz-like linear equations and to boundary rational matrix interpolation problems, Linear Algebra Appl., 254, pp. 251-302, 1997.
- [Kol41] A. N. Kolmogorov, Interpolation and extrapolation of stationary random sequences, Izv. Akad. Nauk SSSR, 5, pp. 3-11, 1941 (in Russian); German summary, pp. 11-14.
- [KR86] A. G. Konheim and M. Reiser, The moveable-boundary multiplexor: Stability and Decomposability, in Teletraffic Analysis and Computer Performance Evaluation, O. J. Boxma, J. W. Cohen, and H. C. Tijms, eds., North-Holland, Amsterdam, pp. 375-394, 1986.
- [KS91] T. KAILATH AND A. H. SAYED, Fast algorithms for generalized displacement structures, in Proc. Internat. Symposium Math. Theory of Networks and Systems, H. Kimura and S. Kodama, eds., 2, pp. 27–32, Kobe, Japan, 1991.
- [KS95a] T. KAILATH AND A. H. SAYED, Displacement structure: Theory and applications, SIAM Rev., 37, pp. 297-386, 1995.
- [KS95b] T. KAILATH AND A. H. SAYED, On lossless cascades in structured matrix factorization, Arch. Für Electronik und Übertragungstechnik, 49, pp. 307-312, 1995.
- [KSH99] T. KAILATH, A. H. SAYED, AND B. HASSIBI, State-Space Estimation, Prentice-Hall, Englewood Cliffs, NJ, 1999.
- [Kun78] S. Y. Kung, A new identification and model reduction algorithm via singular value decomposition, in Proc. Asilomar Conf. on Circuits, Systems and Comp., pp. 705-714, Asilomar, CA, 1978.
- [KVM78] T. KAILATH, A. VIEIRA, AND M. MORF, Inverses of Toeplitz operators, innovations and orthogonal polynomials, SIAM Rev., 20, pp. 106-119, 1978.
- [LBK91] H. LEV-ARI, Y. BISTRITZ, AND T. KAILATH, Generalized Bezoutians and families of efficient zero-location procedures, IEEE Trans. Circuits Systems, 38, pp. 170–185, 1991.

- [Laf75] J. C. LAFON, Base tensorielle des matrices des Hankel (ou de Toeplitz), applications, Numer. Math., 23, pp. 349-361, 1975.
- [LK84] H. LEV-ARI AND T. KAILATH, Lattice filter parametrization and modeling of nonstationary processes, IEEE Trans. Inform. Theory, 30, pp. 2-16, 1984.
- [LK86] H. LEV-ARI AND T. KAILATH, Triangular factorization of structured Hermitian matrices, Oper. Theory Adv. Appl. 18, pp. 301-324, 1986.
- [LK92] H. LEV-ARI AND T. KAILATH, State-space approach to factorization of lossless transfer functions and structured matrices, Linear Algebra Appl., 162–164, pp. 273–295, 1992.
- [Lev47] N. LEVINSON, The Wiener RMS (Root-Mean-Square) error criterion in filter design and prediction, J. Math. Phys., 25, pp. 261-278, 1947.
- [Lev83] H. Lev-Ari, Nonstationary Lattice-Filter Modeling, Ph.D. dissertation, Stanford University, Stanford, CA, 1983.
- [Lev97] H. Lev-Ari, Displacement structure: Two related perspectives, in Communications, Computation, Control, and Signal Processing, A. Paulraj, V. Roychowdhury, and C. D. Schaper, eds., Kluwer, Norwell, MA, pp. 233-241, 1997.
- [LG77] J. LEROUX AND C. GUEGUEN, A fixed-point computation of parcor coefficients, IEEE Trans. Acoustics Speech Signal Process., 25, pp. 257–259, 1977.
- [LM85] S. Q. LI AND J. W. MARK, Performance of voice/data integration on a TDM switch, IEEE Trans. Comm., 33, pp. 1265-1273, 1985.
- [LQ87] F. T. Luk and S. Qiao, A fast but unstable orthogonal triangularization technique for Toeplitz matrices, Linear Algebra Appl., 88/89, pp. 495-506, 1987.
- [LR93] G. LATOUCHE AND V. RAMASWAMI, A logarithmic reduction algorithm for Quasi-Birth-Death processes, J. Appl. Probab., 30, pp. 650-674, 1993.
- [LS96] G. LATOUCHE AND G. STEWART, Numerical methods for M/G/1 type queues, in Computations with Markov Chains, W. J. Stewart, ed., Kluwer Academic Publishers, Norwell, MA, pp. 571-581, 1996.
- [LT85] P. LANCASTER AND M. TISMENETSKI, *The Theory of Matrices*, Academic Press, New York, 1985.
- [Mar80] L. Marple, A new autoregressive spectrum analysis algorithm, IEEE Trans. Acoustics Speech Signal Process., 28, pp. 441–454, 1980.
- [Mar81] L. MARPLE, Efficient least squares FIR system identification, IEEE Trans. Acoustics Speech Signal Process., 29, pp. 62-73, 1981.
- [Mar82] L. MARPLE, Fast algorithms for linear prediction and system identification filters with linear phase, IEEE Trans. Acoustics Speech Signal Process., 30, pp. 942-953, 1982.
- [Mas69] J. L. MASSEY, Shift-register synthesis and BCH decoding, IEEE Trans. Inform. Theory, 15, pp. 122–127, 1969.
- [McC87] P. McCullagh, Tensor Methods in Statistics, Chapman and Hall, London, 1987.
- [Mei97a] B. Meini, New convergence results on functional iteration techniques for the numerical solution of M/G/1 type Markov chains, Numer. Math., 78, pp. 39–58, 1997.
- [Mei97b] B. Meini, An improved FFT-based version of Ramaswami's formula, Comm. Statist. Stochastic Models, 13, pp. 223-238, 1997.
- [Men91] J. M. MENDEL, Tutorial on higher-order statistics (spectra) in signal processing and system theory: Theoretical results and some applications, Proc. IEEE, 79, pp. 278-305, 1991.
- [Mil68] L. MILNE-THOMSON, Theoretical Hydrodynamics, 5th ed., Macmillan Press, London, 1968.
- [Mor70] M. Morf, personal communication, 1970.

