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EDITORIAL
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Editorial: Analytical and Numerical Methods for Differential Equations and Applications

Jesus Martin-Vaquero[1]*, *Bruce Wade*[2], *Juan L. García Guirao*[3] *and Feliz Minhós*[4]

[1]University of Salamanca, Salamanca, Spain, [2]University of Louisiana at Lafayette, Lafayette, LA, United States, [3]Universidad Politécnica de Cartagena, Cartagena, Spain, [4]University of Evora, Évora, Portugal

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Editorial on the Research Topic

Analytical and Numerical Methods for Differential Equations and Applications

In the last few decades, new mathematical problems and models, described by differential equations, have brought to light applications in many areas including Physics, Chemistry, Engineering, Biomedicine, and Economics, among others.

This research topic shows the large amount of different types of differential equations, thus it contains a selection of papers with recent advances in subjects as different as delay differential equations, nonlinear partial differential equations (PDEs), studied analytically or numerically, or because of their applications, fractional PDEs, and q-differential equations, etc. We would like to thank all the contributors of this issue, and also the referees. They all worked hard to shed some light on these topics for young researchers who would like to investigate some of these areas. Thus, in this research topic, readers can find papers on varying numerical methods and applications.

Delay differential equations (DDEs): During the last few years, there have been many studies on DDEs. A very special type of retarded delay differential equations called fuzzy hybrid retarded equations are studied in [1]. For these equations, numerical schemes based on Runge-Kutta schemes are a good option to obtain accurate solutions.

Recent advances in stochastic or fractional ODEs and PDEs have been published in the last few years. In this special issue, researchers can find two papers on a fractional PDEs model by [2] and [3], solved numerically with different procedures.

Many scientific papers study PDEs, their applications, and also analytical procedures to study their properties. Thus, an analytical solution of the Biswas-Arshed equation is obtained in [4]. This is a non-linear PDE with important applications in physics. In a similar topic, the variable-coefficient Heisenberg ferromagnetic spin chain (vcHFSC) equation is considered in [5]. This equation is also a nonlinear PDEs method, and it can be solved with Lie-algebra groups.

However, many other nonlinear PDEs are transformed into large systems of nonlinear ordinary differential equations (ODEs), where efficient solvers are necessary. In some cases, these PDEs need to be solved in complex geometries, a recent approach is described in [6], where a new procedure to solve nonlinear parabolic PDEs in triangles is explained. But, in other cases, research groups focus their works on the applications of these PDEs such as in [7]. For example, many physical (such as the magneto-hydrodynamics [MHD] problem analyzed in [8]), industrial, or complex economical situations can be modeled by nonlinear PDEs. Chemistry is another very important area; in Awais-Kuman, the authors modelized the peristaltic flow

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****Correspondence:***
Jesus Martin-Vaquero
jesmarva@usal.es

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dynamics of (Cu-H2O) nanofluid in a homogeneous porous medium. They solved their model numerically in order to be able to physically interpret how the different parameters that appear in their equation affect the outcome. Another important area of interest is mechanics, thus two papers in this research topic are related with this field: In a study by Alanazi et al. [9], a q-differential problem is solved with applications in Newtonian mechanics and Mushtaq et al. [10] describes a *Python* solver to solve some important quantum mechanical eigenvalue PDE problems (such as the Schroedinger) in one or more dimensions.

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All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

REFERENCES

1. Dhandapani PB, Baleanu D, Thippan J, and Sivakumar V. Fuzzy Type RK4 Solutions to Fuzzy Hybrid Retarded Delay Differential Equations. *Front Phys* (2019) 7:168. doi:10.3389/fphy.2019.00168
2. Nawaz R, Kumam P, Farid S, Shutaywi M, Shah Z, and Deebani W. Application of New Iterative Method to Time Fractional Whitham-Broer-Kaup Equations. *Front Phys* (2020) 8:104. doi:10.3389/fphy.2020.00104
3. El-Ajou A, and Al-Zhour Z. A Vector Series Solution for a Class of Hyperbolic System of Caputo Time-Fractional Partial Differential Equations with Variable Coefficients. *Front Phys* (2021) 9:525250. doi:10.3389/fphy.2021.525250
4. Aliyu AI, Inc M, Yusuf A, Baleanu D, and Bayram M. Dark-Bright Optical Soliton and Conserved Vectors to the Biswas-Arshed Equation with Third-Order Dispersions in the Absence of Self-phase Modulation. *Front Phys* (2019) 7:28. doi:10.3389/fphy.2019.00028
5. Liu N. Invariant Solutions and Conservation Laws of the Variable-Coefficient Heisenberg Ferromagnetic Spin Chain Equation. *Front Phys* (2020) 8:260. doi:10.3389/fphy.2020.00260
6. Martín-Vaquero J. ESERK Methods to Numerically Solve Nonlinear Parabolic PDEs in Complex Geometries: Using Right Triangles. *Front Phys* (2020) 8:367. doi:10.3389/fphy.2020.00367
7. Medina D, and Padilla P. The Global Attractor of the Allen-Cahn Equation on the Sphere. *Front Appl Math Stat* (2020) 6:20. doi:10.3389/fams.2020.00020
8. Awais M, Kumam P, Parveen N, Ali A, Shah Z, and Thounthong P. Slip and Hall Effects on Peristaltic Rheology of Copper-Water Nanomaterial through Generalized Complaint Walls with Variable Viscosity. *Front Phys* (2020) 7:249. doi:10.3389/fphy.2019.00249
9. Alanazi AM, Ebaid A, Alhawiti WM, and Muhiuddin G. The Falling Body Problem in Quantum Calculus. *Front Phys* (2020) 8:43. doi:10.3389/fphy.2020.00043
10. Mushtaq A, Noreen A, and Olaussen K. Numerical Solutions of Quantum Mechanical Eigenvalue Problems. *Front Phys* (2020) 8:390. doi:10.3389/fphy.2020.00390

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