

Stability of Linear Systems and Two-Term Equations with Prabhakar Derivatives: Spectral Criteria and Computations

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Abstract

We investigate stability and instability properties for (i) linear fractional systems and (ii) two-term linear fractional differential equations incorporating Prabhakar-type derivatives. Using Laplace-transform techniques, we derive the corresponding characteristic equations, connecting asymptotic stability properties to the location of characteristic roots in suitable complex sectors. The analysis distinguishes stability properties that depend on the fractional orders from those that are robust with respect to order variations, highlighting how the Prabhakar parameters deform classical stability wedges known from Caputo-type counterparts.

Numerical investigations are also presented to complement the theoretical results: we compute stability maps and root/eigenvalue loci across fractional orders and Prabhakar parameters and validate predicted regimes through time-domain simulations. Our aim is to provide unified analytical and computational tools for the stability analysis of Prabhakar-type fractional-order systems.

References

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