The distance to instability and singularity for structured matrix pencils

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Abstract

The stability analysis of dynamical systems leads to the eigenstructure analysis of matrix pencils $\lambda E - A$. The associated system is asymptotically stable if the pencil is regular, all finite eigenvalues are in the left half plane and the infinite eigenvalues are semisimple. There are several challenging open problems that will be discussed. The first is the distance to instability, i.e. the smallest perturbation to E and A that puts an eigenvalue on the imaginary axis, or makes the pencil singular. For the first question there are well-known methods but the second problem is still open, although progress has been recently made, [5, 2]. When the problem is structured such as in port-Hamiltonian systems the distance to instability is much larger than for the unstructured case [3, 4]. This opens a lot of opportunities to exploit the structure to the advantage of robustness of a system under perturbation. We also discuss the converse problem of finding the distance to the boundary of the stable pencils for a given unstable pencil [1].

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Keywords

distance to instability, distance to the nearest singular pencil, nearest stable pencil, structured distances, port-Hamiltonian system.

References

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