Pan, V. Y.; **Kunin, M.**; **Murphy, B.**; **Rosholt, R. E.**; **Tang, Y.**; **Yan, X.**; **Cao, W.**
Linking the TPR1, DPR1 and arrow-head matrix structures. (English) Zbl 1132.15009
Comput. Math. Appl. 52, No. 10-11, 1603-1608 (2006).

Summary: Some recent polynomial root-finders rely on effective solution of the eigenproblem for special matrices such as DPR1 (that is, diagonal plus rank-one) and arrow-head matrices. We examine the correlation between these two classes and their links to the Frobenius companion matrix, and we show a Gauss similarity transform of a TPR1 (that is, triangular plus rank-one) matrix into DPR1 and arrow-head matrices. Theoretically, the known unitary similarity transforms of a general matrix into a block triangular matrix with TPR1 diagonal blocks enable the extension of the cited effective eigen-solvers from DPR1 and arrow-head matrices to general matrices. Practically, however, the numerical stability problems with these transforms may limit their value to some special classes of input matrices.

MSC:

15A18 Eigenvalues, singular values, and eigenvectors
15B57 Hermitian, skew-Hermitian, and related matrices
65H05 Numerical computation of solutions to single equations
12Y05 Computational aspects of field theory and polynomials (MSC2010)
26C10 Real polynomials: location of zeros
65F15 Numerical computation of eigenvalues and eigenvectors of matrices

Keywords:

algebraic eigenproblem; similarity transforms; arrow-head matrices; diagonal plus rank-one matrix; triangular plus rank-one matrix; polynomial root-finders; Frobenius companion matrix; numerical stability

Full Text: DOI

References:

[1] Wilkinson, J.H., The algebraic eigenvalue problem, (1965), Clarendon Press Oxford · Zbl 0258.65037

[2] Golub, G.H.; Van Loan, C.F., Matrix computations, (1996), The Johns Hopkins University Press Baltimore, MD · Zbl 0865.65009

[3] Stewart, G.W., Matrix algorithms, volume II: eigensystems, (1998), SIAM Philadelphia, PA · Zbl 0910.65012

[4] D.A. Bini, L. Gemignani and V.Y. Pan, QR-like algorithms for generalized semiseparable matrices, Technical Report 1470, Department of Math., University of Pisa, Pisa, Italy, July 2003.

[5] Bini, D.A.; Gemignani, L.; Pan, V.Y., Inverse power and durand/kerner iteration for univariate polynomial root-finding, Computers and mathematics with applications, 47, 2/3, 447-459, (2004) · Zbl 1054.65046

[6] Bini, D.A.; Gemignani, L.; Pan, V.Y., Improved initialization of the accelerated and robust QR-like polynomial root-finding, Electronic transactions on numerical analysis, 17, 195-205, (2004) · Zbl 1065.65065

[7] V.Y. Pan, B. Murphy, R.E. Rosholt, Y. Tang and X. Yan, Eigen-solving via small-rank modification (to appear).

[8] Stewart, G.W., Matrix algorithms, volume II: eigensystems, (1998), SIAM Philadelpia, PA · Zbl 0910.65012

[9] Vanderbil, R.; Van Camp, E.; Van Barel, M.; Mastronardi, N., Orthogonal similarity transformation of a symmetric matrix into a diagonal-plus-semiseparable one with free choice of the diagonal, Numerische Mathematik, 102, 709-726, (2006) · Zbl 1086.65040

[10] Eidelman, Y.; Gohberg, I., Fast inversion algorithms for a class of block structured matrices, Contemporary mathematics, 281, 17-38, (2001) · Zbl 1004.65038

[11] Vanderbil, R.; Van Barel, M.; Mastronardi, N., A note on the representation and definition of semiseparable matrices, Numerical linear algebra with applications, 12, 839-858, (2005) · Zbl 1164.15341