AIMS Mathematics, 10(6): 13692–13694.
DOI: 10.3934/math.2025616
Received: 13 June 2025
Accepted: 13 June 2025
Published: 13 June 2025

https://www.aimspress.com/journal/Math

Editorial

Special Issue "Harmonizing Theory with Practice in Swarm and Evolutionary Computation"

Yong-Hyuk Kim*

School of Software, Kwangwoon University, 20 Kwangwoon-ro, Nowon-gu, Seoul 01897, Republic of Korea

* **Correspondence:** Email: yhdfly@kw.ac.kr; Tel: +8229405212.

Swarm and Evolutionary Computation (SEC) has established itself as a powerful nature-inspired computational framework for solving complex and nonlinear optimization problems. Beyond its theoretical elegance, SEC has increasingly demonstrated its capacity to address real-world challenges across a variety of domains, including energy systems, data science, engineering, and finance. As the field matures, bridging the gap between theory and application has become both a necessity and a driving force for innovation.

This special issue, "*Harmonizing Theory with Practice in Swarm and Evolutionary Computation*", was conceived as a follow-up to the 2023 *Mathematics* journal special issue, "*Swarm and Evolutionary Computation—Bridging Theory and Practice*" [1]. While the previous issue emphasized algorithmic fusion and application potential, the current collection focuses more deeply on the integration of theoretical advancement with concrete, domain-specific implementations. Out of 17 submitted manuscripts, six high-quality papers were selected after a rigorous review process, each showcasing the dynamic interplay between SEC theory and its practical utility.

These selected contributions collectively demonstrate how conceptual developments in SEC can be effectively translated into real-world problem solving, affirming the complementary nature of theory and practice.

In the first paper, Alghamdi et al. [2] tackle the Optimal Power Flow (OPF) problem in renewable-integrated power systems by proposing a hybrid Grey Wolf Particle Swarm Optimization (GWPSO) algorithm. Their work addresses the theoretical challenge of balancing exploration and exploitation and applies it successfully to energy cost minimization and carbon emission reduction—highlighting the algorithm's real-world environmental relevance.

The second contribution, by Wang et al. [3] introduces the MSFSS algorithm to address the

persistent challenge of imbalanced classification in machine learning. By integrating multiple sampling strategies with a Whale Optimization Algorithm-driven feature selection mechanism, the study illustrates how theoretical ensemble and optimization designs can improve robustness and performance under practical data constraints.

In the third paper, Lee et al. [4] enhance community detection in social networks by combining genetic algorithms with stochastic hill climbing within a memetic framework. This hybridization mitigates common limitations such as premature convergence, and the inclusion of local search methods significantly improves result consistency—demonstrating how theoretical augmentation directly contributes to practical graph-based problem solving.

In the fourth article, Ye et al. [5] develop a hybrid deep learning model that integrates CNN, Transformer, and BiLSTM architectures with an improved Sparrow Search Algorithm (SSA) for hyperparameter tuning. Applied to sewage flow prediction under varying rainfall conditions, this work embodies the synergy of deep learning and evolutionary optimization—where theoretical integration yields tangible improvements in time-series forecasting accuracy.

Choi [6], in the fifth paper, introduces a simplified eigenvector-based crossover operator for Differential Evolution (DE) using a rank-one update. This approach reduces computational complexity without sacrificing performance, exemplifying how theoretical simplification can enhance real-world optimization efficiency within established DE frameworks.

Finally, Moon and Yoon [7] propose an adaptive greedy repair operator in a genetic algorithm for the Minimum Vertex Cover problem. Their approach dynamically adjusts greediness parameters based on convergence levels, enhancing constraint satisfaction and solution diversity. This study exemplifies how nuanced theoretical design leads to robust performance across diverse and complex discrete optimization instances.

Together, these six papers serve as strong evidence that theoretical rigor and practical applicability in SEC are not mutually exclusive but mutually reinforcing. Each contribution underscores how algorithmic innovation, grounded in theory, can effectively respond to real-world demands, further strengthening the relevance and versatility of SEC methodologies.

As guest editors, we extend our sincere appreciation to all authors for their outstanding submissions and to the reviewers for their thoughtful and constructive feedback. We hope this special issue will inspire further research at the intersection of SEC theory and application, and contribute meaningfully to both academic advancement and practical innovation.

Guest Editor:

Professor Yong-Hyuk Kim, School of Software, Kwangwoon University, 20 Kwangwoon-ro, Nowon-gu, Seoul 01897, Republic of Korea
Email: yhdfly@kw.ac.kr

Acknowledgments

I would like to thank the AIMS publishing editorial team, all the peer reviewers, and all the authors who contributed to this Special Issue. This work was supported by Korea Institute of Marine Science & Technology Promotion (KIMST) funded by the Ministry of Oceans and Fisheries, Korea (RS-2022-KS221629).

Conflict of interest

The author declares no conflict of interest.

References

1. Y. H. Kim, F. Caraffini, Preface to "Swarm and Evolutionary Computation—Bridging Theory and Practice", *Mathematics,* **11**(2023), 1209. https://doi.org/10.3390/math11051209
2. H. Alghamdi, L. Hua, M. Riaz, G. Hafeez, S. Ullah, M. M. Zaidi, et al., An optimal power flow solution for a power system integrated with renewable generation, *AIMS Math.*, **9** (2024), 6603–6627. https://doi.org/10.3934/math.2024322
3. S. X. Wang, C. B. Shao, S. Xu, X. B. Yang, H. L. Yu, MSFSS: A whale optimization-based multiple sampling feature selection stacking ensemble algorithm for classifying imbalanced data, *AIMS Math.*, **9** (2024), 17504–17530. https://doi.org/10.3934/math.2024851
4. D. Lee, J. Kim, Y. Yoon, Improving modularity score of community detection using memetic algorithms, *AIMS Math.*, **9** (2024), 20516–20538. https://doi.org/10.3934/math.2024997
5. J. Ye, L. Dai, H. Y. Wang, Enhancing sewage flow prediction using an integrated improved SSA-CNN-Transformer-BiLSTM model, *AIMS Math.*, **9** (2024), 26916–26950. https://doi.org/10.3934/math.20241310
6. T. J. Choi, An efficient eigenvector-based crossover for differential evolution: Simplifying with rank-one updates, *AIMS Math.*, **10** (2025), 3500–3522. https://doi.org/10.3934/math.2025162
7. S. H. Moon, Y. Yoon, An adaptive greedy repair operator in a genetic algorithm for the minimum vertex cover problem, *AIMS Math.*, **10** (2025), 13365–13392. https://doi.org/10.3934/math.2025600

AIMS Press