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New & Forthcoming Publications in Linear Algebra

V. V. Prasolov: *Problems and Theorems in Linear Algebra*

Book Review by S. W. Drury, *McGill University*

Problems and Theorems in Linear Algebra by V. V. Prasolov [Translations of Mathematical Monographs, vol. 134, American Mathematical Society, 1994, xviii + 225 pp., ISBN 0-8218-0236-4] is a breath of fresh air in comparison with most textbooks on Linear Algebra. The author has set out with the objective of presenting the standard theorems of his subject in unusual and interesting ways. Very little is assumed in the way of prerequisites: linear space, basis, linear map and determinant. Parts of the book are accessible to strong undergraduates, but it will mostly be read by graduate students and mathematical professionals. The book lacks the cohesiveness necessary for use as a graduate course text—it is really a long series of vignettes which, while linked together in places, do not provide a systematic and complete discussion of the subject.

The section on linear dependence and independence in most linear algebra texts will not contain anything to excite the more seasoned reader. Here the situation is different. As an illustration, Prasolov presents a 1988 result of Bernard Aupetit on the linear dependence of operator powers. After reading this section, one feels that Aupetit's Theorem deserves to be better known. The whole book is pervaded by such "diamonds in the rough".

The first three chapters are devoted to basic topics: Determinants, Linear Spaces and Canonical Forms. Then follow four chapters on more specialized topics: Matrices of Special Form, Multilinear Algebra, Matrix Inequalities and Matrices in Algebra and Calculus. Included are many topics usually shunned in linear algebra texts. We find here treatments of Complexification and Realification, the Pfaffian, Clifford algebras, Quaternions and the Cayley numbers. A feature of the book is the inclusion of problem sets at the end of each section. These are generally well suited to the material presented. There are complete solutions at the end of each chapter. The exposition is generally good, the emphasis being on ideas rather than details. Abstract concepts, such as the exterior product, are used in places that call for the abstract while more concrete concepts such as matrices are used in others. The passage between the two, where necessary, is usually accomplished seamlessly. There are occasional misprints and in places the English translation could be improved. Nevertheless this is an excellent book, both for armchair reading and for the reference shelf.

Books on Linear Algebra and Some Related Topics: 1994–1995

by Simo Puntanen, *University of Tampere* & George P. H. Styan, *McGill University*

Listed below are all the books on linear algebra that we have been able to identify that have been published in 1994 or already in 1995 (or are in press); some selected books in closely related fields are also included as are some books that are in press. References to reviews in *Mathematical Reviews* [MR], *Linear Algebra and Its Applications* [LAA] and *Image* are given in square brackets; (P) denotes paperback and (H) hard cover.

This list is a proper subset of *A Guide to Books on Matrices and Books on Inequalities, with Statistical and Other Applications* by George P. H. Styan & Simo Puntanen, which will be published as a Special Issue of *Linear Algebra and Its Applications*. A pre-print version (hard copy) of this Guide is available as Report A283 [Dept. of Mathematical Sciences, University of Tampere, December 1993, 65 pp.] from Simo Puntanen: SJP@UTA.FI. Soft copy of the current version is available from George Styan: MT56@MUSICA.MCGILL.CA.

Agarwal, Ravi P., ed. (1994). *Inequalities and Applications.* World Scientific, ca. 592 pp., ISBN 981-02-1830-3.

Allenby, R. B. J. T. (1995). *Linear Algebra.* Edward Arnold, xii + 227 pp., ISBN 0-340-61044-1.

Anderson, T. W.; Fang, K. T. & Olkin, I., eds. (1994). *Multivariate Analysis and Its Applications.* Managing Editor: F. J. Hickernell. IMS Lecture Notes–Monograph Series, vol. 24. Institute of Mathematical Statistics, xiv + 472 pp., ISBN 0-940600-35-8 (P). [Proceedings of Symposium held in Hong Kong, March 16–18, 1992.]

Anton, Howard (1994). *Elementary Linear Algebra.* Seventh Edition. Wiley, xvi + 620 pp., ISBN 0-471-58742-7 (H), ISBN 0-471-00828-1 (text & software). [*Student Solutions Manual:* Grobe & Grobe (1994); *Test Bank:* Schwartz (1994); *Computerized Test Bank,* ISBN 0-471-00824-9 (IBM), ISBN 0-471-00826-5 (Macintosh); *Linear Kit,* ISBN 0-471-61998-1; *Linear Algebra Applications Software* (from Intellipro), ISBN 0-471-00827-3. Original version: 1973; Second Edition: 1977, 366 pp., translated into Arabic, Japanese, Spanish; Third Edition translated into Bahasa Indonesia; Fourth Edition: 1984, xiii + 449 pp.; Fifth: 1987, xv + 475 pp.; Sixth: 1991, xv + 570 pp.]

Anton, Howard & Rorres, Chris (1994). *Elementary Linear Algebra: Applications Version.* Seventh Edition. Wiley, xvi + 843 pp., ISBN 0-471-58741-9 (H), ISBN 0-471-07276-01 (text & software). ["Expanded version" of Anton (1994), with first 10 chapters identical.]

Axelsson, Owe (1994). *Iterative Solution Methods.* Cambridge University Press, xiii + 654 pp., ISBN 0-521-44524-8. [*Image* 13:6.]

Barrett, Richard; Berry, Michael; Chan, Tony F.; Demmel, James; Donato, June; Dongarra, Jack J.; Eijkhout, Victor; Pozo, Roldan; Romine, Charles H. & van der Vorst, Henk A. (1994). *Templates for the Solution of Linear Systems: Building Blocks for Iterative Methods.* SIAM, xiv + 112 pp., ISBN 0-89871-328-5 (P). [MR 94m:65002.]

Basilevsky, Alexander (1994). *Statistical Factor Analysis and Related Methods: Theory and Applications.* Wiley, xxiii + 737 pp., ISBN 0-471-57082-6.

Bauldry, William C.; Evans, Benny & Johnson, Jerry A. (1995). *Linear Algebra with* MAPLE®. Wiley, xiii + 275 pp., ISBN 0-471-06368-1 (P).

Berman, Abraham & Plemmons, Robert J. (1994). *Nonnegative Matrices in the Mathematical Sciences.* Classics in Applied Mathematics, vol. 9. SIAM, xx + 340 pp., ISBN 0-89871-321-8 (P). ["Corrected Republication" (but 2 pages incorrectly printed—replacement pages available from SIAM: Ed). Original version: 1979, Academic Press, xviii + 316 pp., MR 82b:15013.]

Bini, Dario & Pan, Victor Y. (1994). *Polynomial and Matrix Computations, Volume 1: Fundamental Algorithms.* Birkhäuser, xvi + 415 pp., ISBN 0-8176-3786-9.

Boehm, Wolfgang & Prautzsch, Hartmut (1994). *Geometric Concepts for Geometric Design.* A. K. Peters, Wellesley, Mass., xviii + 402 pp., ISBN 1-56881-004-0. [MR 94j:65002.]

Boyd, Stephen; El Ghaoui, Laurent; Feron, Eric & Balakrishnan, Venkataramanan (1994). *Linear Matrix Inequalities in System and Control Theory.* Studies in Applied Mathematics, vol. 15. SIAM, ix + 193 pp., ISBN 0-89871-334-X (H). [*Image* 13:6.]

Bronson, Richard (1995). *Linear Algebra: An Introduction.* Academic Press, ca. 614 pp., ISBN 0-12-135245-5.

Bugl, Paul (1995). *Differential Equations: Matrices and Models.* Prentice Hall, ca. 680 pp., ISBN 0-02-316540-5.

Caliński, T. & Kala, R., eds. (1994). *Proceedings of the International Conference on Linear Statistical Inference LINSTAT '93.* Production Editor: I. Siatkowski. Mathematics and Its Applications, vol. 306. Kluwer, Dordrecht, xviii + 306 pp., ISBN 0-7923-3136-2.

Ciarlet, Philippe G. (1994). *Introduction à l'analyse numérique matricielle et à l'optimisation: cours et exercises.* In French. Fifth Printing. Masson, xii + 279 pp., ISBN 2-225-68893-1 (P). [MR 84c:65002a. Original version: 1982; fourth printing: 1990.]

Ciarlet, Philippe G. & Lions, Jacques Louis, eds. (1994). *Handbook of Numerical Analysis, Volume III.* North-Holland, Amsterdam, ca. 778 pp., ISBN 0-444-89928-6. [*Volume I,* North-Holland, Amsterdam, viii + 652 pp., ISBN 0-444-70366-7, 1990, MR 91f:65001; *Volume II: Finite Element Methods, Part 1,* x + 928 pp., ISBN 0-444-70365-9, 1991, MR 92f:65001.]

Cohn, P. M. (1994). *Elements of Linear Algebra.* Chapman & Hall, xiv + 221 pp., ISBN 0-412-55280-9.

Courant, Richard & Hilbert, David (1994). *Methods of Mathematical Physics, Volume I.* In English. Reprint Edition. Revised Translation from the German. Wiley, xv + 561 pp., ISBN 0-471-50447-5. [Original English version: 1953, Interscience.]

Crowe, Michael J. (1994). *A History of Vector Analysis: The Evolution of the Idea of a Vectorial System.* Corrected Reprint Edition. Dover, xviii + 270 pp., ISBN 0-486-67910-1 (P). [MR 94j:01003. "Slightly corrected reprint of the Dover edition of 1985, which was an unabridged and corrected republication" of the original version: 1967, University of Notre Dame Press, MR 37:5070, "and which contained a new Preface by the author. The 1994 edition adds a Publishers Note."]

Cullen, Charles G. (1994). *An Introduction to Numerical Linear Algebra.* PWS-Kent, xiii + 314 pp. & disk (for MATALG), ISBN 0-534-93690-3.