- [Mor74] M. Morf, Fast Algorithms for Multivariable Systems, Ph.D. thesis, Stanford University, Stanford, CA, 1974.
- [Mor80] M. Morf, Doubling algorithms for Toeplitz and related equations, in Proc. IEEE Internat. Conf. on Acoustics, Speech and Signal Process., Denver, CO, pp. 954-959, 1980.
- [MSK74] M. MORF, G. S. SIDHU, AND T. KAILATH, Some new algorithms for recursive estimation in constant, linear, discrete-time systems, IEEE Trans. Automat. Control, 19, pp. 315-323, 1974.
- [MT96] M. MIRANDA AND P. TILLI, Block Toeplitz matrices and preconditioning, Calcolo, 33, pp. 79-86, 1996.
- [Mus53] N. Muskhelishvili, Some Basic Problems of the Mathematical Theory of Elasticity, P. Noordhoff Ltd., Groningen, Holland, 1953.
- [MW80] W. MILLER AND C. WRATHALL, Software for Roundoff Analysis of Matrix Algorithms, Academic Press, New York, 1980.
- [Neu89] M. F. NEUTS, Structured Stochastic Matrices of M/G/1 Type and Their Applications, Marcel Dekker, New York, 1989.
- [Ng94] M. NG, Fast iterative methods for solving Toeplitz-plus-Hankel least squares problems, Electron Trans. Numer. Anal., 2, pp. 154-170, 1994.
- [NM93] C. NIKIAS AND J. MENDEL, Signal processing with higher-order spectra, IEEE Signal Process. Magazine, 10, pp. 10-57, 1993.
- [NP93] C. NIKIAS AND A. PETROPULU, Higher-Order Spectra Analysis. A Nonlinear Signal Processing Framework, Prentice-Hall, Englewood Cliffs, NJ, 1993.
- [NP96] M. NG AND R. PLEMMONS, Fast RLS adaptive filtering by FFT-based conjugate gradient iterations, SIAM J. Sci. Comput., 7, pp. 920-941, 1996.
- [NPT96] J. NAGY, R. PLEMMONS, AND T. TORGERSEN, Iterative image restoration using approximate inverse, IEEE Trans. Image Process., 5, pp. 1151-1162, 1996.
- [Oci93] C. A. O'CINNEIDE, Entrywise perturbation theory and error analysis for Markov chains, Numer. Math., 65, pp. 109–120, 1993.
- [Oda91] T. Oda, Moment analysis for traffic associated with Markovian queueing systems, IEEE Trans. Comm., 39, pp. 737-745, 1991.
- [Olk86] J. Olkin, Linear and Nonlinear Deconvolution Problems, Ph.D. thesis, Rice University, Houston, TX, 1986.
- [Ost40] A. M. Ostrowski, Recherches sur la methode de Graeffe et les zeros des polynomes et des series de Laurent, Acta Math., 72, pp. 99-257, 1940.
- [Pai73] C. C. PAIGE, An error analysis of a method for solving matrix equations, Math. Comp., 27, pp. 355-359, 1973.
- [Pal90] D. Pal, Fast Algorithms for Structured Matrices with Arbitrary Rank Profile, Ph.D. dissertation, Stanford University, Stanford, CA, 1990.
- [Pan90] V. Y. PAN, Computations with dense structured matrices, Math. Comp., 55, pp. 179–190, 1990.
- [Pan92a] V. Y. PAN, Parallel solution of Toeplitz-like linear systems, J. Complexity, 8, pp. 1-21, 1992.
- [Pan92b] V. Y. PAN, Parametrization of Newton's iteration for computation with structured matrices and applications, Comput. Math., 24, pp. 61-75, 1992.
- [Pan93a] V. Y. PAN, Concurrent iterative algorithms for Toeplitz-like linear systems, IEEE Trans. Parallel Distributive Systems, 4, 5, pp. 592-600, 1993.
- [Pan93b] V. Y. PAN, Decreasing the displacement rank of a matrix, SIAM J. Matrix Anal. Appl., 14, pp. 118-121, 1993.

