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TOPIC: Efficient Knowledge Transfer with Similar Mating Probability and Dimension-aware Selection for Many-Task Optimization

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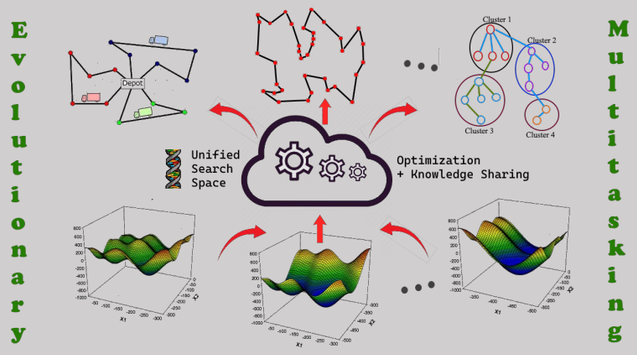
Introduction

Handling a large number of client requests concurrently in cloud computing demands an efficient optimization algorithm.

Inspired by the classical Evolutionary Algorithm (EA), Gupta et al. proposed Multifactorial Evolutionary Algorithm (MFEA) based on multifactorial biological inheritance.

Despite its widespread application and development, MFEA has two limitations: (1) the bounded random mating probability and (2) no techniques for managing knowledge transfer between dimensions exist.



Results

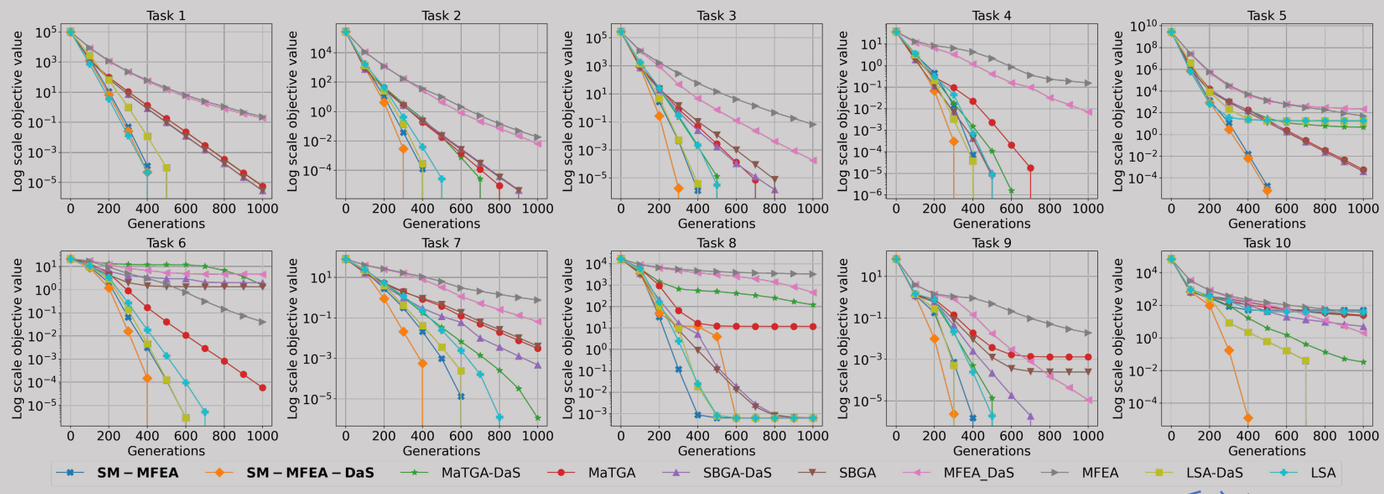
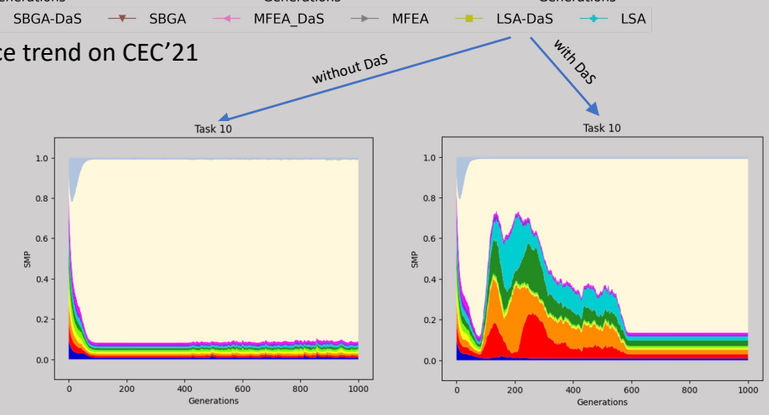


Fig 1. Convergence trend on CEC'21

Algorithms	Better	Equal	Worse	p-value	Decision
MFEA	388	0	112	0	+
LSA	315	4	181	0	+
SBGA	306	0	196	0.009	+
MaTGA	269	0	231	0.038	+
EME-BI	244	118	138	0	+
SM-MFEA	147	212	141	0	+