Das Gupta, Somesh; Ghosh, J. K.; Mitra, Sujit Kumar; Mukhopadhyay, A. C; Rao, P. S. S. N. V. P. & Sarma, Y. R., eds. (1994). *Selected Papers of C. R. Rao, Volume 2.* Indian Statistical Institute & Halsted Press, ix + 504 pp., ISBN 0-470-22092-9. [Includes papers on generalized inverses of matrices and their applications, published: 1955–1965.]

Datta, Biswa Nath (1995). *Numerical Linear Algebra.* Brooks/Cole, xxii + 680 pp., ISBN 0-534-17466-3.

Edwards, H. M. (1995). *Linear Algebra.* Birkhäuser, ca. 300 pp., ISBN 0-8176-3731-1.

Ellis, Wade, Jr.; Lodi, Ed & Johnson, Eugene W. (1994). *Maple V Flight Manual, Release 2: Tutorials for Calculus, Linear Algebra, and Differential Equations.* Brooks/Cole, xxi + 183 pp., ISBN 0-534-21235-2 (P). [Original version/Release 1: 1992.]

Evans, Benny & Johnson, Jerry A. (1994). *Linear Algebra with* DERIVE®. Wiley, x + 280 pp. ISBN 0-471-59194-7 (P).

Fraleigh, John B. & Beauregard, Raymond A. (1995). *Linear Algebra.* Third Edition. Addison-Wesley, xii + 595 pp., ISBN 0-201-52675-1. [With diskette: LINTEK 3.0, Educational PC Software, ISBN 0-201-96694-8. Original version: 1987, xv + 518 pp.; Second Edition: 1990, xiii + 571 pp.]

Gelfand, I. M.; Kapranov, M. M. & Zelevinsky, A. V. (1994). *Discriminants, Resultants, and Multidimensional Determinants.* Birkhäuser, x + 523 pp., ISBN 0-8176-3660-9.

Geurts, A. J. & Praagman, C. V. (1994). *A Fortran Subroutine for Column Reduction of Polynomial Matrices.* EUT Report-WSK no. 94-01. Dept. of Mathematics & Computing Science, Eindhoven University of Technology, ii + 70 pp.

Gilbert, Jimmie & Gilbert, Linda (1995). *Linear Algebra and Matrix Theory.* Academic Press, ca. 432 pp., ISBN 0-12-282970-0.

Gilbert, John R. & Kershaw, Donald, eds. (1994). *Large-Scale Matrix Problems and the Numerical Solution of Partial Differential Equations: Papers from the Fifth Summer School in Numerical Analysis held at the University of Lancaster, Lancaster, July 19–31, 1992.* Advances in Numerical Analysis, vol. III. Oxford University Press, viii + 212 pp., ISBN 0-19-853463-9.

Golub, Gene H.; Greenbaum, A. & Luskin, M. (1994). *Recent Advances in Iterative Methods.* IMA Volumes in Mathematics & Its Applications, vol. 60. Springer-Verlag, ca. 248 pp., ISBN 0-387-94252-1.

Green, Peter J. & Silverman, Bernard W. (1994). *Nonparametric Regression and Generalized Linear Models: A Roughness Penalty Approach.* Monographs on Statistics & Applied Probability, vol. 58. Chapman & Hall, xi + 182 pp., ISBN 0-412-30040-0.

Grobe, Charles A., Jr. & Grobe, Elizabeth M. (1994). *Student Solutions Manual.* Wiley, ISBN 0-471-30622-3. [Solutions Manual to Anton (1994).]

Grossman, Stanley I. (1994). *Elementary Linear Algebra.* Fifth Edition. Saunders, xx + 758 pp., ISBN 0-03-097354-6. [Original version: 1980, Wadsworth, x + 387 pp.; Fourth Edition: 1991, 576 pp.]

Hackbusch, Wolfgang (1994). *Iterative Solution of Large Sparse Systems of Equations.* In English. Slightly revised translation from the 1991 German original. Applied Mathematical Sciences, vol. 95. Springer-Verlag, xxii + 429 pp., ISBN 0-387-94064-2 (H). [MR 94k:65002.]

Hadi, Ali S. *Matrix Algebra as a Tool.* In press, ca. xiii + 208 pp.

Halmos, Paul R. (1995). *Linear Algebra Problem Book.* Mathematical Association of America, ca. 340 pp., ISBN 0-88385-322-1 (P).

Hill, David R. & Zitarelli, David E. (1994). *Linear Algebra Labs with* MATLAB®. Macmillan [Prentice Hall], 296 pp., ISBN 0-02-354811-8 (P).

Horn, Roger A. & Johnson, Charles R. (1994). *Topics in Matrix Analysis.* In English. Corrected Reprint Edition. Cambridge University Press, viii + 607 pp., ISBN 0-521-46713-6 (P). [*Image* 13:7. Original version: 1991, ISBN 0-521-30587-X (H), LAA 174:243–246, MR 92e:15003, *Image* 7:21–22.]

Huppert, Bertram & Schneider, Hans, eds. (1994). *Helmut Wielandt: Mathematische Werke/Mathematical Works, Volume 1: Group Theory.* With essays on some of Wielandt's works by Gerhard Betsch, Brian Hartley, I. Martin Isaacs, Otto H. Kegel & Peter M. Neumann. Walter de Gruyter, xx + 802 pp., ISBN 3-11-012452-1. [*Volume 2: Linear Algebra and Analysis,* in press, ISBN 3-11-012453-X.]

Jacob, B. (1995). *Linear Functions and Matrix Theory: An Introduction.* Springer-Verlag, ca. 348 pp., ISBN 0-387-94451-6 (P).

Jánich, Klaus (1994). *Linear Algebra.* Springer-Verlag, 204 pp., ISBN 0-387-94128-2.

Krzanowski, W. J. & Marriott, F. H. C. (1994). *Multivariate Analysis, Part I: Distributions, Ordination and Inference.* Kendall's Library of Statistics, vol. 1. Edward Arnold & Halsted Press, ix + 280 pp., ISBN 0-340-59326-1 & ISBN 0-470-23382-6. [*Part 2: Classification, Covariance Structures and Repeated Measurements* forthcoming.]

Lancaster, Peter & Rodman, Leiba. *Algebraic Riccati Equations.* Oxford University Press, ca. 472 pp., in press.

Lascaux, P. & Theodor, R. (1994). *Analyse numérique matricielle appliquée à l'art de l'ingénieur, Tome 2: Méthodes itératives.* In French. Second Edition. Masson, Paris, xxvi + 310 pp., ISBN 2-225-84546-8.

Lay, David C. (1994). *Linear Algebra and Its Applications.* Addison-Wesley, xvi + 505 pp., ISBN 0-201-52031-1 (H), ISBN 0-201-52032-X (Instructor's Edition).

Leon, Steven J. (1994). *Linear Algebra with Applications.* Fourth Edition. Macmillan [Prentice Hall], xvi + 506 pp., ISBN 0-02-369831-4. [Original version: 1980, xii + 338 pp.; Second Edition: 1986, xv + 408 pp.; Third Edition: 1990, xv + 458 pp. (H) & Maxwell Macmillan International Edition, Singapore (P); MATLAB® Exercises for the Fourth Edition, 37 pp., (P).]

Leon, Steven J.; Herman, Eugene & Faulkenberry, Richard, eds. *ATLAST Computer Exercises for Linear Algebra.* In press.

Lewis, John G., ed. (1994). *Proceedings of the Fifth SIAM Conference on Applied Linear Algebra: Snowbird, Utah, June 15–18, 1994.* [Proceedings in Applied Mathematics, vol. 72.] SIAM, x + 578 pp., ISBN 0-89871-336-6 (P).

Marcus, Marvin (1994). *A Survey of Finite Mathematics.* Dover, x + 486 pp., ISBN 0-486-67553-X (P). [Original version: 1969, Houghton Mifflin (H).]

The MathWorks, Inc. (1995). *The Student Edition of* MATLAB® *Version 4.* Prentice Hall, xiv + 494 pp., ISBN 0-13-184995-6 (Windows), ISBN 0-13-184987-5 (Mac), ISBN 0-13-184979-4 (User's Manual).

Matstoms, Pontus (1994). *Sparse QR Factorization with Applications to Linear Least Squares Problems.* Linköping Studies in Science and Technology: Dissertations, no. 337. Dept. of Mathematics, Linköping University, x + 219 pp., ISBN 91-7871-234-3.

Milovanović, G. V. *et al.*, eds. (1994). *Topics in Polynomials: Extremal Problems, Inequalities, Zeros.* World Scientific, ca. 592 pp., ISBN 981-02-0499-X.

Neuts, Marcel F. (1995). *Matrix-Geometric Solutions in Stochastic Models: An Algorithmic Approach.* Reprint Edition. Dover, xiii + 332 pp., ISBN 0-486-68342-7 (P). [Original Version: 1981, Johns Hopkins, MR 82j:60177.]

Nicholson, W. Keith (1994). *Elementary Linear Algebra with Applications.* Third Edition. PWS-Kent, xviii + 540 pp., ISBN 0-534-93666-0. [Supplements: *Solutions Manual, Test Material, Student Guides.* Original version: 1986, xiii + 557 pp.; Second Edition: 1990, xvi + 576 pp.]

Norman, Daniel (1995). *Introduction to Linear Algebra for Science and Engineering.* Addison-Wesley, xvii + 555 pp., ISBN 0-201-60210-5.

Patel, Rajni V.; Laub, Alan J. & Van Dooren, Paul M., eds. (1994). *Numerical Linear Algebra Techniques for Systems and Control.* IEEE Press, xi + 724 pp., ISBN 0-7803-0443-8.

Penny, John & Lindfield, George (1995). *Numerical Methods using* MATLAB®. Ellis Horwood, xii + 328 pp., ISBN 0-13-030966-4.

Prasolov, V. V. (1994). *Problems and Theorems in Linear Algebra.* In English. Translated from the Russian by D. A. Leites. Translations of Mathematical Monographs, vol. 134. American Mathematical Society, xviii + 225 pp., ISBN 0-8218-0236-4.

