Tutorial Proposal to CEC 2025

Title: Decomposition Evolutionary Multi-Objective Optimization: What We Know from the Literature and What We are not Clear from a Data Science Perspective

Abstract: Evolutionary multi-objective optimization (EMO) has been a major research topic in the field of evolutionary computation for three decades. It has been generally accepted that combination of evolutionary algorithms and traditional optimization methods should be a next generation multi-objective optimization solver. As the name suggests, the basic idea of the decomposition-based technique is to transform the original complex problem into simplified subproblem(s) so as to facilitate the optimization. Decomposition methods have been well used and studied in traditional multi-objective optimization. Multi-objective evolutionary algorithm based on decomposition (MOEA/D) decomposes a multi-objective problem into a number of subtasks, and then solves them in a collaborative manner. MOEA/D provides a very natural bridge between multi-objective evolutionary algorithms and traditional decomposition methods. It has been a commonly used evolutionary algorithmic framework in recent years. In this tutorial, we will provide a comprehensive literature review of MOEA/D and a graph data mining of the literature within this realm.
Keywords: Decomposition techniques, evolutionary multi-objective optimization, MOEA/D

Short description of the tutorial: Within this tutorial, a comprehensive introduction to MOEA/D will be given and selected research results will be presented in more detail. More specifically, we are going to (i) introduce the basic principles of MOEA/D in comparison with other two state-of-the-art EMO frameworks, i.e., Pareto- and indicator-based frameworks; (ii) present a general overview of some state-of-the-art MOEA/D variants and their applications; (iii) discuss the future opportunities for possible further developments. (iv) The other half of this tutorial is a graph data mining way to analyze the current research landscape with the realm of MOEA/D. We expect to provide a holistic understanding about the research community and developmental view of research topics. This tutorial is expected to be less than 90 minutes including the discussion session.

Classification of the tutorial: This tutorial is advanced level but with a gender introduction at the outset.

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A short vitae of the organizer: Ke Li is a Reader in Computer Science at the Department of Computer Science, University of Exeter. He earned his PhD from City University of Hong Kong. After a year as a postdoctoral research associate at Michigan State University, he moved to the UK and took the post of research fellow at University of Birmingham. His current research interests include the evolutionary multi-objective optimization, machine learning, human-AI collaboration, and applications in life sciences and software engineering. He is the founding chair of IEEE CIS Task Force on Decomposition-based Techniques in Evolutionary Computation. He currently serves in the Editorial Board of seven peer-reviewed journal including the prestigious IEEE Transactions on Evolutionary Computation, Evolutionary Computation Journal. He served as a guest editor in Neurocomputing Journal and Multimedia Tools and Applications Journal. He has been awarded a prestigious UKRI Future Leaders Fellowship, Turing Fellowship, Kan Tong Po International Fellowship, and an Amazon Research Award.

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A short vitae of the organizer: Qingfu Zhang is a Chair Professor at the Department of Computer Science, City University of Hong Kong. His main research interests include evolutionary computation, optimization, neural networks, data analysis, and their applications. He is currently leading the Metaheuristic Optimization Research (MOP) Group in City University of Hong Kong. Professor Zhang is an Associate Editor of the IEEE Transactions on Evolutionary Computation and the IEEE Transactions Cybernetics. MOEA/D, a multiobjective optimization algorithm developed in his group, won the Unconstrained Multiobjective Optimization Algorithm Competition at the Congress of Evolutionary Computation 2009, and was awarded the 2010 IEEE Transactions on Evolutionary Computation Outstanding Paper Award. He has

been on the list of the Thomson Reuters Highly Cited Researchers in computer science since 2016.

Potential target audience: The intended audience of this tutorial can be both novices and people familiar with EMO or MOEA/D. In particular, it is self-contained that foundations of multi-objective optimization and the basic working principles of EMO algorithms will be included for those without experience in EMO to learn. Open questions will be posed and highlighted for discussion at the latter session of this tutorial.

Expected number of participants: This tutorial is expected to involve around 50 participants.

Details on previously held versions of the proposed tutorial including venues: This tutorial was delivered in GECCO 2018 (Kyoto, Japan), GECCO 2019 (Prague, Czech Republic) to GECCO 2020 (Cancún, Mexico), GECCO 2021 (Lille, France) and GECCO 2022 (Boston USA); PPSN 2020 (Leiden, The Netherlands), PPSN 2022 (Dortmund, Germany), and PPSN 2024 (Hagenberg, Austria); IEEE CEC 2023 (Chicago, USA), IEEE WCCI 2024 (Yokohama, Japan); IEEE SSCI 2021 (Orlando, USA) and IEEE SSCI 2022 (Singapore).