



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Four different aspects of the study of matrix polynomials are considered in this thesis. Firstly, the vector space based study of linearizations of square regular matrix polynomials undertaken by Mackey et al. (*Vector spaces of linearizations for matrix polynomials, SIAM J. Matrix Anal. Appl., 28(4):971--1004, 2006*) is extended to the case of the rectangular matrix polynomials. Secondly, it is established that there is a wide choice of linearizations of rectangular matrix polynomials arising from the proposed vector spaces that can be used to solve the associated complete eigenvalue problem for the matrix polynomial in a globally backward stable manner. Thirdly, the distance from a given square matrix polynomial to a nearest matrix polynomial with an elementary divisor of the form $(\lambda - \lambda_0)^j$, $j \geq r$, for a given complex number λ_0 and an integer $r > 1$, is considered. Fourthly, the distance from a given square matrix polynomial to a nearest normal rank deficient matrix polynomial with a given lower bound on the rank deficiency is considered. Special emphasis is on the distance to a nearest singular (or non-regular) matrix polynomial. Both the distance problems are considered in their most general forms and are long standing open questions. In each case, the matrix polynomials of interest are characterized in terms of the suitable rank deficiency of certain block Toeplitz matrices. Based on these characterizations, optimizations for computing the said distances are formulated and upper and lower bounds are derived in various norm settings. In particular, the distance to a nearest singular matrix polynomial is established as the reciprocal of certain μ -value problem and a numerical strategy to compute it based on the information about the minimal indices of a nearest singular matrix polynomial is proposed. The distances are computed via numerical software and compared with several upper and lower bounds in numerical experiments. Results are shown to compare favorably with those in the literature.