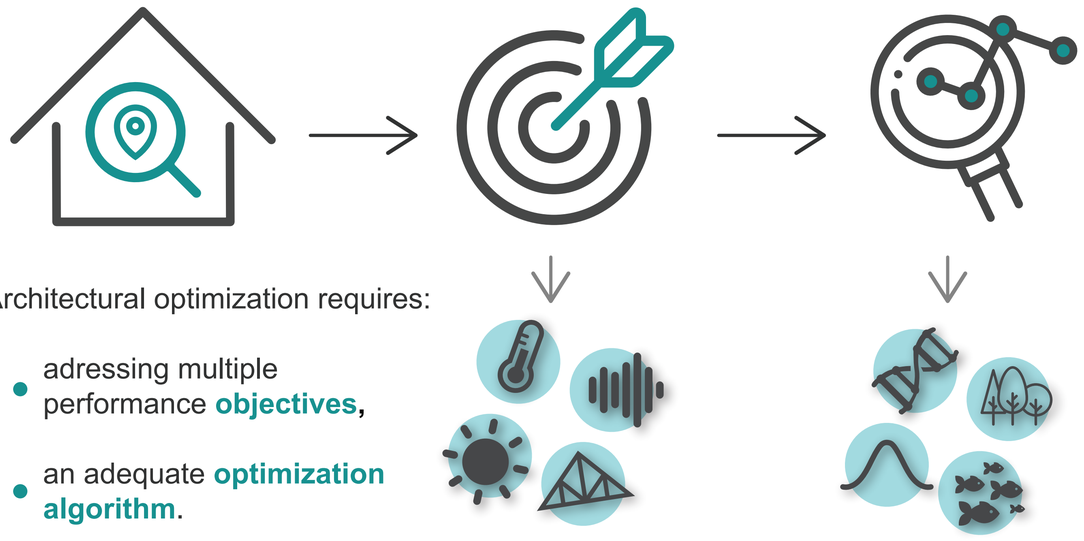
The Cost of Daylight
A Parallelized Approach to Multi-Objective Optimization

PLEA 2020 A CORUÑA
Planning Post Carbon Cities
1-3 September 2020

INÊS PEREIRA, INESC-ID, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

ANTÓNIO LEITÃO, INESC-ID, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

1 MULTI-OBJECTIVE OPTIMIZATION



Architectural optimization requires:

- adressing multiple performance **objectives**,
- an adequate **optimization algorithm**.

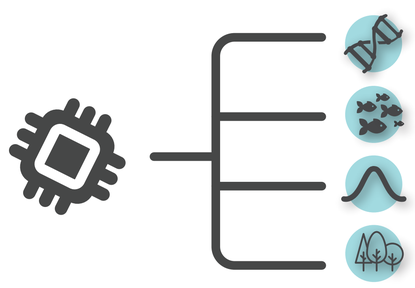
Wolpert's No Free Lunch Theorem: No optimization algorithm outperforms all others in all problems.

For a given optimization problem, finding an adequate algorithm requires testing multiple ones: **a highly time-consuming task**.

2 PARALLELIZATION

To reduce the time spent testing different optimization algorithms, we **parallelized the tests**.

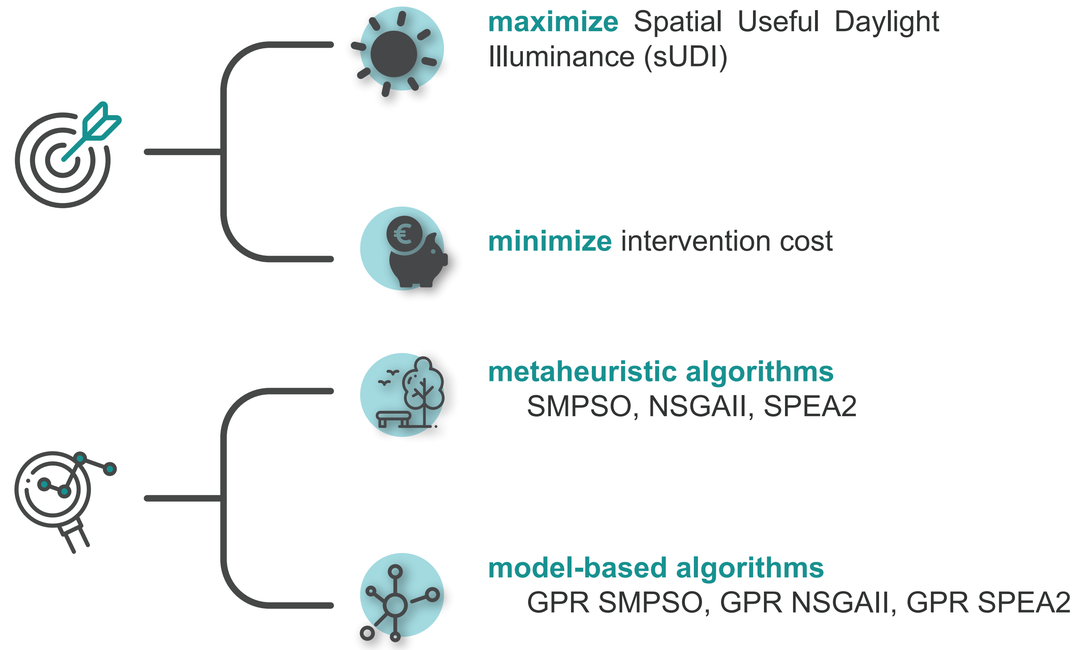
A different CPU thread is assigned to each optimization algorithm, allowing the **simultaneous execution** of as many optimization runs as possible.



This **drastically reduces** the time needed to test multiple optimization algorithms.