Redfern, Darren & Campbell, Colin. *The* MATLAB® *Handbook.* Springer-Verlag, 400 pp., in press, ISBN 0-387-94200-9 (P).

Schwartz, Randy (1994). *Test Bank.* Wiley, ISBN 0-471-30848-X. [Test Bank for Anton (1994).]

Shaked, Moshe & Shanthikumar, J. George (1994). *Stochastic Orders and Their Applications.* Academic Press, xvi + 545 pp., ISBN 0-12-638160-7.

Sigmon, Kermit. MATLAB® *Primer.* Fourth Edition. CRC Press, in press. [*Image* 13:7. Original version: 1989, Dept. of Mathematics, University of Florida, Gainesville, ii + 22 pp. (P); Third Edition: 1993.]

Simmonds, James G. (1994). *A Brief on Tensor Analysis.* Second Edition. Springer-Verlag, xiv + 112 pp., ISBN 0-387-94088-X. [MR 94h:53001. Original version: 1982, MR 84h:53002.]

Spindler, Karlheinz (1994). *Abstract Algebra with Applications, Volume I: Vector Spaces and Groups.* Marcel Dekker, xviii + 756 pp., ISBN 0-8247-9144-4. [MR 94i:00002a.]

Spindler, Karlheinz (1994). *Abstract Algebra with Applications, Volume II: Rings and Fields.* Marcel Dekker, xvi + 531 pp., ISBN 0-8247-9159-2. [MR 94i:00002b.]

Strum, Robert D. & Kirk, Donald E. *Contemporary Linear Systems using* MATLAB®. PWS/Kent, in press, ISBN 0-53-493273-8.

Sturmfels, Bernd, ed. (1994). *Theory of Algebraic Invariants: Introductory Course by David Hilbert.* In English. Translated from the German. Based on Notes taken by Sophus Marxen. Cambridge University Press, 206 pp., ISBN 0-521-44457-8 (H), ISBN 0-521-44903-0 (P). [First English translation of the class notes from Hilbert's 1897 course on invariant theory.]

Tran Van Hiep (1994). *Algèbre: Cours et exercices corrigés.* In French. Presses Universitaires de France, xiv + 730 pp., ISBN 2-13-046091-7.

Tucker, Alan (1994). *Linear Algebra: An Introduction to the Theory and Use of Vectors and Matrices.* Macmillan [Prentice Hall], xiii + 440 pp., ISBN 0-02-421581-3.

Van Dooren, Paul M., ed. (1994). *Linear Algebra for Control Theory.* IMA Volumes in Mathematics & Its Applications, vol. 62. Springer-Verlag, 189 pp., ISBN 0-387-94267-X.

Wang, Song-Gui & Chow, Shein-Chung (1994). *Advanced Linear Models: Theory and Applications.* Statistics: Textbooks and Monographs, vol. 141. Marcel Dekker, x + 537 pp., ISBN 0-8247-9169-X.

Watkins, David S. (1991). *Fundamentals of Matrix Computations.* Wiley, xiv + 449 pp., ISBN 0-471-61414-9 (H), ISBN 0-471-54601-1 (P). [LAA 171:275–277, MR 92a:65012. Errata list (1994) by anonymous ftp from am-ath.washington.edu. cd pub/watkins and get fmcerrata.ps.gz & hard copy from DAVID.WATKINS@NA-NET.ORNL.GOV.]

Wilkinson, J. H. (1994). *Rounding Errors in Algebraic Processes.* Reprint Edition. Dover, vii + 161 pp., ISBN 0-486-67999-3 (P). ["Unaltered republication" of the original version: 1963, Prentice Hall, MR 28:4661.]

Linear Algebra and Its Applications—LAA

Forthcoming Special Issues

Proceedings of the Conference "Matrices and Graphs" in Honor of John Maybee's 65th Birthday: Boulder, Colorado, May 7–8, 1993. Special Editor: J. Richard Lundgren.

Proceedings of the Workshop "Nonnegative Matrices, Applications and Generalizations" and the 8th Haifa Matrix Theory Conference (May–June 1993). Special Editors: Shmuel Friedland, Daniel Hershkowitz & Raphael Loewy.

Special Issue Honoring Miroslav Fiedler and Vlastimil Pták. Special Editors: Wayne Barrett, Angelika Bunse-Gerstner & Nicholas Young.

Proceedings of the Fourth Conference of the International Linear Algebra Society (Rotterdam, August 1994). Special Editors: Harm Bart, Ludwig Elsner & Andre Ran.

Special Issue Honoring J. J. Seidel. Special Editors: Aart Blokhuis, Willem H. Haemers & Alan J. Hoffman.

Fifth Special Issue on Linear Algebra and Statistics: Dedicated to C. R. Rao in Celebration of his 75th Birthday. Special Editors: R. B. Bapat, George P. H. Styan & Hans Joachim Werner.

A Guide to Books on Matrices and Books on Inequalities, with Statistical and Other Applications by George P. H. Styan & Simo Puntanen.

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LINEAR ALGEBRA
and Its Applications

FORTHCOMING ARTICLES

Partial Contents for the Forthcoming Special Issue Honoring Miroslav Fiedler and Vlastimil Ptak

Two Sided Interpolation for Matrix Functions with Entries in the Hardy Space
Daniel Alpay and Vladimir Bolotnikov

Majorization Relations for Hadamard Products
T. Ando

Completing a Block Diagonal Matrix With a Partially Prescribed Inverse
Wayne W. Barrett, Charles R. Johnson, Michael E. Lundquist and Hugo J. Woerdeman

Colorability of Induced Matroids
Richard A. Brualdi and Amelia Fonseca

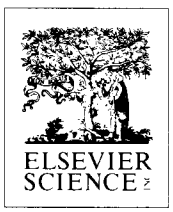
Toeplitz Operators and the Berezin Transform on H^2
Miroslav Englis

Transistor Circuits and Potentially Stable Operating Points
Michael M. Green and Alan N. Willson Jr.

Cross-Positive Matrices Revisited
Peter Gritzmann, Victor Klee and Bit-Shun Tam

The Stability of Inversion Formulas for Toeplitz Matrices
Martin H. Gutknecht and Marlis Hochbruck

On A Subclass of P_0
Sy-Ming Guu and Richard W. Cottle



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Reports on Linear Algebra Events Attended

First Southeastern Linear Algebra Conference

Chattanooga, Tennessee: May 27–28, 1994

We are very grateful to Tom Markham and Ron Smith for helping us identify some of the people in the photo published on page 10 of the last issue of *Image*. From left to right, are—back row: Frank Uhlig, Carolyn Eschenbach, Kuiyuan Li, Charlie Johnson, y_1, Stan Byrd, Peter Nylen; second row from back: y_2, Peter Gibson, Tom Markham, Paul Binding, Jason Zhang; second row from front: Chi-Kwong Li, Chris Hill, Tin Yau Tam, Jim Weaver, Frank Hall, Ron Smith; front row: y_3, In'sook Ma, Wa-sin So, and A. A. Ebiefung. The Editors of *Image* look forward to learning the identities of y_1, y_2, and y_3.

2nd Workshop on Numerical Ranges and Numerical Radii
Coimbra, Portugal: August 8–12, 1994

Report by Natalia Bebiano

This Workshop was held at the Department of Mathematics of the University of Coimbra, August 8-12, 1994. There were about thirty participants from China, Japan, Netherlands, USA and Portugal, and 22 talks were given. The Workshop provided opportunities for researchers to exchange research problems, ideas and experience on the subject that might stimulate further development. There will be no proceedings for the workshop, but the editors of *Linear and Multilinear Algebra* plan to publish those papers on the subject in a single issue that were submitted by December 31, 1994, and are subsequently accepted.

The study of numerical ranges and numerical radii has a long and very rich history. It goes back to the pioneering research of Toeplitz and Hausdorff in the beginning of the century. While many interesting results have been discovered, many problems are still open and deserve investigation. In fact, this subject is related to and has applications in various branches of pure and applied science. Moreover, many different mathematical tools are useful in the study of this field, which is, therefore, a most valuable testing ground of a wide range of techniques. The workshop reflected the fact that "numerical ranges and numerical radii" is a subject full of potentiality with incidences in many other research fields. It also signified the rapid development of the subject. The first Workshop in this series was held at the College of William and Mary, Williamsburg, in August 1992. These meetings are the continuation of the Symposium on the same theme that took place in September 1991 at the 4th SIAM Conference on Applied Linear Algebra in Minneapolis. The 3rd Workshop of this series will take place in Sapporo, Japan, in August 1996.

Besides the academic program, there were several social activities, including a reception at the Town Hall of Figueira da Foz, a visit to the Roman ruins of Conimbriga and to the medieval castle of Montemor-o-Velho. Also, the participants visited the historical buildings of the University of Coimbra. The conference dinner was at the Restaurant Piscinas. Support of the workshop came from Departamento de Matemática of the University of Coimbra, Junta Nacional de Investigação Científica e Tecnológica, Fundação Luso-Americana para o Desenvolvimento, Fundação Oriente, JNICT Project PBIC/C/CEN/1129/92 "Representação de Grupos e Análise Combinatória" and JNICT Project STRDA/C/CEN/529/92 "Desenvolvimentos Recentes em Álgebra Linear" and a NATO Research Project.

List of Participants: H. Albuquerque (Univ. of Coimbra), O. Azenhas (Univ. of Coimbra), T. Ando (Hokkaido University), N. Bebiano (Univ. of Coimbra), I. Cabral (Universidade Nova de Lisboa), J. Dias da Silva (Univ. of Lisbon), J. L. M. van Dorsselaer (Leiden University), C. Gamas (Univ. of Coimbra), R. Grone (San Diego State

University), K. Gustafson (Univ. of Colorado), Y. Jang (Univ. of Coimbra), C. R. Johnson (College of William and Mary), D. S. Keeler (Miami University), A. Leal Duarte (Univ. of Coimbra), C.-K. Li (College of William and Mary), M. E. Miranda (Univ. of Coimbra), H. Nakazato (Hirosaki University), K. Okubo (Hokkaido University of Education), G. N. de Oliveira (Univ. of Coimbra), J. da Providencia (Univ. of Coimbra), J. F. Queiró (Univ. of Coimbra), L. Rodman (College of William and Mary), F. C. Silva (Univ. of Lisbon), F. Silva Leite (Univ. of Coimbra), M. N. Spijker (Leiden University), I. Spitkovsky (College of William and Mary), R. C. Thompson (Univ. of California, Santa Barbara), N. K. Tsing (Univ. of Hong Kong), and J. L. Vitória (Univ. of Coimbra).

