How perturbations propagate along the solutions of linear ordinary differential equations: a relative error analysis

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In this talk, we are going to present how perturbations in the coefficient matrix A propagate along the solutions of n-dimensional linear ordinary differential equations

$$\begin{cases} y'(t) = Ay(t), \ t \geq 0, \\ y(0) = y_0. \end{cases}$$

In other words we are considering the conditioning of the problem

$$(y_0, A) \mapsto e^{tA} y_0$$

and an asymptotic analysis of condition numbers, as $t \to +\infty$, will be given. The analysis is accomplished for the case where A is normal matrix.

We remark that conditioning of such problems attained less attention in literature. At the best of our knowledge there are only two papers [1] and [2] on this topic. These papers present computational aspects of the condition number. On the other hand our study is more on theoretical aspects of the condition number. It studies how this condition number depends on the time t and the initial data y_0. Also the asymptotic behavior of condition number as $t \mapsto +\infty$ is part of our study.

Joint work with S. Maset

References

[1] A. Al-Mohy and N. Higham, *Computing the action of the matrix exponential, with an application to exponential integrators*, SIAM Journal on Scientific Computing, 33 (2011) no. 2, 488-511.

[2] E. Deadman., *Estimating the condition number of $f(A)b$*, Numerical Algorithms, 70 (2015), 287–308.