Fig 2. Compare algorithms with/without DaS strategy on WCCI22

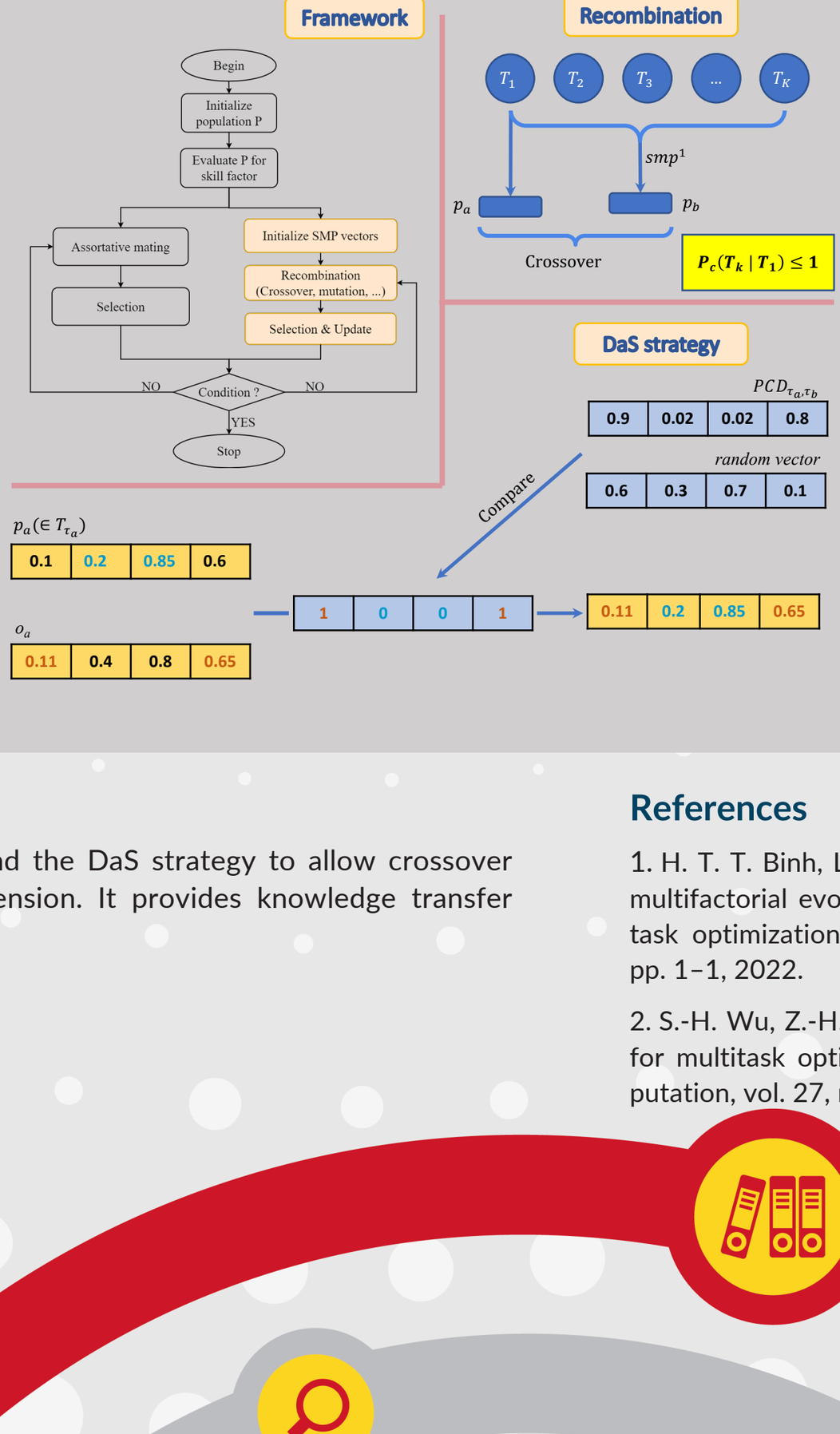


Objective

To address the limitations of conventional MFEA, this poster proposes Similar Mating Multifactorial Evolutionary Algorithm (SM-MFEA) for many-task optimization problems. This algorithm uses a Similar Mating Probability (smp) parameter to maximize the mating probability of any task pair by leveraging previous successful transfers.

Beside SM-MFEA, we propose a new strategy, Dimension-aware Selection (DaS) that uses KL - Divergence to measure tasks similarity in every dimension. Subsequently, dimensions with high similarity between tasks have higher transfer probability.

Methodology



Conclusion

Similar mating probability (smp) is used to leverage past successful transfers to determine the optimal knowledge transfer probability for every pair of tasks.

A dimension-aware selection (DaS) strategy improves knowledge transfer efficiency on each dimension between two tasks.

Experimental results on benchmark datasets show that the proposed SM-MFEA algorithm is much better than other state-of-the-art algorithms in terms of solution quality, convergence trend, and running time.

Rewards

1. Accepted at the Genetic and Evolutionary Computation Conference 2023 (GECCO-2023).

2. Won first prize with this proposal-based algorithm at the Competition on Evolutionary Multi-task Optimization held at the 2022 World Conference on Computational Intelligence (IEEE-WCCI2022).

Future works

In the future work, we extend the DaS strategy to allow crossover multiple parents on each dimension. It provides knowledge transfer more effectively.

References

1. H. T. T. Binh, L. V. Cuong, T. B. Thang, and N. H. Long, "Ensemble multifactorial evolution with biased skill-factor inheritance for many-task optimization," IEEE Transactions on Evolutionary Computation, pp. 1–1, 2022.

2. S.-H. Wu, Z.-H. Zhan, K. C. Tan, and J. Zhang, "Orthogonal transfer for multitask optimization," IEEE Transactions on Evolutionary Computation, vol. 27, no. 1, pp. 185–200, 2023.