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EDITORIAL

Special issue dedicated to Biswa Nath Datta on the occasion of his 70th birthday

This special issue of *Numerical Linear Algebra with Applications* is dedicated to our friend and colleague, Biswa Datta, on the occasion of his 70th birthday. During his long and distinguished career, Biswa Datta has made many significant contributions to linear algebra and control theory. Much of his research has been focused on the development of linear algebra-based numerical methods for the solution of important problems in control theory and vibration analysis. Eigenvalue assignment, Sylvester-observer equations, model updating, and inverse eigenvalue problems are some of the areas in which Datta has made valuable contributions.

Biswa Datta obtained his doctorate in 1972 from the University of Ottawa. He held several positions in India, Nigeria, Brazil, and the USA before becoming Professor of Mathematical Sciences at Northern Illinois University in 1981, where he has been since. There, he became Presidential Research Professor and Distinguished Research Professor. Biswa Datta's interest in interdisciplinary research lead to adjunct professorships in Electrical and Mechanical Engineering at Northern Illinois University since 2003 as well as being elected a fellow of the IEEE. In addition, he has received two Senior Fulbright Specialist Awards, an IEEE Distinguished Lecturer Award, several IEEE Plaques of Honor, an IEEE Banquet Award, and a Lifetime Achievement Medal of Honor.

Biswa Datta has been active in the Society of Industrial and Applied Mathematics (SIAM), the International Linear Algebra Society (ILAS), and the Institute for Electrical and Electronics Engineers (IEEE), and has organized several very nice conferences within the framework of these organizations. He also has been involved in the organization of numerous other conferences and workshops in the USA, Europe, Asia, and Australia, and presented a large number of lectures and courses in many countries all over the world.

Biswa Datta has supervised 10 PhD students (see the succeeding list) and 14 Master's students. He has authored two popular textbooks 'Numerical Methods for Linear Control Systems', Academic Press, San Diego, 2003, and 'Numerical Linear Algebra and Applications', 2nd ed., SIAM, Philadelphia, 2010, and edited a large number of books and special journal volumes. In addition, he has written over 110 research papers.

This special issue contains 17 papers, which address a variety of theoretical issues and applications loosely associated with inverse problems. Brief summaries of the papers, listed in lexicographical order by the first author's last name, follow:

In [1], Kalman filtering for large-scale problems is considered. The conjugate gradient iteration is used within the Kalman filter for quadratic minimization, and the required low-rank approximations of the covariance and inverse-covariance matrices are obtained.

In [2], an efficient algorithm for constructing a pseudo-Jacobi matrix from given spectral data is proposed and analyzed.

In [3], the stability of two-dimensional linear systems is investigated. New sufficient conditions for the asymptotic stability are derived in terms of linear matrix inequalities.

In [4], a block Arnoldi method for solving the continuous low-rank Sylvester matrix equation $AX + XB = EFT$, where A and B are large and sparse, and E and F are of low-rank, is proposed. An alternating direction implicit preconditioner gives rise to a Stein equation, to which a block Krylov method is applied to extract an approximate solution of low rank.

In [5], the stability of repetitive processes, a distinct class of 2D systems of both theoretical and practical interest, is considered. Simpler, and hence, computationally more efficient, stability tests are developed and are extended to allow control law design.

In [6], the strong stability of a symplectic matrix is investigated from algorithmic and numerical viewpoints based on theory developed by S. K. Godunov. The theory is based on a formulation of the Krein–Gelfand–Lidskii characterization of strong stability, and is well suited for numerical calculations.

In [7], the solution of discrete inverse problems by Tikhonov regularization is discussed. Transformation to standard form is considered, and a simple geometric motivation is provided.

In [8], the computation of a few eigenpairs with smallest eigenvalues in absolute value of quadratic eigenvalue problems is considered. A semi-orthogonal generalized Arnoldi method is proposed for a generalized eigenvalue problem. A refinement scheme also is devised to improve the accuracy of the Ritz vectors for the quadratic eigenvalue problem.

In [9], a new approach to computing the entire set of stabilizing controllers for a given continuous-time linear time-invariant system is developed by using recent results from interval positivity. The discrete counterpart also is discussed.

In [10], the pole assignment problems for time-invariant linear and quadratic control systems with time-delay in the control is investigated. Closed-loop eigenvectors are chosen from their corresponding invariant subspaces, possibly optimizing some robustness measure, and explicit expressions for the feedback matrices are given. The condition of the problems is also investigated.

In [11], the explicitly known eigenvalues and eigenvectors of tridiagonal Toeplitz matrices are used to investigate the sensitivity of the spectrum to perturbations. Explicit expressions for the structured distance to the closest normal matrix, the departure from normality, and the ε-pseudospectrum are derived. Applications to inverse eigenvalue problems, the construction of Chebyshev polynomial-based Krylov subspace bases, and Tikhonov regularization are considered.

In [12], the mixed sensitivity minimization problem is revisited for a class of single-input–single-output unstable infinite dimensional plants with low order weights. The design of H^∞ controllers with integral action is considered, and connections with the Hamiltonian approach are established.

In [13], a new realizability criterion for the real nonnegative inverse eigenvalue problem is introduced. If this criterion is satisfied, then a realizing matrix can be constructed. This new criterion is easily adaptable to be sufficient for the construction of a symmetric nonnegative matrix with a given spectrum. The criterion also can be extended to a family of sufficient conditions for the problem to be solvable.

In [14], three inverse problems for the class of unilevel block α-circulants are solved.

In [15], the optimal solution for the regulator control problem of Markov jump linear systems subject to second moment constraints is addressed. The solution is characterized explicitly using linear matrix inequalities.

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In [16], an alignment algorithm for reconstructing global coordinates of a given data set from coordinates constructed for data points in small local neighborhoods, through computing a spectral subspace of an alignment matrix, is proposed. Under certain conditions, the null space of the alignment matrix recovers global coordinates even when local point sets are of different dimensions.

In [17], Stefan problems with one phase are studied. A meshless numerical scheme, based on the method of fundamental solutions, for solving a two-phase Stefan problem with variable diffusion coefficients, is also developed.

It is a pleasure to dedicate this volume to our friend Biswa Datta on the occasion of his 70th birthday in recognition of his contributions to linear algebra and control theory, his enthusiasm for numerical linear algebra and its applications, and his efforts over the years to bring together researchers in linear algebra with scientists and engineers who work on applications. We would like to thank Maya Neytcheva for all her help with this volume.

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