

Fast QR Eigenvalue Algorithms for Companion Matrices and Pencils

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Recently the exploitation of *quasiseparable* and *rank structures* in the context of the matrix eigenvalue problem has lead to a significant computational breakthrough. Based on this approach we can devise some novel adaptations of the customary *QR algorithm* for eigenvalue computation of *companion* matrices and pencils. These adaptations enjoy the robustness and the rapid convergence properties of the QR algorithm but also take advantage of the structure by running in linear time per iteration and using linear memory space.

In the first part of this talk we present techniques and results that are used in the design of the fast variants of the QR algorithm. A basic role is played by the representation of the structures involved in terms of parameters called *generators*. Matrix operations are reduced to manipulations among generators thus yielding a dramatic reduction of the computational cost.

In the second part of the talk we address some computational issues behind the implementation of our fast adaptations of the QR algorithm. The use of quasiseparable and rank structures in the solution of matrix eigenvalue problems is a quite novel research area and sets up several computational problems concerning the choice and the minimality of the parametrizations involved, their numerical robustness and their behavior under shifting and cutting strategies.