4th Conference of The International Linear Algebra Society Rotterdam, The Netherlands: August 15–19, 1994

Report by M. A. Kaashoek & A. C. M. Ran

The Fourth Conference of the International Linear Algebra Society was held in Rotterdam, The Netherlands, on August 15-19, 1994, with Harm Bart as the chief organizer. The conference covered a wide range of topics, with some emphasis on operator theory. The main body of the program consisted of 35 invited plenary lectures and four minisymposia. In addition, there were 17 sessions with a total of 73 contributed talks. [*Text continues on page 34–Ed.*]

[*Rotterdam ILAS Meeting: Text continued from page 31–Ed.*] The opening lecture was delivered by I. Gohberg, after being presented with the Hans Schneider Prize. The topic of his lecture was "Infinite Systems of Linear Equations", in which he discussed the use of the projection method to solve classes of infinite systems of linear equations, and covered more than a century of linear algebra. This lecture also stressed the emphasis this conference had on topics in operator theory and their relation to linear algebra.

The plenary lectures treated a wide spectrum of problems arising from different branches of linear algebra and its applications: numerical linear algebra, analysis of structured matrices, eigenvalue problems, connections with systems theory, rational matrix valued functions, extension and completion problems, convexity, discrete mathematics, multilinear algebra, analysis of positive matrices, indefinite inner products and classification problems for matrices.

The subjects of the mini-symposia were: "Topics in norm theory", "Linear Algebra and Systems Theory", "Perturbation Theory" and "Economic and Econometric Applications of Matrix Theory". Many lectures, if not all, illustrated the point that progress in linear algebra is very much stimulated through its connections with applications and other mathematical areas. A theme which was also stressed by J. J. Seidel in his conference dinner address. The 155 participants came from all over the world with a large contingent from Eastern European countries and from the United States. The excellent scientific atmosphere triggered many formal and informal discussions. The participants also enjoyed the conference tour to the Delta works. The hospitality of the city of Rotterdam, in particular, of the Erasmus University was highly appreciated.

Second International Summer School on Linear Algebra Guangzhou, China: August 29–September 2, 1994

Report by Graciano de Oliveira

The Second International Summer School on Linear Algebra was held at Zhongshan University, Guangzhou (Canton), China, August 29–September 2, 1994. The First Summer School took place in Macau in 1990.

This Second Summer School was organized by J. C. Chen and Li Luoluo. The principal speakers were: J. C. Chen, Jiang Erxiong, Li Luoluo, Liu Bolian, Graciano de Oliveira, João Queiró, E. Marques de Sá, F. C. Silva, N. K. Tsing, Bit-Shun Tam and Zhang Mou-Chen. There were about 30 participants, mostly from China and Portugal but also from Hong Kong and Taiwan. This Summer School was sponsored by The International Linear Algebra Society (ILAS); financial support came from the Gulbenkian Foundation, Orient Foundation and Lingnan Foundation, whom the organizers wish to thank.

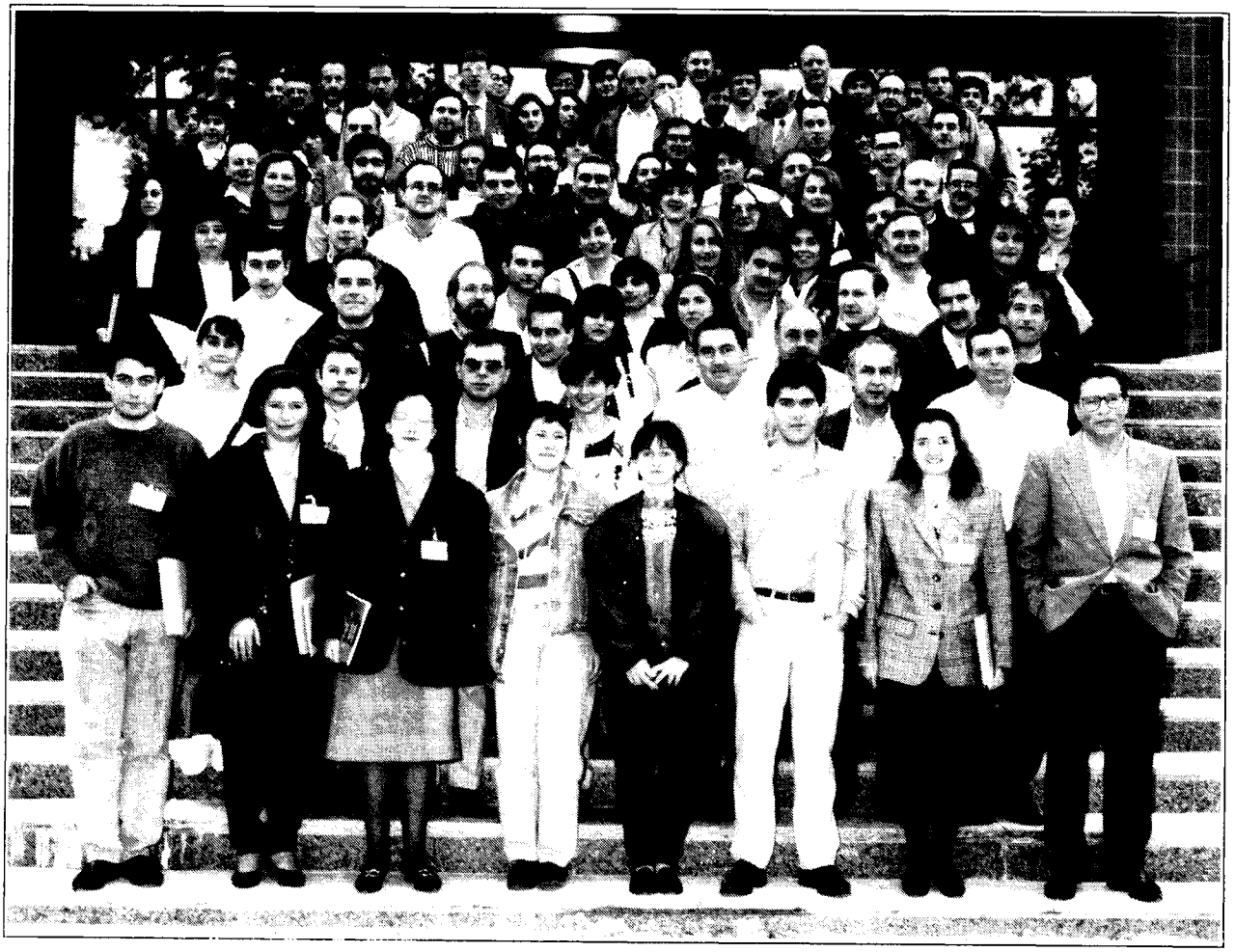
Symposium on Matrix Analysis and Applications Vitoria-Gasteiz, Spain: September 21–23, 1994

Report by Immaculada de Hoyos

A Symposium on Matrix Analysis and Applications was held in Vitoria-Gasteiz, Spain, September 21–23, 1994. The main characteristic of this Symposium from the viewpoint of its organization can be summed up in one word: flexibility. This Symposium continues a series of meetings on linear algebra, matrix theory, matrix analysis and their applications, held in Portugal and Spain since 1982. These scientific meetings took place in Coimbra (1982), Vitoria (1983), Coimbra (1984), Valencia (1987), Lisbon (1988), Valencia (1989) and some workshops in Lisbon and Coimbra in 1990–1994. A Conference organized by the ILAS was held in Lisbon in 1992. This Symposium at Vitoria-Gasteiz was jointly sponsored by the ILAS and the Basque Country University and was organized by the Department of Applied Mathematics, Statistics and Operations Research of that university.

A hundred and ten participants attended the conference: Spain (84), Portugal (14), Russia (2), Germany (2), United Kingdom (1), The Netherlands (1), United States (1), Ukraine (1), Poland (1), Italy (1), Hong Kong (1) and China (1). There was 7 one-hour plenary talks, 8 thirty minutes talks and 53 fifteen minutes contributed papers with two parallel sessions almost all the time. Some of the considered topics were: the core of linear algebra; control linear systems and its physical, economic and biological applications; orthogonal polynomials, selective modal analysis and its applications to electric power systems; matrices depending on parameters; numerical matrix analysis (mainly on parallel computing and singular values); computational algebraic topology; symbolic computation with polynomials; random matrices; circulant matrices and the n bodies problem; the Jacobian conjecture for polynomial maps; etc. There was also a ninety minutes debate session on the teaching of linear algebra moderated by Juan M. Gracia and presented by Francisco Marcellan and Charles R. Johnson. This debate made evident the existence of tensions between: the linear algebra and the theory of matrices, the matrix manipulation and the underlying geometry, the texts that have been or are being used and the new generation of books about these matters, the prefabricated academic problems and the possibilities offered by the computer packages, the Bourbakian background of the teachers and that based on the last two decades of research in linear algebra.

On the opening day Juan M. Gracia encouraged the Portuguese and Spanish delegates to write a book on the interlacing of invariant factors of matrices showing the development of this theme in the last fifteen years. On Thursday, September 22, 1994 a photo was taken of all the attendees who were willing to pose. The members of the Vitoria linear algebra group are more or less in the front row. The chairs of the scientific committee and organizing committee were Ion Zaballa (on the right of the third row from front) and Juan Gracia (on the right of the front row), respectively. In this meeting it was shown that there are some up-and-coming researchers in linear algebra among the younger generations. There also appeared many new people from different parts of Spain working in this area.