- [Par80] B. Parlett, The Symmetric Eigenvalue Problem, Prentice-Hall, Englewood Cliffs, NJ, 1980.
- [Par86] S. V. Parter, On the distribution of the singular values of Toeplitz matrices, Linear Algebra Appl., 80, pp. 115-130, 1986.
- [PK93] D. PAL AND T. KAILATH, Fast triangular factorization and inversion of Hermitian, Toeplitz, and related matrices with arbitrary rank profile, SIAM J. Matrix Anal. Appl., 14, pp. 1016-1042, 1993.
- [PS91] V. Y. PAN AND R. SCHREIBER, An Improved Newton iteration for the generalized inverse of a matrix with applications, SIAM J. Sci. Statist. Comput., 12, pp. 1109–1131, 1991.
- [PZHD97] V. Y. PAN, A. L. ZHENG, X. H. HUANG, AND O. DIAS, Newton's iteration for inversion of Cauchy-like and other structured matrices, J. Complexity, 13, pp. 108-124, 1997.
- [Qia88] S. QIAO, Hybrid algorithm for fast Toeplitz orthogonalization, Numer. Math., 53, pp. 351-366, 1988.
- [Ram88] V. RAMASWAMI, A stable recursion for the steady state vector in Markov chains of M/G/1 type, Comm. Statist. Stochastic Models, 4, pp. 183-188, 1988.
- [RG94] P. A. REGALIA AND V. S. GRIGORASCU, Analytic criteria underlying the full-rank cumulant slice problem, 10th IFAC Symp. System Identification, Copenhagen, pp. 1071-1075, 1994.
- [Ris73] J. RISSANEN, Algorithms for triangular decomposition of block Hankel and Toeplitz matrices with application to factoring positive matrix polynomials, Math. Comp., 27, pp. 147–154, 1973.
- [RK84] S. K. RAO AND T. KAILATH, Orthogonal digital filters for VLSI implementation, IEEE Trans. Circuit Systems, 31, pp. 933-945, 1984.
- [RM89] P. A. REGALIA AND S. K. MITRA, Kronecker products, unitary matrices, and signal processing applications, SIAM Rev., 31, pp. 586-613, 1989.
- [ROF92] L. RUDIN, S. OSHER, AND E. FATEMI, Nonlinear total variation based noise removal algorithms, Phys. D, 60, pp. 259-268, 1992.
- [Saa96] Y. SAAD, Iterative Methods for Sparse Linear Systems, PWS Publishing Company, Boston, MA, 1996.
- [Sav76] J. E. SAVAGE, The Complexity of Computing, John Wiley, New York, 1976.
- [Say92] A. H. SAYED, Displacement Structure in Signal Processing and Mathematics, Ph.D. dissertation, Stanford University, Stanford, CA, 1992.
- [SB95] D. R. SWEET AND R. P. BRENT, Error analysis of a fast partial pivoting method for structured matrices, Proc. SPIE, 2563, Advanced Signal Processing Algorithms, Bellingham, WA, pp. 266–280, 1995.
- [Sch17] I. Schur, Uber potenzreihen die im Inneren des Einheitskreises beschränkt sind, J. Reine Angew. Math., 147, pp. 205–232, 1917 (English translation in Oper. Theory Adv. Appl. 18, pp. 31–88, 1986).
- [Sch33] G. SCHULTZ, Iterative berechnung der reziproken matrix, Z. Angew. Math. Mech., 13, pp. 57-59, 1933.
- [SCK94] A. H. SAYED, T. CONSTANTINESCU, AND T. KAILATH, Time-variant displacement structure and interpolation problems, IEEE Trans. Automat. Control, 39, pp. 960-976, 1994.
- [SCK95] A. H. SAYED, T. CONSTANTINESCU, AND T. KAILATH, Square-root algorithms for structured matrices, interpolation, and completion problems, IMA Vol. Math. Appl. 69, Springer-Verlag, New York, pp. 153–184, 1995.
- [SD97b] M. STEWART AND P. VAN DOOREN, Stability issues in the factorization of structured matrices, SIAM J. Matrix Anal. Appl., 18, pp. 104-118, 1997.

