

Editorial

Feature Paper Collection of *Mathematical and Computational Applications*—2023

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This Special Issue comprises the second collection of papers submitted by both the Editorial Board Members (EBMs) of the journal *Mathematical and Computational Applications* (MCA) and the outstanding scholars working in the core research fields of MCA. Therefore, this collection typifies the most insightful and influential original articles that discuss key topics in these fields. More precisely, this issue contains 13 research articles published in MCA between May and December 2023. All papers are briefly outlined below, organized chronologically by their publication times.

In [1], Romo-González and Mezura-Montes use deep learning techniques to discriminate between healthy individuals and patients with breast cancer, based on the banding patterns obtained from the Western Blot strip images of the autoantibody response to antigens of the T47D tumor line. The authors propose that neuroevolving convolutional neural networks (CNNs) can be used to find the optimal architecture to achieve competitive ranking, taking Western Blot images as the input. The CNN obtained reached 90.67% accuracy, 90.71% recall, 95.34% specificity, and 90.69% precision in classifying three different classes (healthy, benign breast pathology, and breast cancer).

Bacterial Vaginosis (BV) is a common disease and recurring public health problem for which all possible combinations of the pathogens of a possible case of infection are not known, complicating diagnosis at the onset of the disease. Salvador-González et al. contribute to this line of research in [2]. The experimental results obtained by the authors allowed a reduced subset of biologically meaningful association rules to be selected for the numerical treatment of the considered objective function.

In [3], Vázquez-Santiago et al. propose an open-set recognition (OSR) strategy with an extension for new class discovery aimed at vehicle make-and-model recognition (VMMR). The results show that the presented strategy can effectively address this problem as an OSR problem, and furthermore, it is able to simultaneously recognize the new classes hidden within the rejected objects. The proposed VMMR method is a benchmark for future domain-specific OSR.

In [4], Eivazi et al. provide a clear description of the algorithmic FE² structure together with a particular integration of deep neural networks. This allows for a suitable training strategy, where particular knowledge of the material behavior is considered to reduce the required amount of training data. The resulting method yields a significant speed-up of the FE² computations, and an efficient implementation of the trained neural network in a finite element code is provided. Moreover, the deep neural network surrogate model is able to overcome the load-step size limitations of the representative volume element (RVE) computations in step-size controlled computations.

In [5], Kakuli et al. use Lie symmetry to analyze the Hunter–Saxton equation, an equation relevant to the theoretical analysis of nematic liquid crystals. The proposed method has two main advantages over the classical double-reduction method: firstly, it is more



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efficient as it can reduce the number of variables and order of the equation in a single step. Secondly, by incorporating conservation laws, physically meaningful solutions that satisfy important physical constraints can be obtained.

Páez-Rueda et al. [6] study the approximation of one-dimensional smooth closed-form functions with compact support using a mixed Fourier series. Their method improves the signal processing performance in a wide range of scenarios. Moreover, this paper provides comprehensive examples of one-dimensional problems to showcase the advantages of this approach.

In [7], González Flores and Barrera Sánchez review some grid quality metrics and define some new quality measures for quadrilateral elements. Furthermore, they define new discrete functionals, which are implemented as objective functions in an optimization-based method for quadrilateral grid generation and improvement. These functionals are linearly combined with a discrete functional whose domain has an infinite barrier at the boundary of the set of unfolded grids to preserve convex grid cells in each step of the optimization process.

Middle East respiratory syndrome coronavirus (MERS-CoV) is a highly infectious respiratory illness that poses a significant threat to public health. In [8], Fatima et al. develop a precise mathematical model to capture the transmission dynamics of MERS-CoV. Stability theory is employed to analyze the local and global properties of the model, providing insights into the system's equilibrium states and their stability. Sensitivity analysis is conducted to identify the most critical parameter affecting the transmission dynamics. The model can serve as a valuable tool for public health authorities when designing effective control and prevention strategies, ultimately reducing the burden of MERS-CoV on global health.

In [9], Deb and Ehrgott analyze and outline the properties of generalized dominance structures for multi-objective optimization which help provide insights into the resulting optimal solutions. The theoretical and deductive results of this study can be utilized to create more meaningful dominance structures for practical problems, understand and identify resulting optimal solutions, and help develop better test problems and algorithms for multi-objective optimization.

In [10], Wang et al. present an innovative cascade predictor to forecast the state of recurrent neural networks (RNNs) with delayed output. The new predictor is more useful than the conventional single observer in predicting neural network states when the output delay is arbitrarily large but known. In contrast to examining the stability of error systems solely employing the Lyapunov–Krasovskii functional (LKF), several new global asymptotic stability standards are obtained by combining the application of the Linear Parameter Varying (LPV) approach, LKF, and convex principle. The latter is verified by several numerical simulations.

In [11], Sánchez-García et al. analyze the determination of interplanetary trajectories from Earth to Mars to evaluate the cost of the required impulse magnitudes for an areostationary orbiter mission design. The results show that, for the dates of the minimum-energy Earth–Mars transfer trajectory, a low value for the maneuvers to achieve an areostationary orbit is obtained for an arrival hyperbola with the minimum possible inclination, in addition to a capture into an elliptical trajectory with a low periapsis radius and an apoapsis in the stationary orbit.

The preventive measures taken to curb the spread of COVID-19 have emphasized the importance of wearing face masks to prevent potential infection with serious diseases during daily activities or for medical professionals working in hospitals. In [12], Melin et al. investigate various existing methods employing artificial intelligence and deep learning to detect whether individuals are wearing face masks. The results demonstrate that the bat algorithm obtained better results than the other metaheuristics analyzed in this study.

Finally, in [13], Annunziato and Borzí present a method for the analysis of super-resolution microscopy images. The method is based on the analysis of stochastic trajectories of particles moving on the membrane of a cell with the assumption that this motion is

determined by the properties of this membrane. The results demonstrate the ability of the proposed method to reconstruct the potential of a cell membrane by using synthetic data similar those captured by super-resolution microscopy of luminescent activated proteins.

Conflicts of Interest: The authors declare no conflicts of interest.

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