Selected Forthcoming Linear Algebra Events

CERFACS Linear Algebra 1995: Toulouse France

The Linear Algebra Year at CERFACS for the Calendar Year 1995 will be focused particularly in two periods: spring and autumn. One of the main constituents will be a series of workshops ... at present four are planned. Each workshop will last for three days and will be preceded by a one-day tutorial. The workshop titles and dates are: April 10–14: Iterative methods; September 25–29: Linear algebra in optimization; June 5–9: Direct methods; October 16–20: Eigenvalues and beyond. There will also be an extensive visitor programme supporting both senior visitors and young scientists for visits of from one week to several months. It is hoped to support the visits fully but, at the time of writing, it is not known what level of funding has been obtained. To register your interest as a prospective visitor or workshop attendee or just to receive further information please contact: Chiara Puglisi, Parallel Algorithm Team CERFACS, 42 avenue G Coriolis, F-31057 Toulouse Cedex; PUGLISI@CERFACS.FR, FAX (33) 61.19.30.00.

Western Canada Linear Algebra Meeting

Lethbridge, Alberta: April 28–29, 1995

You and your colleagues are invited to attend the Western-Canada Linear Algebra Meeting (W-CLAM), to be held April 28–29, 1995, at the Univ. of Lethbridge. This small regional meeting follows up a meeting held in Regina in 1993, and it is intended to draw together workers in Linear Algebra and related fields to present accounts of their recent work and facilitate informal discussions on matters of relevance to them. Participants are invited to contribute a talk on linear algebra or its applications of 30-45 minutes duration, depending on the number of participants. Although there are no registration fees and no formal requirement to register, participants are requested to inform one of the organizers of their intention to attend, by April 15, 1995, to facilitate planning. There are no funds available for travel or accommodation expenses incurred by participants, but an informal luncheon will be provided at no cost on the second day. This meeting is open to students and visitors to the region as well as your colleagues who may be interested, whether or not they are visiting in Western Canada.

For further information, contact one of the four organizers: Robert Craigen, Dept. of Mathematics and Computer Science, Univ. of Lethbridge, Lethbridge, Alberta, Canada T1K 3M4; CRAIGEN@CS.ULETH.CA, tel. (1-403) 329-0106 *or* Doug Farenick, Dept. of Mathematics and Statistics, Univ. of Regina, Regina, Saskatchewan, Canada S4S 0A2; FARENICK@ABEL.MATH.UREGINA.CA, tel. (1-306) 585-4425 *or* Steve Kirkland Dept. of Mathematics and Statistics Univ. of Regina, Regina, Saskatchewan, Canada S4S 0A2; KIRKLAND@MAX.CC.UREGINA.CA, tel. (1-306) 585-4352, *or* Peter Lancaster Dept. of Mathematics and Statistics, Univ. of Calgary, Calgary, Alberta, Canada T2N 1N4; LANCASTER@ACS.UCALGARY.CA, tel. (1-403) 282-5150.

Ninth Haifa Matrix Theory Conference

Haifa, Israel: May 29–June 1, 1995

The Mathematics Department at the Technion, supported by its Institute for Advanced Studies in Mathematics, will hold the Ninth Haifa Matrix Theory Conference on May 29–June 1, 1995. The program will consist of plenary talks (30 minutes each) as well as contributed talks (20 minutes each), aiming to cover all aspects of matrix theory and linear algebra. The members of the Organizing Committee—Avi Berman, Moshe Goldberg, Danny Hershkowitz, Leonid Lerer, Raphael Loewy, and Abraham Zaks—invite those who are interested in contacting us as soon as possi-

ble, and no later than March 31, 1995. Those who wish to contribute a talk should attach a short abstract. We have reserved a limited number of rooms at the Hotel Shulamit in Haifa. Reduced rates are US$54 for a single room and $62 for a double room, breakfast included. The conference program includes: 1. Reception on Monday, May 29 (gratis). 2. Half day tour on Tuesday, May 30 ($20 per person). 3. Banquet on Wednesday, May 31 ($30 per person). There will be a registration fee of $40. For further information contact: Danny Hershkowitz, Dept. of Mathematics, Technion–Israel Institute of Technology, Haifa 32000, Israel; HERSHKOW@TECHUNIX.TECHNION.AC.IL.

ATLAST Linear Algebra Workshops: Summer 1995

ATLAST is an NSF-ILAS Project to Augment the Teaching of Linear Algebra through the use of Software Tools. The project will offer two faculty workshops on the use of software in teaching linear algebra in the summer of 1995

June 21–24: Univ. of Washington, Seattle. Presenter: Jane Day, San Jose State University.

July 19–22: College of William and Mary, Williamsburg, Virginia: Presenter: David Hill, Temple University.

Workshop participants will learn about existing commercial linear algebra software packages and will be trained in the use of the MATLAB software package. Attendees will learn how to effectively incorporate computer exercises and laboratories into undergraduate linear algebra courses. Participants will work with exercises from the forthcoming ATLAST Book and will be expected to design additional computing exercises at a level suitable for assigning to an undergraduate linear algebra class. These exercises will be class tested during the school year following the workshop and then submitted to the project director for inclusion in the ATLAST database. Some of these exercises will either be included in later editions of the ATLAST book or made available to the general public through the Mathematics Archives at the Univ. of Tennessee, Knoxville.

The project was conceived by the Education Committee of the International Linear Algebra Society (ILAS), with Steven J. Leon serving as the ATLAST Project Director; the Assistant Director is Richard Faulkenberry. Both are in the Mathematics Dept. of the Univ. of Massachusetts–Dartmouth. The ATLAST project is funded by a National Science Foundation Faculty Enhancement grant. This is the fourth year of ATLAST workshops. Past workshops have been a rousing success. We are confident that the '95 workshops will be even better.

All teachers of undergraduate linear algebra courses at colleges or universities in the USA are invited to apply for the ATLAST workshops. The deadline for applications is March 20, 1995. Late applications will be accepted on a space-available basis. Each workshop will be limited to thirty participants. The ATLAST Project provides room and board for all participants accepted. A screening committee will review applications and notify applicants of its decisions early in April. For further information and application forms contact: Steven J. Leon, ATLAST Project Director, Dept. of Mathematics, Univ. of Massachusetts–Dartmouth, Old Westport Road, North Dartmouth, MA 02747-2300, USA; FAX (1-508) 999-8901, ATLAST@UMASSD.EDU.

Numerical Linear Algebra on Parallel Processors

San Francisco, California: June 12–16, 1995

Pending final budgetary approval, there will be an NSF-CBMS Regional Conference in the Mathematical Sciences at the Univ. of San Francisco, June 12–16, 1995. The topic of the conference will be Numerical Linear Algebra on Parallel Processors. The principal lecturer will be James Demmel (Univ. of California, Berkeley), who will deliver ten one-hour lectures during the conference. Topics may include but are not limited to the following: (1) parallel architectures and parallel software; (2) parallel algorithms for dense matrices; matrix multiplication; Gaussian elimination; least squares problems; eigenvalues and eigenvectors; (3) parallel algorithms for sparse matrices; matrix partitioning algorithms; direct methods; and iterative methods. These lectures will be supplemented by lectures by several other specialists in the field. These supplementary lectures will cover selected related topics such as multifrontal methods for matrix factorization, domain decomposition methods, parallel finite elements, graph partitioning, and applica-

tions. The NSF will provide support for thirty participants covering transportation, lodging and meals. Lodging and meals will be on the campus of the Univ. of San Francisco. The conference is intended for researchers and those wishing to begin research in numerical linear algebra on parallel processors. To apply, send a message indicating your interest to Peter Pacheco, Dept. of Mathematics, Univ. of San Francisco, 2130 Fulton Street, San Francisco, CA 94117, USA; PETER@USFCA.EDU. Applications received before April 1, 1995, will receive full consideration.

International Symposium: Iterative Methods in Linear Algebra

Blagoevgrad, Bulgaria: June 17–20, 1995

Organized by The International Association for Mathematics and Computers in Simulation (IMACS) and The Center of Informatics and Computer Technology at the Bulgarian Academy of Sciences (BAS), the Second IMACS International Symposium on Iterative Methods in Linear Algebra will be held in Blagoevgrad, Bulgaria, June 17–20, 1995. The International Program Committee comprises: Owe Axelsson (Nijmegen), Randolph Bank (San Diego), Robert Beauwens (Brussels), Tony Chan (Los Angeles), Françoise Chatelin (Paris), Ivan T. Dimov (Sofia), Stefka Dimova (Sofia), Jack J. Dongarra (Knoxville), Iain S. Duff (Rutherford Appleton Lab.), Richard E. Ewing (College Station), Roland Freund (Murray Hill), Krassimir Georgiev (Sofia), Apostolos Hadjidimos (Purdue), Sven Hammarling (NAG, Oxford), Piet Hemker (Amsterdam), Oleg Iliev (Sofia), Michail Kaschiev (Sofia), David Kincaid (Austin, Texas), Yousef Saad (Minneapolis), Harry Yserentant (Tübingen), Henk van der Vorst (Utrecht), Junping Wang (Laramie), Ragnar Winther (Oslo), and David H. Wood (Delaware). The Local Organizing Committee consists of Svetozar Margenov and Panayot Vassilevski (CICT at BAS, Sofia).

The topics for this Symposium include: Matrix analysis, convergence acceleration, preconditioning techniques, methods for nonsymmetric, indefinite, singular and overdetermined systems, sparse eigenproblems. Applications to: partial differential equations (multigrid methods, domain decomposition methods, spectral methods), systems theory, least squares problems, parallel matrix computation. Software development: Sparse linear systems, sparse eigenproblems, application oriented software; on sequential machines; on parallel machines.