- [Sei90] A. SEILA, Multivariate estimation of conditional performance measure in regenerative simulation, Amer. J. Math. Management Sci., 10, pp. 17-45, 1990.
- [Sil83] B. SILBERMANN, On the limiting set of singular values of Toeplitz matrices, Linear Algebra Appl., 182, pp. 35-43, 1983.
- [SK92] A. H. SAYED AND T. KAILATH, Recursive solutions to rational interpolation problems, Proc. IEEE Internat. Symposium on Circuits and Systems, 5, pp. 2376–2379, San Diego, 1992.
- [SK94a] A. H. SAYED AND T. KAILATH, Extended Chandrasekhar recursions, IEEE Trans. Automat. Control, 39, pp. 619-623, 1994.
- [SK94b] A. H. SAYED AND T. KAILATH, A state-space approach to adaptive RLS filtering, IEEE Signal Process. Magazine, 11, pp. 18-60, 1994.
- [SK95a] A. H. SAYED AND T. KAILATH, Fast algorithms for generalized displacement structures and lossless systems, Linear Algebra Appl., 219, pp. 49-78, 1995.
- [SK95b] A. H. SAYED AND T. KAILATH, A look-ahead block Schur algorithm for Toeplitz-like matrices, SIAM J. Matrix Anal. Appl., 16, pp. 388-413, 1995.
- [SKLC94] A. H. SAYED, T. KAILATH, H. LEV-ARI, AND T. CONSTANTINESCU, Recursive solutions of rational interpolation problems via fast matrix factorization, Integral Equations Operator Theory, 20, pp. 84–118, 1994.
- [SLK94a] A. H. SAYED, T. KAILATH, AND H. LEV-ARI, Generalized Chandrasekhar recursions from the generalized Schur algorithm, IEEE Trans. Automat. Control, 39, pp. 2265-2269, 1994.
- [SLK94b] A. H. SAYED, H. LEV-ARI, AND T. KAILATH, Time-variant displacement structure and triangular arrays, IEEE Trans. Signal Process., 42, pp. 1052-1062, 1994.
- [SM90a] A. SWAMY AND J. M. MENDEL, ARMA parameter estimation using only output cumulants, IEEE Trans. Acoustics Speech Signal Process., 38, pp. 1257-1265, 1990.
- [SM90b] A. SWAMY AND J. M. MENDEL, Time and lag recursive computation of cumulants from a state space model, IEEE Trans. Automat. Control, 35, pp. 4-17, 1990.
- [SM92] A. SWAMY AND J. M. MENDEL, Identifiability of the AR parameters of an ARMA process using only output cumulants, IEEE Trans. Automat. Control, 38, pp. 268-273, 1992.
- [ST98] S. SERRA AND P. TILLI, Extreme eigenvalues of multilevel Toeplitz matrices, preprint.
- [Ste73] G. W. STEWART, Introduction to Matrix Computations. Academic Press, New York, 1973.
- [Ste77] G. W. STEWART, Perturbation bounds for the QR factorization of a matrix, SIAM J. Numer. Anal., 14, pp. 509-518, 1977.
- [Ste79] G. W. STEWART, The effect of rounding error on an algorithm for downdating a Cholesky factorization, J. Inst. Math. Appl., 23, pp. 203-213, 1979.
- [Ste94] W. J. STEWART, Introduction to the Numerical Solution of Markov Chains, Princeton University Press, Princeton, NJ, 1994.
- [Ste95] G. W. Stewart, On the solution of block Hessenberg systems, Numer. Linear Algebra Appl., 2, pp. 287-296, 1995.
- [Ste98] M. Stewart, Stable pivoting for the fast factorization of Cauchy-like matrices, preprint.
- [Str86] G. Strang, A proposal for Toeplitz matrix calculations, Stud. Appl. Math., 74, pp. 171-176, 1986.
- [SV86] A. VAN DER SLUIS AND H. A. VAN DER VORST, The rate of convergence of conjugate gradients, Numer. Math., 48, pp. 543-560, 1986.
- [SVS83] K. SRIRAM, P. K. VARSHNEY, AND J. G. SHANTHIKUMAR, Discrete-time analysis of integrated voice/data multiplexers with and without speech activity detectors, IEEE J. Selected Areas Comm., 1, pp. 1124-1132, 1983.

