Directional perturbation in structured matrix eigenproblems

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The design and analysis of structure-preserving algorithms to solve matrix eigenproblems with a specific structure has led in the last decades to a steady interest in structured eigenvalue perturbation theory, i.e. in determining the behavior of eigenvalues and other spectral objects (e.g., invariant subspaces, sign characteristics,...) when a matrix or operator is subject to perturbations belonging to the same class of operators as the unperturbed one. It is well known that this behavior may be quite different from the behavior under arbitrary, nonstructured perturbations.

In this talk we give an overview of first order structured perturbation theory, i.e. of results involving the local variation of eigenvalues as expressed by their directional derivatives, constrained by the fact that perturbations are restricted within the class of interest. Such results are relevant in many practical situations when eigenvalues need to be pushed in certain specific directions, or must be moved as fast as possible away from a critical (or dangerous) region by a small structured perturbation. Special emphasis is made on classes of matrices and matrix pencils with symmetries in some indefinite scalar product, which often arise in applications in the context of Control and Systems Theory.