Special Sessions will include:

"The influence of high-nonnormality on the reliability of iterative methods in Computational Linear Algebra" by Françoise Chatelin (Université de Paris–IX) and Valerie Fraysee (CERFACS, Toulouse),

"Krilov-subspace methods for nonsymmetric and indefinite linear systems" by Roland Freund (AT&T Bell Labs., Murray Hill),

"Iterative Monte Carlo methods" by Ivan T. Dimov (CICT at BAS, Sofia),

"Robust Preconditioners" or "Industrial Problems" by Yousef Saad (Univ. of Minnesota, Minneapolis),

"Parallel Algorithms for Krylov Spaces" by Bernard Philippe, (IRISA, Rennes).

For more information contact: Svetozar Magenov & Panayot Vassilevski, CICT at Bulgarian Academy of Sciences, "Acad. G. Bontchev" St., Block 25A, BG-1113 Sofia; IMACS95@BGEARN.BITNET or PANAYOT@BGEARN.BITNET.

IMA Conference on Linear Algebra and Its Applications

Manchester, England: July 10–12, 1995

The Institute of Mathematics & Its Applications in conjunction with the Manchester Centre for Computational Mathematics is sponsoring a conference on Linear Algebra and Its Applications, Monday 10th to Wednesday 12th July, 1995 at the Univ. of Manchester. The conference aims to cover the latest developments in numerical linear algebra, matrix theory and applications of linear algebra. It immediately follows ICIAM 95 in Hamburg. The conference will consist of two and a half days of invited and contributed talks and posters, with an excursion on the Tuesday afternoon, 11th July 1995, and a conference dinner on the Tuesday evening.

The Organizing Committee for the conference consists of N. J. Higham (Chair, Univ. Manchester), I. S. Duff (Rutherford Appleton Laboratory & CERFACS), R. Fletcher (Univ. Dundee), T. L. Freeman (Univ. Manchester), S. J. Hammarling (NAG Ltd., Oxford) & N. K. Nichols (Univ. Reading).

Invited speakers and provisional titles include these 40-minute talks:

R. A. Brualdi (Univ. Wisconsin–Madison): Spectral radius of matrices of zeros and ones,

J. W. Demmel (Univ. of California, Berkeley): Recent progress in serial and parallel algorithms for the algebraic eigenvalue problem and singular value decomposition,

G. H. Golub (Stanford University),

P. C. Hansen (Technical Univ. Denmark, Lyngby): Regularization of large-scale discrete ill-posed problems.

R. A. Horn (Univ. of Utah):

Hadamard products, unitarily invariant norms, and perturbation bounds for the polar decomposition.

G. Strang (MIT): Teaching of linear algebra.

H. van der Vorst (Utrecht): A generalized Jacobi-Davidson iteration method for linear eigenvalue problems,

P. Van Dooren (CESAME, Louvain la Neuve): The Schur algorithm for Toeplitz matrices,

A. J. Wathen (Univ. of Bristol): Iterative solution of large, sparse linear systems arising in PDEs.

M. H. Wright (AT&T Bell Labs.):

Something old, something new, something borrowed: Connections between linear algebra and optimization.

And these 30-minute talks:

Z. Bai (Univ. of Kentucky): Adaptive block Lanczos algorithm for large scale non-Hermitian eigenvalue problem,

A. Edelman (MIT): From dense numerical linear algebra to materials science to Riemannian geometry,

N. I. M. Gould (Rutherford Appleton Lab.): Linear algebra in optimization,

D. J. Higham (Univ. of Dundee),

N. Mackey (Western Michigan University, Kalamazoo):

Convergence of Jacobi-like methods for the symmetric eigenproblem,

R. Mathias (College of William & Mary): Accurate eigenvalue computations,

H. Park (Univ. of Minnesota): Accurate triangularization of Toeplitz matrices,

D. Ruiz (CERFACS, Toulouse): Preconditioners for the block conjugate gradient algorithm,

B. Smith (Univ. of California, Los Angeles),

G. Starke (Karlsruhe): Multilevel minimal residual methods.

For further information contact Pamela Irving, The Conference Officer, The Institute of Mathematics and Its Applications (IMA), Catherine Richards House, 16 Nelson Street, Southend-on-Sea, Essex SS1 1EF, England, UK; FAX (44-1702) 354111, tel. (44-1702) 354020, IMACRH@V-E.ANGLIA.AC.UK.

Fourth International Workshop on Matrix Methods for Statistics

Montréal, Québec: July 15–16, 1995

The Fourth International Workshop on Matrix Methods for Statistics will be held in Montréal, on Saturday, July 15 and Sunday, July 16, 1995, the weekend immediately following the Joint Annual Meeting of the Statistical Society of Canada (SSC) and the Institute of Mathematical Statistics (IMS). This Workshop is co-sponsored by the International Linear Algebra Society (ILAS). The International Organizing Committee comprises R. William Farebrother (Univ. of Manchester), Simo Puntanen (Univ. of Tampere), George P. H. Styan (McGill University; chair), and Hans Joachim Werner (Universität Bonn). The Workshop venue, Le Centre Sheraton Hotel (1201 Boulevard René-Lévesque West, Montréal), is the same as for the Joint Annual SSC/IMS Meeting that precedes it.

The purpose of this Workshop is to stimulate research and, in an informal setting, to foster the interaction of researchers in the interface between matrix theory and statistics. This Workshop will provide a forum for statisticians

and mathematicians working in the areas of linear algebra and matrix theory to become better informed of the latest developments and newest techniques and to interchange ideas with researchers from a wide variety of countries. Invited guest speakers are expected to come from these countries: Canada, Chile, China, Croatia, Czech Republic, Denmark, Estonia, Finland, Germany, India, Japan, The Netherlands, New Zealand, Poland, Portugal, Slovenia, Sweden, Turkey, United Kingdom, and the United States. Funding for non-Canadian guest speakers' travel and local expenses has been requested from the Natural Sciences and Engineering Research Council of Canada (NSERC).

The following persons have been invited to speak and are expected to participate: Fikri Akdeniz (Adana), S. Ambikkumar (McGill), T. W. Anderson (Stanford), Natália M. Bebiano (Coimbra), James V. Bondar (Carleton), Tadeusz Caliński (Poznań), S. W. Drury (McGill), Morris L. Eaton (Minnesota), R. William Farebrother (Manchester), Miroslav Fiedler (Prague), Luis S. Firinguetti (Santiago), Gene H. Golub (Stanford), Ali S. Hadi (Cornell), Jeffrey J. Hunter (Massey), Tõnu Kollo (Tartu), Alexander Kovačec (Coimbra), Augustyn Markiewicz (Poznań), Thomas Mathew (Baltimore), Jorma K. Merikoski (Tampere), Renate Meyer (Auckland), Sujit Kumar Mitra (Delhi), Kenneth Nordström (Helsinki), Ingram Olkin (Stanford), Matjaz Omladič (Ljubljana), Josip E. Pečarić (Zagreb), Michael D. Perlman (Washington), Serge Provost (Western Ontario), Simo Puntanen (Tampere), C. Radhakrishna Rao (PennState), Alastair J. Scott (Auckland), Shayle R. Searle (Cornell), Peter Šemrl (Maribor), Gerald E. Subak-Sharpe (New York), Yoshio Takane (McGill), Ene-Margit Tiit (Tartu), Götz Trenkler (Dortmund), Song-Gui Wang (Beijing), Hans Joachim Werner (Bonn), Henry Wolkowicz (Waterloo) and Haruo Yanai (Tokyo).

Talks are expected to cover the following topics: biased estimation in linear models, bounds for matrix sums, bounds for singular values, Campbell-Youla inverse, canonical correlations, Cochran's Theorem, control theory, convex matrix functions, matrix convexity, econometrics, eigenvalues and optimization, generalized inverses, generalized least squares, Kantorovich inequality, Kiefer ordering, least squares with missing observations, Marcus-de Oliveira conjecture, matrix inequalities, matrix special functions, mixed model of the analysis of variance, modified eigenvalue problems, multidimensional scaling, multivariate statistical analysis, orthogonal projectors, partially generalized least squares, positive definite matrices, predictive g-inverse, seemingly unrelated regressions, sexy matrices, shorted operators, stochastic matrices, and tensor products.

This Workshop is the fourth in a series. The previous three Workshops were held as follows: (1) Tampere, Finland: August 1990, (2) Auckland, New Zealand: December 1992, and (3) Tartu, Estonia: May 1994. The 5th Workshop in this series is scheduled to be held in Dunedin, New Zealand, in late August 1995 (in connection with the A. C. Aitken Centenary Conference) and the 6th in Shrewsbury, England, August 1996.

It is expected that papers from this Fourth International Workshop on Matrix Methods for Statistics will be published in the Sixth Special Issue on Linear Algebra and Statistics of *Linear Algebra and Its Applications.*

Registration fees are: ILAS, IMS or SSC Members: C$50/US$45; non-members: C$65/US$60; students: C$15/US$15. These rates are valid through May 15, 1995. A late surcharge of C$15/US$15 will apply thereafter for all non-student participants.

Contributed papers are welcome! Submit a one-paragraph abstract, in English or French: no more than 10 lines please! Please use plain TEX, LATEX or Microsoft Word (for the Mac) and send the abstract to George Styan, preferably by e-mail to MT56@MUSICA.MCGILL.CA. All abstracts should arrive by 15 May 1995.

Requests for more information concerning the scientific program, as well as any organizational questions, should be directed to: George P. H. Styan, Dept. of Mathematics and Statistics, McGill University, Burnside Hall, 805 ouest, rue Sherbrooke, Montréal, Québec, Canada H3A 2K6; MT56@MUSICA.MCGILL.CA, FAX (1-514) 398-3899.

Fifth Conference of the International Linear Algebra Society

Atlanta, Georgia: August 16–19, 1995

The Fifth Conference of the International Linear Algebra Society (ILAS) will be held in the Urban Life Conference Center at Georgia State University, Atlanta, August 16-19, 1995. The purpose of this conference is to bring together researchers/educators in all fields of Linear Algebra/Matrix Analysis, pure and applied, allowing a broad interchange of ideas and discussion of recent developments in these areas. The conference focuses on the usual topics of the ILAS conferences, but in addition will put special emphasis on Education of Linear Algebra and on Structured Matrices.

