PERFECT SHIFTS FOR HESSENBERG-HESSENBERG PENCILS

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In this talk we analyze the stability of the problem of performing a rational QZ step with a shift that is an eigenvalue of a given regular pencil $H - \lambda K$ in unreduced Hessenberg–Hessenberg form. This problem appears when downdating orthogonal rational functions with prescribed poles, i.e., remove a node from the corresponding discrete inner product. In exact arithmetic, the backward rational QZ step moves the eigenvalue to the top of the pencil, while the rest of the pencil is maintained in Hessenberg–Hessenberg form, which then yields a deflation of the given shift. But in finite-precision the rational QZ step gets "blurred" and precludes the deflation of the given shift at the top of the pencil. In this talk we show that when we first compute the corresponding eigenvector to sufficient accuracy, then the rational QZ step can be constructed using this eigenvector, so that the exact deflation is also obtained in finite-precision.

If time permits, we show how the residual can be improved using a scaling procedure and how the method can be applied to general rank structured pencils.