NONSTANDARD SOLVERS FOR THE SOLUTION OF FRACTIONAL DIFFERENTIAL MODELS WITH APPLICATIONS

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Over the past few decades, time-fractional differential models have garnered significant attention. They offer a more accurate description of a wide array of natural phenomena and processes in the applied sciences than their integer-order counterparts, especially when modeling systems with memory effects. Solving real-life problems modeled by this type of problems requires reliable and computationally efficient numerical schemes. Reliability is assured by stability and the preservation of the problem's key qualitative behaviors. To this end, we propose two classes of methods for time-fractional reaction-advection-diffusion problems, based on the L1 and Grünwald-Letnikov methods in time and on nonstandard finite differences in space. Both schemes are stable and positivity preserving. We show the effectiveness of these schemes by two significant applications: one from chemical engineering and another concerning the transport of charge carriers in disordered semiconductors, such as those found in lithium batteries.

References

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