mathematics

MDPI

Editorial

Preface to the Special Issue on "Optimization Theory and Applications"

Árpád Bűrmen* and **Tadej Tuma**

Department of Electronics, Faculty of Electrical Engineering, University of Ljubljana, SI-1000 Ljubljana, Slovenia
* Correspondence: arpad.buermen@fe.uni-lj.si

MSC: 65K10; 90Cxx

Optimization algorithms are an irreplaceable core component of many contemporary tools used in science and engineering. The objective of this Special Issue is to present novel applications of optimization algorithms to real-world problems, as well as new theoretical results. Out of the many papers submitted to the Special Issue, 18 were accepted for publication after a careful peer-review process.

The paper authored by Montoya et al. [1] uses a mixed-integer conic formulation for choosing the location and size of photovoltaic generation units in radially structured AC-distribution networks. The obtained results show significant improvements over several metaheuristic optimizers.

Rojec et al. [2] use optimization for finding a better adaptive parameter schema for the Nelder–Mead optimization algorithm. The parameters of the proposed schema are optimized on problems with dimensions of up to 100. The performance of the obtained schema is compared to that of the existing ones. The results show that it outperforms them both in terms of accuracy, as well as convergence speed.

The paper by Roth et al. [3] uses mixed-integer linear programming for sizing the energy components in a microgrid. Approximation techniques are used for describing nonlinear relationships in real world processes. The proposed approach exhibits good performance, both in terms of approximation error, as well as computation time.

In [4], Balooee et al. studies a new system of generalized multivalued variational-like inequalities in Banach spaces. The paper shows that the system is equivalent to a system of fixed point problems by utilizing the concept of $P - \eta$-proximal mapping. A novel iterative algorithm for finding the approximate solution of the system is proposed.

In [5], Montoya et al. utilize a two-stage optimization approach for finding the optimal selection of fixed-step capacitor banks. The expected load curve is used for estimating the equivalent annual grid operating costs. The effectiveness of the proposed approach is demonstrated via numerical simulations and comparison with the solution of the exact optimization model.

The paper by Wang et al. [6] proposes a quick search dynamic particle swarm optimization algorithm based on fitness distance. The algorithm uses a repository update mechanism based on fitness distance. Experiments on standard benchmark functions show that the proposed algorithm achieves a higher accuracy and clearness with a dynamically changing Pareto optimal front.

The paper by Cano et al. [7] applies a combination of direct search methods with niching strategies to find as many global optima as possible within an affordable computational budget. Two new performance measures for evaluating, comparing, and monitoring the progress of optimization algorithms are defined.

In [8], Kunaver et al. evolve matrix factorization algorithms for recommender systems using grammatical evolution. The approach was tested on several well-known datasets, producing state-of-the-art results with significantly reduced set-up.

Citation: Bűrmen, Á.; Tuma, T. Preface to the Special Issue on "Optimization Theory and Applications". *Mathematics* **2022**, *10*, 4790. https://doi.org/10.3390/math10244790

Received: 17 November 2022
Accepted: 12 December 2022
Published: 16 December 2022

Rojec et al. [9] use artificial evolution for synthesizing failure-resilient analog circuits. Square root and natural logarithm circuits resilient to high-impedance and short-circuit malfunctions are evolved. The simulation results are confirmed with measurements of hardware implementations.

The paper by Olivares and Staffetti [10] explores policies for controlling the spread of SARS-CoV-2 assuming a limited number of effective COVID-19 vaccines and available tests. A compartmental epidemic model is formed and optimal control problems are solved to obtain the policies. The results show that the approach can be helpful in designing vaccination programs and testing plans.

Gul and Cohen [11] present efficient strategies for covering classes of thin domains in the plane using unit discs. The optimization is based on a lattice upon which the covering is constructed. The obtained bounds on the covering exhibit an improvement over the standard honeycomb covering.

Coufal et al. [12] present a novel optimization algorithm based on natural behavior of snow leopards. The algorithm is tested on a standard set of optimization problems and compared to eight well-known optimization algorithms. The results confirm the effectiveness of the proposed algorithm.

Pang et al. [13] use an outer approximation method for solving the unit commitment problem with wind curtailment and pollutant emission in power systems. The practicality of the proposed method is demonstrated on six systems comprising up to 100 thermal units and 1 wind unit.

The paper by Li and Wang [14] establishes arcwise connectedness results for the sets of globally efficient solutions, weakly efficient solutions, Henig efficient solutions, and superefficient solutions of the generalized vector equilibrium problem assuming natural quasi cone-convexity and natural quasi cone-concavity.

Graf et al. [15] presents a dynamic optimization model of contingency flight crew planning extending to crew formation. The model can be used for supporting the decision-making in operations centers of smaller and medium-sized air carriers.

Valencia-Ponce et al. [16] present a method for accelerating the optimization of the Kaplan–Yorke dimension of a chaotic oscillator by adjusting the highest time step used in the numerical methods for solving the oscillator's equations.

Bűrmen et al. [17] analyze the convergence of a randomized simplicial Hessian update. The paper establishes a lower bound on the expected improvement of the approximate Hessian. The obtained bound generalizes an existing result for an update proposed by Leventhal and Lewis.

Nuñez-Perez et al. [18] present the application of three optimization algorithms for increasing the chaotic behavior of the fractional order chaotic Chen system. The paper shows that the optimized chaotic system is suitable for developing a secure communication system and a random number generator.