- [Swa87] P. SWARZTRAUBER, Multiprocessor FFTs, Parallel Comput., 5, pp. 197-210, 1987.
- [Swe82] D. R. SWEET, Numerical Methods for Toeplitz Matrices, Ph.D. thesis, University of Adelaide, Adelaide, Australia, 1982.
- [Swe84] D. R. SWEET, Fast Toeplitz orthogonalization, Numer. Math., 43, pp. 1-21, 1984.
- [Swe93] D. R. SWEET, The use of pivoting to improve the numerical performance of algorithms for Toeplitz matrices, SIAM J. Matrix Anal. Appl., 14, pp. 468-493, 1993.
- [Sze39] G. Szegő, Orthogonal Polynomials, Amer. Math. Soc. Colloq. Publ., 23, AMS, Providence, RI, 1939.
- [TB97] L. N. TREFETHEN AND D. BAU, Numerical Linear Algebra, SIAM, Philadelphia, PA, 1997.
- [TE89] M. A. TEKALP AND A. T. ERDEM, Higher-order spectrum factorization in one and two dimensions with applications in signal modelling and nonminimum phase system identification, IEEE Trans. Acoustics Speech Signal Process., 37, pp. 1537-1549, 1989.
- [Til96] P. Tilli, Some spectral properties of non-hermitian block Toeplitz matrices, Calcolo, 1996.
- [Til97a] P. Tilli, Clustering properties of eigen and singular values of block multilevel Hankel matrices, preprint.
- [Til97b] P. Tilli, On the asymptotic spectrum of Hermitian block Toeplitz matrices with Toeplitz blocks, Math. Comp., 66, pp. 1147-1159, 1997.
- [Til98a] P. Tilli, Singular values and eigenvalues of non-Hermitian block Toeplitz matrices, Linear Algebra Appl., 272, pp. 59-89, 1998.
- [Til98b] P. Tilli, Locally Toeplitz sequences: Spectral properties and applications, Linear Algebra Appl., 278, pp. 91–120, 1998.
- [Til98c] P. TILLI, A note on the spectral distribution of Toeplitz matrices, Linear and Multilinear Algebra, 45, pp. 147-159, 1998.
- [TM99] P. TILLI AND M. MIRANDA, Asymptotic spectra of Hermitian block Toeplitz matrices and preconditioning results, SIAM J. Matrix Anal. Appl., to appear.
- [Tis91] M. TISMENETSKY, A decomposition of Toeplitz matrices and optimal circulant preconditioning, Linear Algebra Appl., 154/156, pp. 105-121, 1991.
- [TP91] A. TEKALP AND G. PAVLOVIĆ, Restoration of scanned photographic images, in Digital Image Restoration, A. Katsaggelos, ed., Springer-Verlag, Berlin, 1991.
- [Tre64] W. F. Trench, An algorithm for the inversion of finite Toeplitz matrices, J. SIAM, 12, pp. 515-522, 1964.
- [Tre86] W. F. Trench, Solution of systems with Toeplitz matrices generated by rational functions, Linear Algebra Appl., 74, pp. 191-211, 1986.
- [Tre90] L. N. TREFETHEN, Approximation theory and numerical linear algebra, in Algorithms for Approximation II, J. Mason and M. Cox, eds., Chapman and Hall, London, 1990.
- [Tuc64] L. R. Tucker, The extension of factor analysis to three-dimensional matrices, in Contributions to Mathematical Psychology, H. Gullikson and N. Frederiksen, eds., pp. 109-127, Holt, Rinehart and Winston, New York, 1964.
- [Tuc66] L. R. Tucker, Some mathematical notes on three-mode factor analysis, Psychometrika, 31, pp. 279-311, 1966.
- [Tug87] J. K. Tugnait, Identification of linear stochastic systems via second- and fourth-order cumulant matching, IEEE Trans. Inform. Theory, 33, pp. 393-407, 1987.
- [Tug95] J. K. Tugnait, Parameter estimation for noncausal ARMA models of non-Gaussian signals via cumulant matching, IEEE Trans. Signal Process., 43, pp. 886–893, 1995.

