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Long-time relative error analysis for linear ODEs with perturbed initial value

S. Maset*

Abstract

We investigate the propagation of initial value perturbations along the solution of a linear ODE $y'(t) = Ay(t)$. This propagation is analized using *relative errors* rather than absolute errors. Our focus is on the long-term behavior of these relative errors, which differs significantly from that of absolute errors. Understanding this long-term behavior provides insights into the growth of perturbation relative errors over all times, not just at large times. Therefore, it represents a crucial and fundamental aspect of the conditioning of linear ODEs and offers new perspectives in linear dynamics, particularly in non-normal dynamics.

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* Dipartimento di Matematica, Informatica e Geoscienze, Università di Trieste, `maset@units.it`