INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study:	Ph.D.
Thesis Title:	"Eigenvalue Backward Errors of Polynomial Eigenvalue Problems under Structure Preserving Perturbations"
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Thesis Submitted to the Department /Center:	Department of Mathematics
Key words for description of Thesis work:	Structured Matrix polynomials, Polynomial Eigenvalue Problem, Structured Eigenvalue Backward Errors

SHORT ABSTRACT

We develop a new framework to obtain computable formulas for structured eigenvalue backward errors of matrix polynomials with various structures under some prespecified norms. In particular, we undertake a detailed analysis of structured eigenvalue backward errors of structured matrix polynomials when the perturbations are measured with respect to $\|.\|_{w,2}$ norm. We obtain explicit formulas for structured eigenvalue backward errors of matrix polynomials with Hermitian, skew-Hermitian, $*$-alternating, $*$-palindromic and $*$-antipalindromic structures in terms of the maximal eigenvalue of a parameter depending Hermitian matrix. We also derive structured eigenvalue backward errors of T-even and T-palindromic polynomials of degree at most 2, T-odd and T-antipalindromic pencils in terms of second largest eigenvalue of a parameter depending Hermitian matrix. For higher degree T-palindromic and T-alternating polynomials we estimate the structured eigenvalue backward error by tight bounds.

Under the same framework, we generalize these ideas to obtain computable bounds for structured eigenvalue backward errors of structured matrix polynomials with respect to $\|.\|_{w,\infty}$ and $\|.\|_{w,F}$ norms. In most cases, the lower bound gives the exact value of the backward error when certain assumptions are met. Numerical experiments suggest that these assumptions are satisfied in practice, thus giving the exact eigenvalue backward error.

Finally, we estimate real eigenpair and eigenvalue backward errors of real matrix polynomials under real perturbations. If the real matrix polynomial has additional structure like Hermitian, $*$-alternating, T-palindromic etc., then in many cases eigenvalue backward errors are computed with respect to perturbations that preserve these additional structures also. We also compute structured eigenvalue and eigenpair backward errors of some special block structured pencils that arise in linear-quadratic optimal control problems with respect to special structure preserving perturbations.

In most cases, we observe that there is a significant difference between the backward errors with respect to perturbations that preserve structure and those with respect to arbitrary perturbations.