- [Tyr91] E. E. TYRTYSHNIKOV, Cauchy-Toeplitz matrices and some applications, Linear Algebra Appl., 149, pp. 1-18, 1991.
- [Tyr92a] E. E. TYRTYSHNIKOV, Singular values of Cauchy-Toeplitz matrices, Linear Algebra Appl., 161, pp. 99–116, 1992.
- [Tyr92b] E. E. TYRTYSHNIKOV, Optimal and superoptimal circulant preconditioners, SIAM J. Matrix Anal. Appl., 13, pp. 459-473, 1992.
- [Tyr94a] E. E. TYRTYSHNIKOV, Influence of matrix operations on the distribution of eigenvalues and singular values of Toeplitz matrices, Linear Algebra Appl., 207, pp. 225-249, 1994.
- [Tyr94b] E. E. TYRTYSHNIKOV, How bad are Hankel matrices?, Numer. Math., 67, pp. 261-269, 1994.
- [Tyr95] E. E. TYRTYSHNIKOV, Circulant preconditioners with unbounded inverses, Linear Algebra Appl., 216, pp. 1-24, 1995.
- [Tyr96a] E. E. TYRTYSHNIKOV, A unifying approach to some old and new theorems on distribution and clustering, Linear Algebra Appl., 232,, pp. 1-43, 1996.
- [Tyr97] E. E. TYRTYSHNIKOV, A Brief Introduction to Numerical Analysis, Birkhäuser, Boston, 1997.
- [TZ97] E. E. TYRTYSHNIKOV AND N. ZAMARASHKIN, Spectra of multilevel Toeplitz matrices: Advanced theory via simple matrix relationships, to appear in Linear Algebra Appl.
- [Var63] R. S. VARGA, Matrix Iterative Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1963.
- [Var92] J. M. VARAH, Backward error estimates for Toeplitz systems, preprint, Computer Science Department, University of British Columbia, Vancouver, 1992.
- [Var93] J. M. VARAH, The prolate matrix, Linear Algebra Appl., 187, pp. 269-278, 1993.
- [Vav91] Z. VAVRIN, A unified approach to Loewner and Hankel matrices, Linear Algebra Appl., 143, pp. 171-222, 1991.
- [VC81] R. S. VARGA AND D.-Y. CAI, On the LU factorization of M-matrices, Numer. Math., 38, pp. 179-192, 1981.
- [VD94] A. J. VAN DER VEEN AND P. M. DEWILDE, On low-complexity approximation of matrices, Linear Algebra Appl., 205/206, pp. 1145-1201, 1994.
- [Vee93] A. J. VAN DER VEEN, Time-Varying System Theory and Computational Modeling: Realization, Approximation, and Factorization. Ph.D. thesis, Delft University of Technology, Delft, The Netherlands, 1993.
- [VO96] C. VOGEL AND M. OMAN, Iterative methods for total variation denoising, SIAM J. Sci. Comput., 17, pp. 227–238, 1996.
- [WH31] N. WIENER AND E. HOPF, On a class of singular integral equations, Proc. Prussian Acad. Math.—Phys. Ser., p. 696, 1931.
- [Wid73] H. WIDOM, Toeplitz determinants with singular generating functions, Amer. J. Math., 95, pp. 333-383, 1973.
- [Wid74] H. WIDOM, Asymptotic behaviour of block Toeplitz matrices and determinants, Adv. Math., 13, pp. 284-322, 1974.
- [Wid75] H. WIDOM, On the limit of block Toeplitz determinants, Proc. Amer. Math. Soc., 50, pp. 167-173, 1975.
- [Wid80] H. WIDOM, Szegő limit theorem: The higher dimensional matrix case, J. Funct. Anal., 39, pp. 182–198, 1980.
- [Wie49] N. WIENER, Extrapolation, Interpolation and Smoothing of Stationary Time Series, with Engineering Applications, Technology Press and Wiley, New York, 1949.
- [Wil61] J. H. WILKINSON, Error analysis of direct methods of matrix inversion, J. Assoc. Comput. Mach., 8, pp. 281-330, 1961.

- [Wil63] J. H. WILKINSON, Rounding Errors in Algebraic Processes, Prentice-Hall, Englewood Cliffs, NJ, 1963.
- [Wil65] J. H. WILKINSON, *The Algebraic Eigenvalue Problem*, Oxford University Press, London, 1965.
- [Wri91] S. WRIGHT, Parallel algorithms for banded linear systems, SIAM J. Sci. Statist. Comput., 12, pp. 824-842, 1991.
- [Yag91] A. YAGLE, New analogues of split algorithms for arbitrary Toeplitz-plus-Hankel matrices, IEEE Trans. Signal Process., 39, pp. 2457-2463, 1991.
- [YL91] J. YE AND S.-Q. LI, Analysis of multi-media traffic queues with finite buffer and overload control—Part I: Algorithm, in Proc. IEEE Infocom 91, Bal Harbour, FL, pp. 1464-1474, 1991.

