CEC'2025 Competition on Dynamic Multiobjective Optimisation

The past decade has witnessed a growing amount of research interest in dynamic multiobjective optimisation, a challenging yet very important topic that deals with problems with multi-objective and time-varying properties. Due to the presence of dynamics, DMOPs are inherently more complex and challenging than static multiobjective problems, posing significant difficulties for evolutionary algorithms (EAs) in solving them. Generally speaking, DMOPs pose at least three main challenges. First, environmental changes are difficult to detect and, if undetected, can mislead the search process, as nondominated solutions found for the previous environment may no longer be valid in the current one. Second, diversity, the key driving force of population-based algorithms, is highly sensitive to dynamics. The dynamic nature of DMOPs, characterized by irregular changes, multimodality, and discrete Pareto optimal sets (PSs) or fronts (PFs), significantly complicates the optimisation process. Finally, the response time for environmental changes is often tight for algorithms. The time constraints on DMOPs require algorithms to strike a balance between diversity and convergence, enabling them to promptly handle environmental changes and closely track time-varying PSs or PFs. These challenges highlight the imperative to introduce more complex and comprehensive test problems, thereby fostering the development of innovative methodologies to tackle them.

Benchmark problems are of great importance to algorithm analysis, which helps algorithm designers and practitioners to better understand the strengths and weaknesses of evolutionary algorithms. In dynamic multi-objective optimisation, there exist several widely used test suites, including FDA, dMOP and JY. However, these problem suites simplify the complexity of variations in real-world problems and only represent certain aspects of actual scenarios. For example, the FDA and dMOP functions have no detection difficulty for algorithms. Environmental changes involved in these problems can be easily detected with one re-evaluation of a random population member. Real-life environmental changes should not be so simple. It has also been recognised that most existing DMOPs are a direct modification of popular static test suites, e.g. ZDT and DTLZ. As a result, the DMOPs are more or less the same regarding their problem properties, and therefore are of limited use when a comprehensive algorithm analysis is pursued. Furthermore, another worrying characteristic of most existing DMOPs is that static problem properties overweigh too much dynamics. A problem property (e.g. strong variable dependency) that is challenging for static multiobjective optimisation may not be a good candidate for dynamic multiobjective optimisation. One reason for this is that a failure of algorithms for DMOPs is not due to the presence of dynamics, but rather the static

property. It is therefore likely to get a misleading conclusion on the performance of algorithms when such DMOPs are used. Additionally, most benchmark designs are based on the assumption that the environments before and after the change are similar. However, in real-world scenarios, many DMOPs involve irregular environmental changes. In such cases, the search directions used by EAs for the current environment may not be suitable for the new environment, especially when the true PS of the new environment significantly deviates from, and in the worst case even points in the opposite direction to, that of the current environment. In a nutshell, a set of diverse and unbiased benchmark test problems for a systematic study of evolutionary algorithms are greatly needed in the area.

In this competition, a total of 20 benchmark functions are introduced, covering representative types of DMOPs (continuous, discrete, and constrained) with diverse properties found in various real-world scenarios, such as irregular changes of PS or PF, time-dependent PF/PS geometries, disconnectivity, degeneration, detectability, and a changing number of decision variables and/or objective functions. Through suggesting a set of benchmark functions with a good representation of various real-world scenarios, we aim to promote the research on evolutionary dynamic multiobjective optimisation. All the benchmark functions have been implemented in **MATLAB code and/or C/C++ code**.

In this competition, the anticipated number of participants will be between 10 and 20. The technical report, including data description, evaluation procedures, established baselines, and schedules, will be released subsequently.

Competition Organizers:

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Short Bio: Shengxiang Yang Shengxiang Yang got his PhD degree in 1999 from Northeastern University, China. He is now a Professor of Computational Intelligence (CI), Director of the Centre for Computational Intelligence, and Deputy Director of the Institute of Artificial Intelligence, De Montfort University, UK. He has worked extensively for 20 years in the areas of CI methods, including EC and artificial neural networks, and their applications for real-world problems. He has over 470 publications with a H-index of 76 and over 22,000 citations (Google Scholar). His

work has been supported by UK research councils, EU FP7 and Horizon 2020, Chinese Ministry of Education, and industry partners, with a total funding of over £2M, of which two UK EPSRC standard research projects have been focused on EC for DOPs. He is now a Vice President of Asia Computational Intelligence Society (ACIS) and has served as an Associate Editor or Editorial Board Member of over ten international journals, including IEEE Transactions on Evolutionary Computation, IEEE Transactions on Cybernetics, Information Sciences, Enterprise Information Systems, and Soft Computing, etc. He was the founding chair of the Task Force on Intelligent Network Systems (TF-INS, 2012-2017) and the chair of the Task Force on EC in Dynamic and Uncertain Environments (ECiDUEs, 2011-2017) of the IEEE CI Society (CIS). He has organised/chaired over 70 workshops and special sessions relevant to ECiDUEs for several major international conferences. He was the founding co-chair of the IEEE Symposium on CI in Dynamic and Uncertain Environments. He has co-authored/co-edited three books, and co-edited over 10 proceedings and journal special issues. He has given over 30 invited keynote speeches or tutorials at international conferences and workshops.