The highlights include: Invited speakers, mini-symposia, contributed papers, Hans Schneider Prize presentation to Shmuel Friedland, banquet, ILAS business meeting, socials, conference proceedings in a special issue of *Linear Algebra and its Applications*. A detailed flyer (containing registration, hotel, abstract, and other information) has been sent out to ILAS members and is available from the organizers.

Invited Speakers include: G. Ammar, W. Barrett, H. Bart, A. Bunse-Gerstner, L. Elsner, S. Friedland, J. Gilbert, G. Harel, R. Horn, I. Ipsen, R. Kaashoek, T. Laffey, C. Meyer, C. Moler, M. Neumann, M. Newman, W. Niethammer, D. Olesky, G. Strang (banquet).

Mini-symposia: Sparse matrices (A. Pothen), Structured matrices (G. Heinig, A. Sayed), Linear algebra in undergraduate education (F. Uhlig, D. Carlson), Distance matrices, geometry and applications (P. Tarazaga).

Organizing Committee: B. N. Datta, F. Hall (co-chair), R. Hartwig, D. Hershkowitz, C. Johnson, V. Mehrmann, A. Pothen, H. Schneider, F. Uhlig, P. M. Van Dooren (co-chair), J. R. Weaver, M. H. Wright.

Local Arrangements Committee: F. J. Hall (chair), M. Bakonyi, J. Bevis, G. Davis, C. Eschenbach, Z. Li, F. Massey, V. Miller.

Contributed papers from all areas of linear algebra and applications are solicited. Papers fitting within the scope of the conference will be accepted, subject to unavoidable limitations of space and time. Selected papers will be scheduled at 15 (+5)-minute presentations in concurrent sessions. Two copies of an extended one-page abstract should be submitted by June 1, 1995, to Paul M. Van Dooren, Univ. Catholique de Louvain, CESAME, Bâtiment Euler, B-1348 Louvain-la-Neuve, Belgium; VANDOOREN@ANMA.UCL.AC.BE, tel. (32-10) 472180.

For more information about this conference contact: Frank J. Hall, Dept. of Mathematics & Computer Science, Georgia State University, Atlanta, GA 30303; FHALL@CS.GSU.EDU, tel. (1-404) 651-2253.

Mini-symposium on Education Issues in Linear Algebra

Atlanta, Georgia: August 17, 1995

A Mini-Symposium on Educational Issues in Linear Algebra will be held at Georgia State University, Atlanta, on Thursday, August 17, 1995, as part of the Fifth Conference of the International Linear Algebra Society (ILAS). of This Mini-Symposium, led by David H. Carlson (San Diego State University) and Frank Uhlig (Auburn University) will focus on Applications and Teaching Uses of Linear Algebra in Other Areas and Disciplines We invite those interested in the aspects of teaching Linear Algebra to submit an abstract for a presentation of 15–20 minutes in this mini-symposium. Our principal interest for the mini-symposium lies in talks that show new (and possibly old) applications of linear algebraic ideas to the teaching and comprehension of other areas or fields in the undergraduate curriculum. However, we will also consider talks on other educational aspects of linear algebra.

Plenary sessions will be given by Guershon Harel (mathematics educator, Purdue University), "On the Pedagogy of Linear Algebra", and Cleve Moler (creator of MATLAB, The Mathworks), "Matrix—the 'Mother' of a Technical Computing Environment". Steven J. Leon (Univ. of Massachusetts–Dartmouth) will discuss how his ATLAST project affects comprehension of abstract concepts in linear algebra, and David Lay (Univ. of Maryland) will present results from a new survey on the teaching of linear algebra. A panel discussion, led by Tom Brieske (Georgia State University), Dave Carlson, David Lay and three local high school teachers, will focus on the role of linear algebra in the high school curriculum. The conference after-dinner speech by Gil Strang (MIT), "Happiness with Linear Algebra", that evening will also focus on mathematical education.

Talks on educational issues which cannot be accommodated in the mini-symposium may be given as Contributed Papers in one or more dedicated sessions at the Conference. We want to encourage those preparing contributions to this educational mini-symposium to contact and discuss plans with the organizers from the beginning. Due to our shortness of funds, we regret that contributors to the mini-symposium cannot be reimbursed by the Conference. We would like to receive presentation abstracts by March 1, 1995, either electronically or by mail. We intend to select the contributions to this mini-symposium as soon as possible thereafter. Abstracts may be sent to either of us: David H. Carlson, Dept. of Mathematical Sciences, San Diego State University, San Diego, CA 92182-7720, USA, CARLSON@MATH.SDSU.EDU; Frank Uhlig, Dept. of Mathematics, Auburn University, Auburn, AL 36849-5310, USA; UHLIGFD@MAIL.AUBURN.EDU.

Third Symposium on Numerical Ranges and Numerical Radii

Sapporo, Japan: August 6–9, 1996

The Third Workshop on Numerical Ranges and Numerical Radii will be held in Sapporo, Japan, August 6–9, 1996. The organizers are Kazuyoshi Okubo and Tsuyoshi Ando. The Workshop will be held in "The Sapporo Guest House" located in the southern part of Sapporo, accessible by subway from the city center. The Guest House, designed for foreign academic visitors, is in very beautiful surroundings. It has lodging facilities: 6 single rooms, 6 twin rooms and one triple room. Each room is nicely furnished with cooking facility. Also washing machines and a dishwasher are available in a common room. The Guest House has a conference room and a nice seminar room, just fit for the Workshop. During the Workshop, a banquet, and excursion or demonstration of Japanese tea ceremony organized by volunteers, are planned. (Because of limitation of time, we cannot arrange both excursion and demonstration.) Though it may be too early to ask your plan for the Workshop of next year, your tentative plans will help us with arrangements. If the number of those who want to stay in the Guest House is greater than that of available beds, we shall reserve rooms in reasonable hotels in the city. Please send your answer before August 31, 1995. For information concerning the workshop please contact: Kazuyoshi Okubo, Mathematics Laboratory, Hokkaido Univ. of Education, Sapporo 002, Japan; OKUBO@S-GROUP.SAP.HOKKYODAI.AC.JP, tel. (81-11) 778-8811, ext 374, FAX (81-11) 778-8822 or Tsuyoshi Ando, Research Institute for Electronic Science, Hokkaido University, Sapporo 060, Japan; ANDO@ELSIP.HOKUDAI.AC.JP, tel. (81-11) 706-3357, FAX (81-11) 706-4966 (*after April 1995:* Faculty of Economics, Hokusei Gakuen University, Atsubetsu-ku, Sapporo 004, Japan).

International Calendar of Events in Linear Algebra & Related Topics

The ❀ identifies ILAS meetings and ☞ new or modified entries. For further details please contact the address in square brackets. FAX (& telephone) numbers begin with the country-city codes in parentheses; e-mail addresses appear in small caps. Please send additions/corrections to George Styan by e-mail to MT56@MUSICA.MCGILL.CA or by FAX to (1-514) 398-3899.

1995

☞ **March 17-18: Raleigh, North Carolina.** Workshop on Krylov Methods & Applications. [CT Kelley, TIM_KELLEY@NCSU.EDU; Dept. of Mathematics, North Carolina State University, Box 8205, Raleigh, NC 27695-8205.]

☞ **April 10-14: Toulouse, France.** Workshop on Iterative Methods. Part of Linear Algebra Year at CERFACS. [C Puglisi, Parallel Algorithm Team, CERFACS, 42 avenue G Coriolis, F-31057 Toulouse Cedex; FAX (33) 61.19.30.00, PUGLISI@CERFACS.FR.] *See also this Image, page 36.*

☞ **April 14-16: Nashville, Tennessee.** 8th Annual Cumberland Conference on Graph Theory, Combinatorics & Computing. Vanderbilt University. [MN Ellingham, Dept. of Mathematics, Vanderbilt University, Nashville, TN 37240; SHANKS@MATH.VANDERBILT.EDU, FAX (1-615) 343-0215.]

☞ **April 28–29: Lethbridge, Alberta.** Western-Canada Linear Algebra Meeting (W-CLAM). Univ. of Lethbridge. [R Craigen, Dept. of Mathematics and Computer Science, Univ. of Lethbridge, Lethbridge, Alberta, Canada T1K 3M4; CRAIGEN@CS.ULETH.CA.] *See also this Image, page 36.*

May 15-19: Québec City. Graphics Interface '95. [P Prusinkiewicz, Dept. of Computer Science, Univ. of Calgary, 2500 University Drive NW, Calgary, Alberta T2N 1N4; PWP@CPSC.UCALGARY.CA, FAX (1-403) 284-4707.]

May 29–June 1: Gadong, Brunei Darussalam. International Conference on Mathematical Modelling (Physical, Biological, Engineering & Social Systems). Universiti Brunei Darussalam. [Dept. of Mathematics, Universiti Brunei Darussalam, Gadong 3186.]

May 25-June 5: Hefei, Anhui Province, China. Summer School & International Conference on Combinatorics. [Ku Tung-Hsin, Hefei Branch: Research Centre of Combinatorial Mathematics & Computer Science, Academia Sinica, PO Box 1110, Hefei, Anhui 230031.]

May 29-June 1: Haifa, Israel. 9th Haifa Matrix Theory Conference. Technion-Israel Institute of Technology. Dept. of Mathematics & Institute for Advanced Studies in Mathematics. [D Hershkowitz, MAR23AA@TECHNION.TECHNION.AC.IL.] *See also this Image, pp. 36–37.*

☞ **June 1–3: Beijing, China.** 2nd International Conference on ABS Methods. [E Spedicato, Dept. of Mathematics, Univ. of Bergamo, FAX (39-35) 234693, EMILIO@UNIBG.IT.]