INDEX

adaptive filtering, 53	Cauchy-like matrix, 8, 49, 57, 108, 109,
algorithm array, 18, 59, 62, 86 Bareiss, 5, 59, 102 CG, 118 generalized Schur, 17, 18, 62, 86, 112 hybrid Schur-Levinson, 30, 109 inversion, 37 Levinson-Durbin, 4, 102, 245 PCG, 122 Schur, 28, 102, 245 tensor Schur, 265	Cayley transform, 247 CG method, 116, 117, 120, 152, 153 Chandrasekhar equations, 53 Chebyshev-Vandermonde matrix, 110 Cholesky factorization, 58, 59, 63, 64, 73, 107, 112 circulant matrix, 6, 50, 122 clustered eigenvalues, 119 coding theory, 56 condition number, 92, 104 congruence, 298
back substitution, 33 backward stability, 58, 85, 105 banded block Toeplitz system, 237, 239 banded matrix, 274 Bareiss algorithm, 5, 59, 102	Crout–Doolittle recursion, 289 cumulants, 242, 244, 248 cyclic reduction, 228, 230–232, 237, 238 Darlington synthesis, 245 deconvolution, 147
error analysis, 59, 112 biharmonic equation, 141 Blaschke matrix, 18, 26, 69, 113 block circulant matrix, 218 block displacement operator, 223 block displacement rank, 223, 227, 228, 238 block Hessenberg form, 211, 214, 224, 225, 228 block Toeplitz matrix, 169, 173, 209, 211, 214, 216, 218, 223–225 block tridiagonal matrix, 211, 227, 231, 237, 238 boundary value problem, 156	deflation, 15 digital filter, 2, 56 direct methods, 53, 116 displacement for tensors, 254 fundamental properties, 13–15 generalized, 9 inertia, 3 rank, 2, 103, 107, 274, 277 structure, 2, 6–11, 60, 157, 222, 246, 276 time-variant, 53 divided difference matrix, 10 doubling algorithm, 225
Carathéodory function, 10 Cauchy interlace theorem, 302 Cauchy matrix, 6, 61, 102, 108, 274	downdating, 59, 112, 113 elementary section, 23 embedding, 31, 58, 85, 114 entropy, 2

equation	algebraic derivation, 305, 313
displacement, 7, 8, 11, 12, 18, 84,	complex case, 305, 312
89, 94, 270, 271	geometric derivation, 306, 313
Fredholm, 2	hyperbolic case, 312
Lyapunov, 11, 259, 260, 285	hybrid Schur-Levinson algorithm, 30, 32
Lyapunov–Stein, 288	37, 109
seminormal, 102	hyperbolic rotation, 65, 113, 309
Stein, 11	H procedure, 68
Wiener-Hopf, 2	mixed downdating, 66, 311
Yule-Walker, 30, 243, 245	OD procedure, 67, 311
explicit structure, 1	F
5. p. 10. 10. 10. 10. 10. 10. 10. 10. 10. 10	IEEE standards, 60
factorization	ill-conditioned matrix, 96, 104
block triangular, 35	image restoration, 146
modified QR, 85	implicit structure, 1
QR, 32, 85, 89, 113	inertia of a matrix, 298
triangular, 2, 5, 6, 15, 58, 61, 62,	inflation, 37
85, 86, 242, 273	input-output model, 53
f-circulant matrix, 196	interpolation, 2, 11, 54, 245
FFT, 13, 217, 235, 238, 275, 291	Carathéodory, 54
floating point processor, 60	Hermite-Fejér, 54
four-block problem, 54	Lagrange, 55
Frobenius norm, 300	Nevanlinna–Pick, 54
Probeinus norm, 500	Padé, 55
Gaussian elimination, 5, 16, 48, 57, 102,	polyspectral, 261
105, 108, 294	invariance property, 13
generalized Hessenberg systems, 237	inverse scattering, 2, 55
	inversion algorithm, 37
generalized Schur algorithm, 17–18, 58	iterative methods, 53, 104, 116, 120
derivation, 18–23	iterative refinement, 76
error analysis, 59, 64–73, 112	, · ·
for tensors, 265	J-lossless system, 54
proper form, 25–27, 62, 86	J-unitary matrix, 3, 87, 88, 301
pseudocode, 81	
generating function, 120, 161	Krylov subspace, 117
generator	
growth, 75, 110	Levinson-Durbin algorithm, 4, 37, 102,
matrix, 3, 60–62, 107	111, 245
nonminimal, 3	error analysis, 4, 58, 112
Givens rotation, 307	linear convergence, 119, 190
Gohberg-Semencul formula, 13	linear phase filtering, 139
Gram-Schmidt procedure, 299	locally Toeplitz matrix, 174–185
	Loewner matrix, 8
Hankel matrix, 1, 8, 61, 102, 274	look-ahead algorithm, 104
Hankel rank, 275	look-ahead Schur algorithm, 34
Hankel-like matrix, 7, 47	lossless system, 55
Hessenberg matrix, 209	Lyapunov condition, 282
higher-order statistics, 243	· · · · · · · · · · · · · · · · · · ·
Hilbert matrix, 103	MAC protocol, 239
homotopy technique, 196	machine precision, 60, 92, 96, 98, 104,
Householder matrix	112

