

Title: Fractional-order advection-dispersion problem solution via the spectral collocation method and the non-standard finite difference technique.

Authors: Nasser Hassan Sweilam, Adel Abd Elaziz El-Sayed, and Salah Boulaaras

Published date: March 2021

Journal name: Chaos, Solitons and Fractals

(ISSN: 0960-0779)

(IF: 5.944, Q1)

Volume: 144; **Number:** 110736.

Publisher: Elsevier

Received: 21 December 2020; **Revised:** 24 January 2021;

Accepted: 25 January 2021; **Available online:** 26 February 2021.

Authors contributions: The authors are contributed equally to this article.

Is the research extracted from a scientific thesis? : No

URL: <https://doi.org/10.1016/j.chaos.2021.110736>;

DOI: [10.1016/j.chaos.2021.110736](https://doi.org/10.1016/j.chaos.2021.110736)

Abstract

In this article, a numerical method for solving a fractional-order Advection-Dispersion equation (FADE) is proposed. The fractional-order derivative of the main problem is presented using the Caputo operator of fractional differentiation. Orthogonal polynomials of the shifted Vieta-Fibonacci polynomials are used as a basis for the desired approximate solution. The main problem is converted into a system of ordinary differential equations. These ODEs system is transformed into algebraic equations through the spectral collocation technique and the non-standard finite difference method. Also, the convergence analysis and the error estimate of the suggested method are investigated. Some numerical applications are introduced to demonstrate the applicability and accuracy of the implemented technique.