

New Trends in Symmetry in Optimization Theory, Algorithms and Applications

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Optimization is an important branch of operations research in applied mathematics and computer science, where functions are optimized over a range of feasible solutions. Along with the rapid development of computer science and the urgent need to solve real-world problems, spectacular advancements have been made in modern optimization theory and its related methods. These advances have had a significant impact on the development of many fields, including statistics, biology, finance, economics, control, and so on [1–10]. Moreover, these developments all span across interdisciplinary areas.

The need to solve large-scale optimization problems in various areas of science, engineering, and technology has led to breakthrough advancements in numerical optimization, including first-order methods and augmented Lagrangian methods. Many optimization methods have contributed to rapid developments in many fields, including operations research, data science, data analytics, machine learning, and artificial intelligence, among others. However, nowadays, many challenges and open questions remain as the size of problems and the need to solve them efficiently is increasing. We thus need to develop new optimization theories, methods, and applications.

The objective of this Special Issue, entitled “Symmetry in Optimization Theory, Algorithms and Applications”, is to provide a platform for scholars to present their latest research on symmetry in optimization theory, methods, and applications. We welcomed submissions related to the latest developments in the area of symmetric cone optimization, symmetric cone complementarity problems, sparse optimization, statistical optimization, financial statistics, biostatistics, portfolio optimization, interior-point methods, first-order optimization methods, machine learning, artificial intelligence, neural networks, and mathematical modeling. In response to the call for papers, 15 papers were submitted for consideration, and 5 papers were finally accepted for publication in this Special Issue after a rigorous peer-review process. This corresponds to an acceptance rate of 33.3%. The papers published in this Special Issue are briefly summarized herein.

In “An Asymmetric Ensemble Method for Determining the Importance of Individual Factors of a Univariate Problem” [11], Mišić et al. propose an ensemble model that embodies an asymmetric optimization process. This model is grounded in the stacking framework of ensemble learning, comprising both logistic regression and various classification techniques. The combiner algorithm within this model incorporates feature selection, thereby enabling dimensionality reduction when addressing the binary classification task of estimating the significance of non-medical factors in ensuring successful inpatient treatment.

In “An Enhanced Ant Colony System Algorithm Based on Subpaths for Solving the Capacitated Vehicle Routing Problem” [12], Ahmed et al. developed an advanced version of the ant colony system algorithm aimed at tackling capacitated vehicle routing problems with a focus on subpaths. Firstly, they adopted the K-nearest neighbor algorithm to identify the most optimal initial solution. Second, they bolstered the diversity inherent in their



Citation: Wang, G.; Tao, J. New Trends in Symmetry in Optimization Theory, Algorithms and Applications. *Symmetry* **2024**, *16*, 284. <https://doi.org/10.3390/sym16030284>

Received: 19 February 2024

Accepted: 23 February 2024

Published: 1 March 2024



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proposed algorithm by strategically preventing the reproduction of identical solutions via the employment of subpaths. Thirdly, they proceeded to apply the Three-Opt algorithm to refine the fully constructed subpaths and the k-Opt algorithm to optimize the subpaths derived from the accumulated experience of navigating them. Finally, the numerical results on some capacitated vehicle routing problems are reported to verify the effectiveness of the presented algorithm.

In “A Three-Dimensional Subspace Algorithm Based on the Symmetry of the Approximation Model and WYL Conjugate Gradient Method” [13], Wang et al. presented a three-dimensional subspace method based on conic models for unconstrained optimization. Firstly, the search direction of the proposed method is generated by minimizing the approximation model of the objective function in a three dimensional subspace. Second, they applied the idea of a WYL conjugate gradient method to characterize the change in gradient direction between adjacent iteration points. Thirdly, the global convergence of the presented algorithm was established by utilizing the strategies of initial stepsize and nonmonotone line search under some mild assumptions. Finally, the numerical results on 80 unconstrained optimization test problems are reported to verify the competitive performance of the proposed method.

In “Preassigned-Time Bipartite Flocking Consensus Problem in Multi-Agent Systems” [14], Cheng et al. addressed the preassigned-time bipartite flocking phenomenon in multi-agent systems. Firstly, a novel category of pre-assigned time consensus protocols, designed to tackle issues in multi-agent scenarios, was proposed. Second, the authors concluded that the agents can be partitioned into two separate and distinct clusters within a finite period by utilizing the structurally balanced graph theory and the Lyapunov stability theorem. Thirdly, the proposed protocol stands out among current fixed or finite-time protocols because the settling time associated with it is a predefined constant and an integral part of the protocol’s parameters. Finally, they provided the substantial evidence that the diameters of these clusters remain bounded and do not depend on other adjustable protocol settings. These findings are rigorously supported by both theoretical analyses and empirical demonstration through simulation.

In “An Improved DCC Model Based on Large-Dimensional Covariance Matrices Estimation and Its Applications” [15], Zhang et al. designed an improved dynamic conditional correlation model by integrating a nonconvex optimization approach. Firstly, they formulated a nonconvex optimization model to estimate covariance matrices, employing both the smoothly clipped absolute deviation and hard-threshold penalty functions. Secondly, the alternating direction method is used to solve the proposed nonconvex optimization model, thus obtaining an optimal estimate for the covariance matrix. Thirdly, they utilized this estimated covariance matrix to substitute the unconditional covariance matrix within the dynamic conditional correlation model. Finally, the numerical results based on the numerical simulations and the classic Markowitz portfolio are provided to demonstrate that the proposed estimator achieves a lower loss compared to alternative variants of the dynamic conditional correlation models.

We would like to express our warmest thanks to the authors who submitted their papers to be considered for publication in this Special Issue. We highly appreciate the reviewers for their careful and critical evaluations of the manuscripts. It is our pleasure to thank Kathy Wang, SI Managing Editor of *Symmetry*, for her support and encouragement during the process of editing this Special Issue.

Author Contributions: All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

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