Estimations of Spectra-Related Parameters for Partitioned Matrices and Weighted Digraphs

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Abstract

Estimation of matrix spectrum and spectra-related parameters plays a crucial role in stability analysis of dynamical systems. We consider new eigenvalue localization sets defined with respect to arbitrary matrix partitions, obtained by imposing simple criteria on aggregation matrices corresponding to the chosen partition. New spectra localizations are further applied in constructing localization sets for singular values and in bounding spectral radius of any given square complex matrix. As another application, we consider generalized weighted digraphs in modeling multidimensional dynamics. Although for multidimensional systems weights are usually represented by Hermitian positive definite matrices, in case of digraphs, with edges being ordered pairs of vertices, the symmetry is lost. In the absence of symmetry in the corresponding block adjacency matrix, we could still apply our estimations that work for any complex square matrix, and obtain bounds for spectral radius of a weighted digraph. Numerical examples illustrate comparison of new localization results to some already known localization sets.

Keywords: Eigenvalue localization, Spectral radius, Partitioned matrices, Singular values, Weighted digraphs, Dynamical systems