☞ **June 5-9: Toulouse, France.** Workshop on Direct Methods. Part of Linear Algebra Year at CERFACS. [C Puglisi, Parallel Algorithm Team, CERFACS, 42 avenue G Coriolis, F-31057 Toulouse Cedex; FAX (33) 61.19.30.00, PUGLISI@CERFACS.FR.]

☞ **June 7-11: Fort Collins, Colorado.** R. C. Bose Memorial Conference on Statistical Design & Related Combinatorics. Colorado State University. [JN Srivastava, Dept. of Statistics, Colorado State University, Fort Collins, Colorado 80523; JSRIVAS@LAMAR.COLOSTATE.EDU, FAX (1-303) 491-7895.]

☞ **June 12-16: San Francisco, California.** Numerical Linear Algebra on Parallel Processors. NSF-CBMS Regional Conference in the Mathematical Sciences. [P Pacheco, Dept. of Mathematics, Univ. of San Francisco, 2130 Fulton Street, San Francisco, CA 94117; PETER@USFCA.EDU.] *See also this Image, pp. 37–38.*

☞ **June 17-20: Blagoevgrad, Bulgaria.** 2nd IMACS International Symposium on Iterative Methods in Linear Algebra. [P Vassilevski, CICT at Bulgarian Academy of Sciences, "Acad. G. Bontchev" Street, Block 25A, BG-1113 Sofia; IMACS95@BGEARN.BITNET.] *See also this Image, page 38.*

☞ **June 19-20: Pasadena, California.** Symposium in Honor of Herbert B. Keller on the Occasion of his 70th Birthday. Athenaeum Faculty Club, California Institute of Technology. [HBK/70 Applied Mathematics, 217-50 Caltech, Pasadena, CA 91125; HBK70@AMA.CALTECH.EDU, WWW page http://www.ama.caltech.edu/~hbk70.]

☞ **June 21-24: Seattle, Washington.** Workshop on Using Software to Teach Linear Algebra. NSF-ILAS Project to Augment the Teaching of Linear Algebra (ATLAST). Featuring Jane Day. Univ. of Washington. [SJ Leon, ATLAST Project Director, Dept. of Mathematics, Univ. of Massachusetts Dartmouth, North Dartmouth, MA 02747; FAX (1-508) 999-8901, ATLAST@UMASSD.EDU.] *See also this Image, page 37.*

June 25-30: Lillehammer, Norway. INTERACT '95: International Federation for Information Processing & Norwegian Computer Society. [Norwegian Computer Society, PO Box 6714 Rodeløkka, N-0503 Oslo; FAX (47-22) 35.46.69, FIRMAPOST@DND.MSMAIL.TELEMAX.NO.]

June 26–30: Dundee, Scotland. 16th Dundee Conference on Numerical Analysis. Univ. of Dundee. [DF Griffiths, Dept. of Math. & Comp. Science, University, Dundee DD1 4HN; NA.GRIFFITHS@NA-NET.ORNL.GOV.]

☞ **July 2–8: Oberwolfach, Germany**. Algebraic & Combinatorial Methods in Multivariate Statistical Analysis. Organizers: MD Perlman & F Pukelsheim. [Mathematisches Forschungsinstitut Oberwolfach Lorenzenhof, D-77709 Oberwolfach-Walke; FAX (49-7834) 97938, KRECK@TOPOLOGIE.MATHEMATIK.UNI-MAINZ.DE.]

July 3–7: Hamburg, Germany. 3rd International Congress on Industrial & Applied Mathematics: ICIAM 95. CCH Congress Centrum. [GAMM, NWFI-Mathematik, Universität Regensburg, D-93053 Regensburg; ICIAM95@VAX1.RZ.UNI-REGENSBURG.D400.DE.]

July 10–12: Manchester, England. IMA Conference on Linear Algebra and Its Applications. Univ. of Manchester. Organizer: N. J. Higham. [P Irving, IMA, 16 Nelson Street, Southend-on-Sea, Essex SS1 1EF, FAX (44-1702) 354-111, IMACRH@V-E.ANGLIA.AC.UK.] *See also this Image, pp. 38–39.*

☞ **July 10-21: Laramie, Wyoming.** Conference on Discrete Mathematics, Combinatorics & Graph Theory. Univ. of Wyoming. [AD Porter, Dept. of Mathematics, Univ. of Wyoming, PO Box 3036, Laramie, WY 82071-3036; ADPORTER@PLAINS.UWYO.EDU.]

☞ ❀ **July 15-16: Montréal, Québec.** 4th International Workshop on Matrix Methods for Statistics. Le Centre Sheraton Hotel. [GPH Styan, MT56@MUSICA.MCGILL.CA.] *See also this Image, pp. 39–40.*

☞ **July 17-August 11: Park City, Utah.** AMS-SIAM Summer Seminar in Applied Mathematics: Mathematics of Numerical Analysis: Real Number Algorithms. [AMS-SIAM Summer Conference Coordinator, PO Box 6887, Providence, RI 02940; DLS@MATH.AMS.ORG.]

☞ **July 19-22: Williamsburg, Virginia.** Workshop on Using Software to Teach Linear Algebra. NSF-ILAS Project to Augment the Teaching of Linear Algebra (ATLAST). Featuring David Hill. Univ. of Washington. [SJ Leon, ATLAST Project Director, Dept. of Mathematics, Univ. of Massachusetts Dartmouth, North Dartmouth, MA 02747; FAX (1-508) 999-8901, ATLAST@UMASSD.EDU.] *See also this Image, page 37.*

☞ ❀ **August 16-19: Atlanta, Georgia.** 5th International Linear Algebra Society (ILAS) Conference. Urban Life Conference Center, Georgia State University. [FJ Hall, Dept. of Mathematics & Computer Science, Georgia State University, Atlanta, GA 30303; FHALL@CS.GSU.EDU.] *See also this Image, pp. 40–41.*

☞ ❀ **August 17: Atlanta, Georgia.** Mini-Symposium on Educational Issues in Linear Algebra. Georgia State University. [DH Carlson, Dept. of Mathematical Sciences, San Diego State University, San Diego, CA 92182-7720; CARLSON@MATH.SDSU.EDU.] *See also this Image, page 41.*

August 24-26: Xi'an, China. 1st International Computing & Combinatorics Conference. [Ming Li, Dept. of Computer Science, Univ. of Waterloo, Waterloo, Ontario N2L 3G1; MLI@MATH.UWATERLOO.CA.]

August 28–September 1: Dunedin, New Zealand. A. C. Aitken Centenary Conference, 3rd Pacific Statistical Congress, New Zealand Statistical Association Annual Meeting & 5th International Workshop on Matrix Methods for Statistics. Univ. of Otago. [BFJ Manly, Dept. of Mathematics & Statistics, Univ. of Otago, PO Box 56, Dunedin; CASM@MATHS.OTAGO.AC.NZ, FAX (64-3) 479-8427.]

☞ **September 25-29: Toulouse, France.** Workshop on Linear Algebra in Optimization. Part of Linear Algebra Year at CERFACS. [C Puglisi, Parallel Algorithm Team, CERFACS, 42 avenue G Coriolis, F-31057 Toulouse Cedex; FAX (33) 61.19.30.00, PUGLISI@CERFACS.FR.]

☞ **October 16-20: Toulouse, France.** Workshop on Eigenvalues & Beyond. Part of Linear Algebra Year at CERFACS. [C Puglisi, Parallel Algorithm Team, CERFACS, 42 avenue G Coriolis, F-31057 Toulouse Cedex; FAX (33) 61.19.30.00, PUGLISI@CERFACS.FR.]

1996

☞ **May 20-22: Victoria, British Columbia.** Triennial SIAM Meeting on Optimization. Royal Roads Military College. [B Buckley, Dept. of Mathematics, Royal Roads Military College, FMO Victoria, BC V0S 1B0; BBUCKLEY@POST.ROYALROADS.CA.]

☞ **July 8–12: Prague, Czech Republic.** Prague Mathematical Conference in Honor of the 70th Birthdays of Ivo Babuška, Miroslav Fiedler, Jaroslav Kurzweil & Vlastimil Pták. [Mathematical Institute, Academy of Sciences, Žitná 25, CZ-115 67 Praha 1; PMC96@EARN/CVUT.CZ, FAX (422-2) 422-7633.]

☞ **July 21-27: Budapest, Hungary.** 2nd European Congress of Mathematics. [Főutca 68, H-1027 Budapest; FAX (36-1) 201-6974, H3341SZA@ELLA.HU.]

☞ **August 6-9: Sapporo, Japan.** 3rd Workshop on Numerical Ranges & Numerical Radii. [T Ando, Research Institute for Electronic Science, Hokkaido University, Sapporo 060; ANDO@ELSIP.HOKUDAI.AC.JP, FAX (81-11) 706-4966 (≥ *April 1995:* Faculty of Economics, Hokusei Gakuen University, Atsubetsu-ku, Sapporo 004).] *See also this Image, page 42.*

❀ **August 14–17: Chemnitz, Germany.** International Linear Algebra Society (ILAS) Conference. [VL Mehrmann, Fakultät für Mathematik, Technische Universität Chemnitz-Zwickau, PSF 964, D-09009 Chemnitz; FAX (49-371) 531-2657, MEHRMANN@MATHEMATIK.TU-CHEMNITZ.DE.]

1997

❀ **May (tentative): Winnipeg, Manitoba.** International Linear Algebra Society (ILAS) Workshop with Emphasis on Linear Algebra in Engineering Problems. [P Lancaster, Dept. of Mathematics, Univ. of Calgary, Calgary, Alberta T2N 1N4; LANCASTER@ACS.UCALGARY.CA.]

1998

❀ **May (tentative): Madison, Wisconsin.** International Linear Algebra Society (ILAS) Conference. [RA Brualdi, Dept. of Mathematics, Univ. of Wisconsin–Madison, Van Vleck Hall, 480 Lincoln Drive, Madison, WI 53706-1388; BRUALDI@MATH.WISC.EDU, FAX (1-608) 263-8891.]