



**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS**

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SHORT ABSTRACT

In this thesis we have studied the various aspects of the localization sets for the spectra and pseudospectra of matrices and matrix polynomials. Given a block upper triangular matrix A , we have derived inner approximations for the pseudospectra of A via the pseudospectra of its diagonal blocks, under the assumption that the non-zero off-diagonal block matrix is of full rank. Next, we have generalized the definitions of four localization sets for eigenvalues, namely, block Ger\v{s}gorin sets, block Brauer sets, block minimal Ger\v{s}gorin sets and permuted pointwise minimal Ger\v{s}gorin sets to matrix polynomials in homogeneous form. The use of the homogeneous form has the advantage of treating both the finite and infinite eigenvalues in a single framework. Several properties of these sets have also been derived. Given a $n \times n$ homogeneous matrix polynomial $P(c,s)$ partitioned with respect to a partition $\pi = \{n_j\}_{j=0}^{\ell}$ of the set $\{1, 2, \dots, n\}$, we have approximated the associated block Ger\v{s}gorin set and block minimal Ger\v{s}gorin set via appropriate pseudospectra levels of the polynomials $P_{k,k}(c,s)$ appearing on the diagonal of the partitioned polynomial. We have identified partitions for which computing the block minimal Ger\v{s}gorin sets is likely to be less computationally intensive than the pointwise minimal Ger\v{s}gorin sets for certain matrix polynomials. Finally, we have studied the localization sets for the eigenvalues of quadratic matrix polynomials using the concept of block Ger\v{s}gorin sets applied to linearizations of the polynomial. The linearizations are chosen from the well-known vector spaces of potential strong linearizations $\mathbb{L}_1(P)$, $\mathbb{L}_2(P)$ and $\mathbb{DL}(P)$. The properties of these sets have been analyzed and used to obtain new and simple upper and lower bounds on the eigenvalues of the matrix polynomial. The analysis of the block Ger\v{s}gorin sets also lead to conditions on the coefficient matrices of the polynomial that are sufficient for the eigenvalues to lie in certain parts of the complex plane. We have also derived various upper bounds on several important distances associated with certain structured and unstructured quadratic matrix polynomials for various choices of norms.