# IEEE CEC 2025 Tutorial Proposal

**Tutorial title: Fair Performance Comparison of Evolutionary Multi-Objective Algorithms**

**Abstract:** Evolutionary multi-objective optimization (EMO) has been a very active research area in recent years. Almost every year, new EMO algorithms are proposed. When a new EMO algorithm is proposed, computational experiments are usually conducted in order to compare its performance with existing algorithms. Then, experimental results are summarized and reported as a number of tables together with statistical significance test results. Those results usually show higher performance of the new algorithm than existing algorithms. However, fair comparison of different EMO algorithms is not easy since the evaluated performance of each algorithm usually depends on experimental settings. This is also because solution sets instead of solutions are evaluated. In this tutorial, we will first explain some commonly-used software platforms and experimental settings for the comparison of EMO algorithms. Then, we will discuss how to specify the common setting of computational experiments, which are used by all the compared EMO algorithms. More specifically, the focus of this tutorial is the setting related to the following four issues: (i) termination condition, (ii) population size, (iii) performance indicators, (iv) test problem. For each issue, we will provide a clear demonstration of its strong effects on comparison results of EMO algorithms. Following that, we will discuss how to handle each of these issues for fair comparison. These discussions aim to encourage the future development of the EMO research field without focusing too much on the development of overly-specialized new algorithms in a specific setting. Finally, we will also suggest some promising future research topics related to each issue.

**Tutorial keywords:** Evolutionary multi-objective optimization, fair performance comparison.

**Potential audiences:** The potential audience includes researchers who are currently working in the area of evolutionary multi-objective optimization (EMO) and those who are interested in the EMO field. This tutorial will provide EMO researchers with a good understanding of the difficulties of fair performance comparison of EMO algorithms. This tutorial will also explain some suggestions about how to handle those difficulties. It is hoped that the tutorial will provide new insights to the audience and promote healthy growth for the EMO community.

**Name, affiliation, and emails of tutorial presenters:**

1. Lie Meng Pang, Southern University of Science and Technology, panglm@sustech.edu.cn

2. Hisao Ishibuchi, Southern University of Science and Technology, hisao@sustech.edu.cn

**Biographies of speakers:**

**Lie Meng Pang** received her Bachelor of Engineering degree in Electronic and Telecommunication Engineering and Ph.D. degree in Electronic Engineering from the Faculty of Engineering, Universiti Malaysia Sarawak, Malaysia, in 2012 and 2018, respectively. She is currently a research associate with the Department of Computer Science and Engineering, Southern University of Science and Technology (SUSTech), China. Her current research interests include evolutionary multi-objective optimization and fuzzy systems.

**Hisao Ishibuchi** is a Chair Professor at Southern University of Science and Technology, China. He was the IEEE Computational Intelligence Society (CIS) Vice-President for Technical Activities in 2010-2013 and the Editor-in-Chief of *IEEE Computational Intelligence Magazine* in 2014-2019. Currently he is an IEEE CIS Administrative Committee Member, an IEEE CIS Distinguished Lecturer, and an Associate Editor of several journals such as *IEEE Transactions on Cybernetics* and *ACM Computing Surveys*. He is also General Chair of IEEE WCCI 2024. He received a Fuzzy Systems Pioneer Award from IEEE CIS in 2019, an Outstanding Paper Award from *IEEE Transactions on Evolutionary Computation* in 2020, an Enrique Ruspini Award for Meritorious Service from IEEE CIS, and Best Paper Awards from FUZZ-IEEE 2009, 2011, EMO 2019, and GECCO 2004, 2017, 2018, 2020, 2021. He also received a JSPS prize in 2007. He is an IEEE Fellow.

**Other info**

The content of our proposed tutorial will be based on the following papers:


[1] H. Ishibuchi, L. M. Pang, and K. Shang, "Difficulties in fair performance comparison of multi-objective evolutionary algorithms [research frontier]," *IEEE Computational Intelligence Magazine*, vol. 17, no. 1, pp. 86-101, 2022. DOI: 10.1109/MCI.2021.3129961

[2] K. Shang, H. Ishibuchi, W. Chen, Y. Nan, and W. Liao, "Hypervolume-optimal μ-distributions on line/plane-based Pareto fronts in three dimensions," *IEEE Transactions on Evolutionary Computation*, vol. 26, no. 2, pp. 349-363, 2022. DOI: 10.1109/TEVC.2021.3093114

[3] H. Ishibuchi, L. M. Pang, and K. Shang, "Numerical analysis on optimal distributions of solutions for hypervolume maximization," in *Proceedings of IEEE International Conference on Systems, Man, and Cybernetics*, pp. 1103-1110, Toronto, Canada, October 2020. DOI: 10.1109/SMC42975.2020.9283265

[4] H. Ishibuchi, L. M. Pang, and K. Shang, "Population size specification for fair comparison of multi-objective evolutionary algorithms," in *Proceedings of IEEE International Conference on Systems, Man, and Cybernetics*, pp. 1103-1110, Toronto, Canada, October 2020. DOI: 10.1109/SMC42975.2020.9282850

[5] H. Ishibuchi, R. Imada, Y. Setoguchi, and Y. Nojima, "Reference point specification in inverted generational distance for triangular linear Pareto front," *IEEE Transactions on Evolutionary Computation*, vol. 22, no. 6, pp. 961-975, 2018. DOI: 10.1109/TEVC.2017.2776226

[6] H. Ishibuchi, R. Imada, Y. Setoguchi, and Y. Nojima, "How to specify a reference point in hypervolume calculation for fair performance comparison," *Evolutionary Computation*, vol. 26, no. 3, pp. 411-440, 2018. https://doi.org/10.1162/evco_a_00226

As additional information, the speakers have experience in delivering tutorials at multiple prestigious international conferences, as outlined below:

**IEEE International Conference on Systems, Man, and Cybernetics (SMC 2024)**
Tutorial title: Introduction to Evolutionary Multi-Objective Optimization
Speakers: Hisao Ishibuchi and Lie Meng Pang

**IEEE World Congress on Computational Intelligence (WCCI) 2024**
Tutorial title: New EMO Algorithm Framework with an Unbounded External Archive: Basic Ideas and Research Directions
Speakers: Lie Meng Pang, Ke Shang, and Hisao Ishibuchi

**IEEE World Congress on Computational Intelligence (WCCI) 2024**
Tutorial title: Fair Performance Comparison of Evolutionary Multi-Objective Algorithms
Speakers: Lie Meng Pang, Ke Shang, and Hisao Ishibuchi

**The Genetic and Evolutionary Computation Conference (GECCO) 2024**
Tutorial title: New Framework of Multi-Objective Evolutionary Algorithms with Unbounded External Archive
Speakers: Hisao Ishibuchi, Lie Meng Pang and Ke Shang

**IEEE 2023 Congress on Evolutionary Computation (CEC)**
Tutorial title: How to Compare Evolutionary Multi-Objective Optimization Algorithms: Parameter Specifications, Indicators and Test Problems
Speakers: Lie Meng Pang, Ke Shang and Hisao Ishibuchi

**The Genetic and Evolutionary Computation Conference (GECCO) 2022**
Tutorial title: Difficulties in Fair Performance Comparison of Multiobjective Evolutionary Algorithms
Speakers: Hisao Ishibuchi, Lie Meng Pang, and Ke Shang

**IEEE World Congress on Computational Intelligence (WCCI) 2022**
Tutorial title: How to Compare Evolutionary Multi-Objective Optimization Algorithms: Parameter Specifications, Indicators and Test Problems
Speakers: Hisao Ishibuchi, Lie Meng Pang, and Ke Shang