Abstract

Title of the thesis: Some Properties of Interval Matrices and Applications

This thesis explores many important properties of interval matrices and their applications. At the initial stage, a methodology is developed for determining the bounds of a solution set of overdetermined systems of linear equations with interval coefficients. The upper and lower bounds of the solution set are derived in explicit form, and the methodology is applied in a Multiple-Input-Multiple-Output (MIMO) wireless communication system.

The major part of the thesis studies the eigenvalue properties of different classes of interval matrices. An iterative process is proposed to determine the interval enclosure of every eigenvalue of an interval matrix. The eigenvector enclosure corresponding to every eigenvalue is obtained. Using these concepts, the interval matrix's singular value decomposition (SVD) enclosure is obtained. The lower bound for the smallest singular value enclosure of interval matrices is estimated, and the relation between these lower bounds is studied.

Another major contribution of the thesis is studying the generalized eigenvalue problem for a pair of interval matrices. The interval enclosures for generalized eigenvalues and eigenvectors are derived under several conditions. Enclosures for generalized eigenvalues of a pair of non-symmetric interval matrices are derived under some reasonable assumptions.

A practical application of interval matrices in finance is explored toward the end of the thesis, where the sensitivity analysis of the optimal portfolio performance is studied. The concept of linear interval equations is used in this process. The data set for the rate of return of different assets is collected from India's financial market. The corresponding interval matrix is constructed, and a methodology is developed to obtain the set of all possible choices for the optimal portfolio of various portfolio optimization models.

Keywords: Interval matrix, System of linear interval equations, MIMO communication system, Singular value decomposition, Singular values, Eigenvalue enclosure, Interval determinant, Interval norm, Interval Portfolio model, and Sensitivity analysis.