probability matrix, 209, 211 Markov chain, 210–215 proper form, 25, 42, 62, 87 M/G/1 type, 211 matrix completion, 11 QBD problem, 211, 227, 231, 237 matrix inversion lemma, 297 QR factorization, 32, 59, 84, 89-100, matrix polynomial, 216 107, 113, 299 matrix power series, 216, 219–222, 233, fast stable algorithm, 114 quadratic convergence, 190 matrix-vector product, 12, 123 method quasi-Toeplitz matrix, 59, 61, 85 queueing network, 143, 212 CG, 117 iterative, 53, 116 Ramaswami's formula, 210, 225 Newton's, 187, 188 reachability matrix, 281 PCG, 122 realization theory, 277 modified Gram-Schmidt, 300 reflection coefficient, 4, 37, 103 multibanded matrix, 274 regularization, 147 multilevel Toeplitz matrix, 165, 173 residual Nerode equivalence, 280 correction, 188, 198 network traffic, 212 error, 4, 58, 106, 239, 240 matrix, 190 Newton's iteration, 187–190 norm, 118, 122, 195 Newton-Toeplitz iteration, 192–196 norm of a matrix, 300 normalized, 106 vector, 106, 117 numerical stability, 51, 57, 85, 103 Riccati equation, 2 backward, 52, 58, 85, 105 Riccati recursion, 53 strong, 105 Riemann sum, 160, 181 weak, 5, 104, 106 Riemann-Lebesgue lemma, 158 observability matrix, 281 rounding error, 64, 103 orthogonal polynomials, 4 Schur algorithm, 5, 28-30, 102, 104 PCG method, 116, 122, 187 Schur complement, 14–17, 21, 30, 31. permutation, 308 63, 71, 85, 88, 89, 96, 224, 229, Perron-Frobenius theorem, 303 232, 269, 270, 294 perturbation analysis, 64 Schur construction, 37 Schur reduction, 15, 295 Pick matrix, 1, 6, 32, 44, 61 second-order statistics, 242, 243, 245 Pick tensor, 242 pivoting, 48, 57, 73 seminormal equations, 114 complete, 48, 57 shift invariance, 156 partial, 48, 57, 105 shift matrix, 3 polyspectrum, 242, 255 shift-structured matrix, 61, 84, 89 positive recurrence, 210 sparse matrix, 1 power series arithmetic, 221 spectral decomposition, 297 preconditioner, 54, 116, 121 spectral distribution, 120, 152-156 band-Toeplitz, 129 spectral norm, 300 circulant, 124 spectrum, 116 for structured matrices, 132 stable algorithm, 105 Strang's, 124 state-space structure, 52, 274 T. Chan's, 126 stochastic matrix, 210 Toeplitz-circulant, 131 structured perturbation, 103 probability invariant vector, 210 superlinear convergence, 126

Sylvester equation, 11 Sylvester's law, 13, 298 Szegő formula, 158, 159, 162, 163, 181

tensor, 242, 248
time-variant structure, 11, 53
Toeplitz matrix, 1, 2, 37, 61, 102, 108, 116, 274
Toeplitz-like matrix, 7, 45, 109, 116, 132, 190
Toeplitz-plus-band matrix, 116, 138
Toeplitz-plus-Hankel matrix, 102, 110, 116, 136
total variation, 148
transformation to Cauchy-like, 50
transmission line, 27
transmission zero, 24
triangular factorization, 2, 5, 6, 9, 16,

58, 61, 86, 295 Tucker product, 248

unitary matrix, 301

Vandermonde matrix, 1, 6, 7, 61, 102 Vandermonde-like matrix, 205

weak stability, 104 well-conditioned matrix, 92, 104 Wiener-Hopf technique, 5

Yule-Walker equations, 4, 243, 245