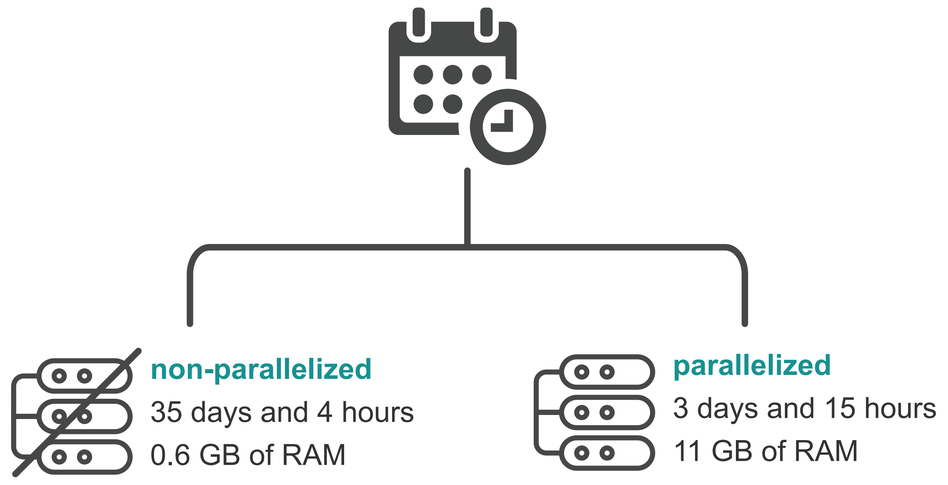
3 CASE STUDY

Intervention for an **exhibition space** using skylights to improve daylight conditions.



Given the stochastic nature of the algorithms, we performed **3 runs** for each one, totalling **18 optimization processes**.

4 SPEEDUP

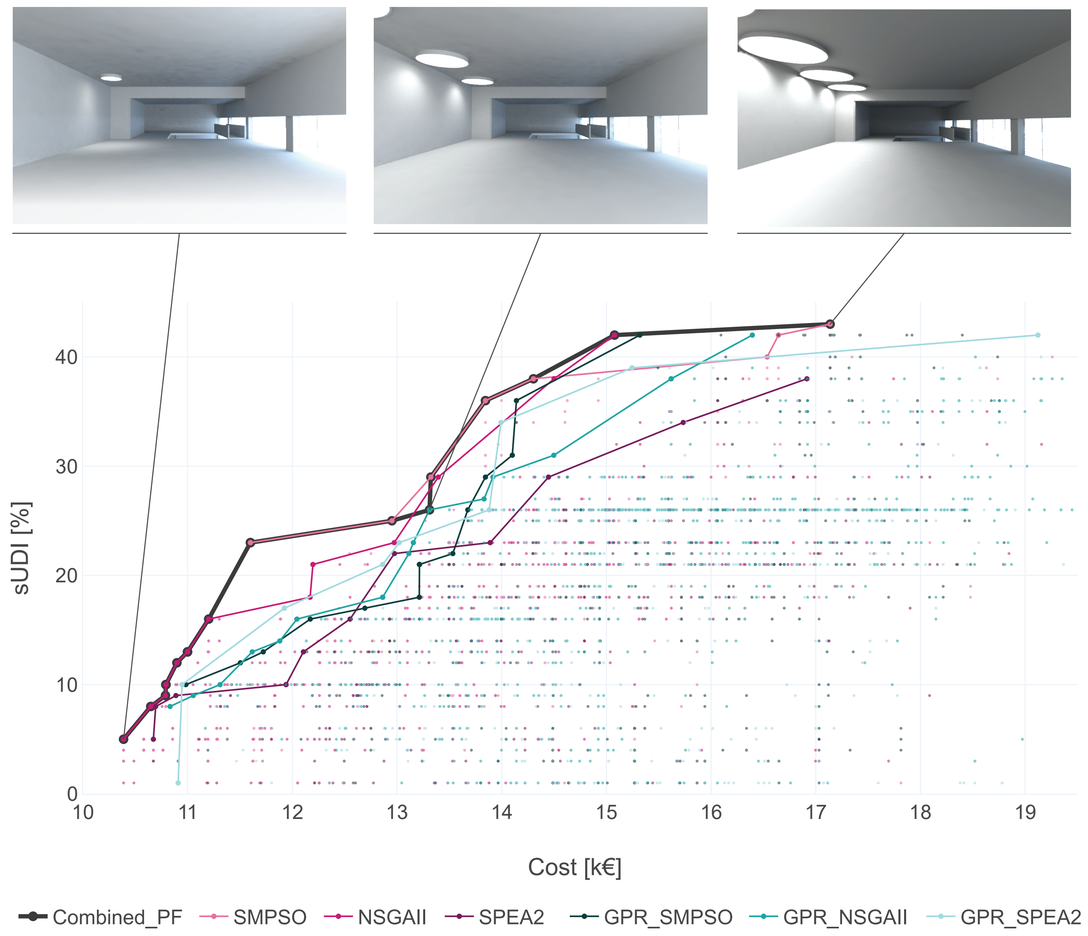


Speedup factor of 9.7.

Improved usage of computational resources.

5 OPTIMIZATION RESULTS

Pareto fronts for all the optimization algorithms tested:



For this problem, **no outstanding** algorithm was found.

By testing multiple ones, a **more complete** Pareto front was produced.

These results provide the architects with better insigths, guiding them towards a **more sustainable** solution.

ACKNOWLEDGEMENTS

This work was supported by national funds through Fundação para a Ciência e a Tecnologia (FCT) with references UIDB/50021/2020 and PTDC/ART-DAQ/31061/2017.

https://algorithmicdesign.github.io/