As guest editors of the Special Issue we would like to thank all authors for contributing their articles. We would also like to express our gratitude to all reviewers whose efforts were instrumental in making this Special Issue an up to date reflection of the current research on optimization theory and applications. We hope the presented papers will motivate further theoretical research and novel applications of optimization.

Author Contributions: Conceptualization, Á.B. and T.T.; methodology, Á.B.; software, Á.B.; validation, Á.B.; formal analysis, Á.B.; investigation, Á.B. and T.T.; resources, Á.B. and T.T.; data curation, Á.B. and T.T.; writing—original draft preparation, Á.B.; writing—review and editing, T.T.; visualization, Á.B. and T.T.; supervision, T.T.; project administration, T.T.; funding acquisition, T.T. All authors have read and agreed to the published version of the manuscript.

Funding: The authors acknowledge the financial support from the Slovenian Research Agency (research core funding No. P2-0246 ICT4QoL—Information and Communications Technologies for Quality of Life).

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

References

1. Montoya, O.; Ramos-Paja, C.; Grisales-Noreña, L. An Efficient Methodology for Locating and Sizing PV Generators in Radial Distribution Networks Using a Mixed-Integer Conic Relaxation. *Mathematics* **2022**, *10*, 2626. [CrossRef]
2. Rojec, Ž.; Tuma, T.; Olenšek, J.; Bűrmen, Á.; Puhan, J. Meta-Optimization of Dimension Adaptive Parameter Schema for Nelder-Mead Algorithm in High-Dimensional Problems. *Mathematics* **2022**, *10*, 2288. [CrossRef]
3. Roth, M.; Franke, G.; Rinderknecht, S. A Comprehensive Approach for an Approximative Integration of Nonlinear-Bivariate Functions in Mixed-Integer Linear Programming Models. *Mathematics* **2022**, *10*, 2226. [CrossRef]
4. Balooee, J.; Chang, S.; Wang, L.; Ma, Z. Algorithmic Aspect and Convergence Analysis for System of Generalized Multivalued Variational-like Inequalities. *Mathematics* **2022**, *10*, 2016. [CrossRef]
5. Montoya, O.; Moya, F.; Rajagopalan, A. Annual Operating Costs Minimization in Electrical Distribution Networks via the Optimal Selection and Location of Fixed-Step Capacitor Banks Us-ing a Hybrid Mathematical Formulation. *Mathematics* **2022**, *10*, 1600. [CrossRef]
6. Wang, S.; Ma, D.; Wu, M. A Quick Search Dynamic Vector-Evaluated Particle Swarm Op-timization Algorithm Based on Fitness Distance. *Mathematics* **2022**, *10*, 1587. [CrossRef]
7. Cano, J.; Alfaro, C.; Gomez, J.; Duarte, A. Out of the Niche: Using Direct Search Methods to Find Multiple Global Optima. *Mathematics* **2022**, *10*, 1494. [CrossRef]
8. Kunaver, M.; Bűrmen, Á.; Fajfar, I. Automatic Grammatical Evolution-Based Optimiza-tion of Matrix Factorization Algorithm. *Mathematics* **2022**, *10*, 1139. [CrossRef]
9. Rojec, Ž.; Fajfar, I.; Burmen, Á. Evolutionary Synthesis of Failure-Resilient Analog Cir-cuits. *Mathematics* **2022**, *10*, 156. [CrossRef]
10. Olivares, A.; Staffetti, E. Optimal Control Applied to Vaccination and Testing Policies for COVID-19. *Mathematics* **2021**, *9*, 3100. [CrossRef]
11. Gul, S.; Cohen, R. Efficient Covering of Thin Convex Domains Using Congruent Discs. *Mathematics* **2021**, *9*, 3056. [CrossRef]
12. Coufal, P.; Hubálovský, Š.; Hubálovská, M.; Balogh, Z. Snow Leopard Optimization Al-gorithm: A New Nature-Based Optimiza-tion Algorithm for Solving Optimization Problems. *Mathematics* **2021**, *9*, 2832. [CrossRef]
13. Pang, X.; Zheng, H.; Huang, L.; Liang, Y. Outer Approximation Method for the Unit Com-mitment Problem with Wind Curtailment and Pollutant Emission. *Mathematics* **2021**, *9*, 2686. [CrossRef]
14. Li, Q.; Wang, S. Arcwise Connectedness of the Solution Sets for Generalized Vector Equilib-rium Problems. *Mathematics* **2021**, *9*, 2532. [CrossRef]
15. Graf, V.; Teichmann, D.; Dorda, M.; Kontrikova, L. Dynamic Model of Contingency Flight Crew Planning Extending to Crew Formation. *Mathematics* **2021**, *9*, 2138. [CrossRef]
16. Valencia-Ponce, M.; Tlelo-Cuautle, E.; de la Fraga, L. Estimating the Highest Time-Step in Numerical Methods to Enhance the Optimization of Chaotic Oscillators. *Mathematics* **2021**, *9*, 1938. [CrossRef]
17. Bűrmen, Á.; Tuma, T.; Olenšek, J. Randomized Simplicial Hessian Update. *Mathematics* **2021**, *9*, 1775.. [CrossRef]
18. Nuñez-Perez, J.; Adeyemi, V.; Sandoval-Ibarra, Y.; Perez-Pinal, F.; Tlelo-Cuautle, E. Maximizing the Chaotic Behavior of Fractional Order Chen System by Evolutionary Algorithms. *Mathematics* **2021**, *9*, 1194. [CrossRef]