

# How does the similarity of metaheuristics Components relate to Empirical Performance?

## Re-evaluating Algorithm Variations using Empirical Similarity

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### Introduction

Two recent approaches have been introduced to measure the similarity between metaheuristics:

- ❖ **Component Similarity:** measures the number of shared components of two algorithms:
- ❖ **Empirical Similarity:** measures the distance between the performance profiles of two algorithms:

### Motivation

- ❖ Different algorithms perform best on different types of problems
- ❖ Small differences in algorithm components can lead to significant variations in performance

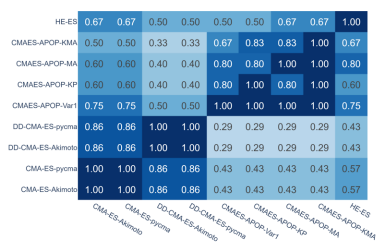
**Question:** How does the similarity of algorithm Components relate to Empirical Similarity?

### Analysis

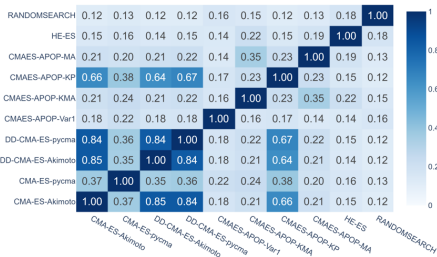
- ❖ **Metaheuristics:** Nine CMA-ES variants due to their shared core structure, but differing only in a few number of components
- ❖ **Benchmark:** 24 single objective functions, divided into five groups based on their main landscape characteristics (COCO)

## Results and Analysis

Component Similarity of the nine CMA-ES variants



Performance Similarity on Multi-Modal Functions with weak Global Structure



Correlation index of Component Similarity and Performance Similarity per group of functions

Functions	Pearson Correlation	P-value
All	0.50	1.68e-6
Group 1	0.49	3.73e-6
Group 2	0.55	9.43e-8
Group 3	0.30	7.36e-3
Group 4	0.33	2.63e-3
Group 5	0.48	4.76e-6

### Contribution

- ❖ We analyze whether **high Component Similarity correlates to high Performance Similarity** on nine CMA-ES variants on the COCO benchmark.
- ❖ We observed a weak to moderate correlation between the similarity metrics; and
- ❖ That the metrics provide complementary insights into the algorithm analysis.

### Conclusion

- ❖ Component Similarity does not always correspond to Performance Similarity;
- ❖ Component Similarity: great importance on how to decompose the algorithms;
- ❖ Empirical Similarity: great importance on the group of problems.

### Future Work

- ❖ How does those similarity metrics scale with the problem's dimension?
- ❖ How do the components interaction affect the performance?



Check out the accompanying paper