Benchmarking the Borg MOEA on the Biobjective bbob-biobj Testbed

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Introduction

Evolutionary Computing Algorithms

Components of the Borg MOEA

- ϵ-archive
- Randomized restart
- Auto-adaptive multi-operator recombination

Adaptation of the ϵ

Results

Conclusion

Evolutionary Computing Algorithms

- The goal is to find the pareto front

> **Definition 2.1.** For $\epsilon \in \mathbb{R}^+$, a vector $u \in \mathbb{R}^n$ Pareto-dominates another vector $v \in \mathbb{R}^n$ if $\forall i \in \{1, 2...n\}$ ($u_i \leq v_i$) and $\exists i \in \{1, 2...n\}$ ($u_i < v_i$). This is denoted $v > u$
>
> **Definition 2.2.** For $\epsilon \in \mathbb{R}^+$, a vector $u \in \mathbb{R}^n$ ϵ-dominates another vector $v \in \mathbb{R}^n$ if $\forall i \in \{1, 2...n\}$ ($u_i \leq v_i + \epsilon$) and $\exists i \in \{1, 2...n\}$ ($u_i < v_i + \epsilon$)
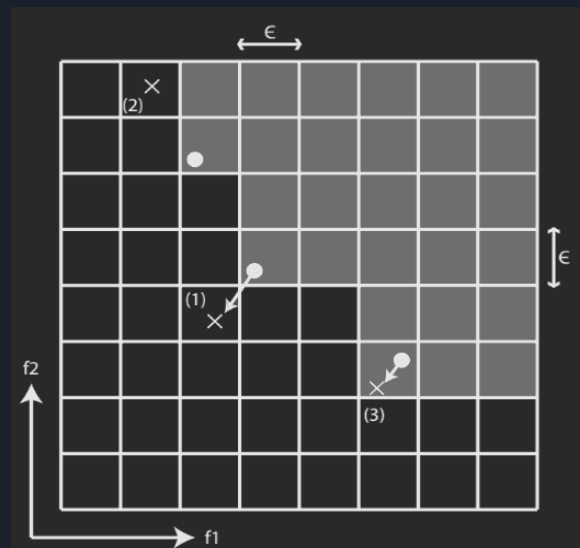
- A population of solutions are "evolved" via evolutionary operators to explore the solution space.
- A record of all non-pareto dominated solutions is kept in an archive.
- Over time, the archive will (hopefully) approximate the pareto front.

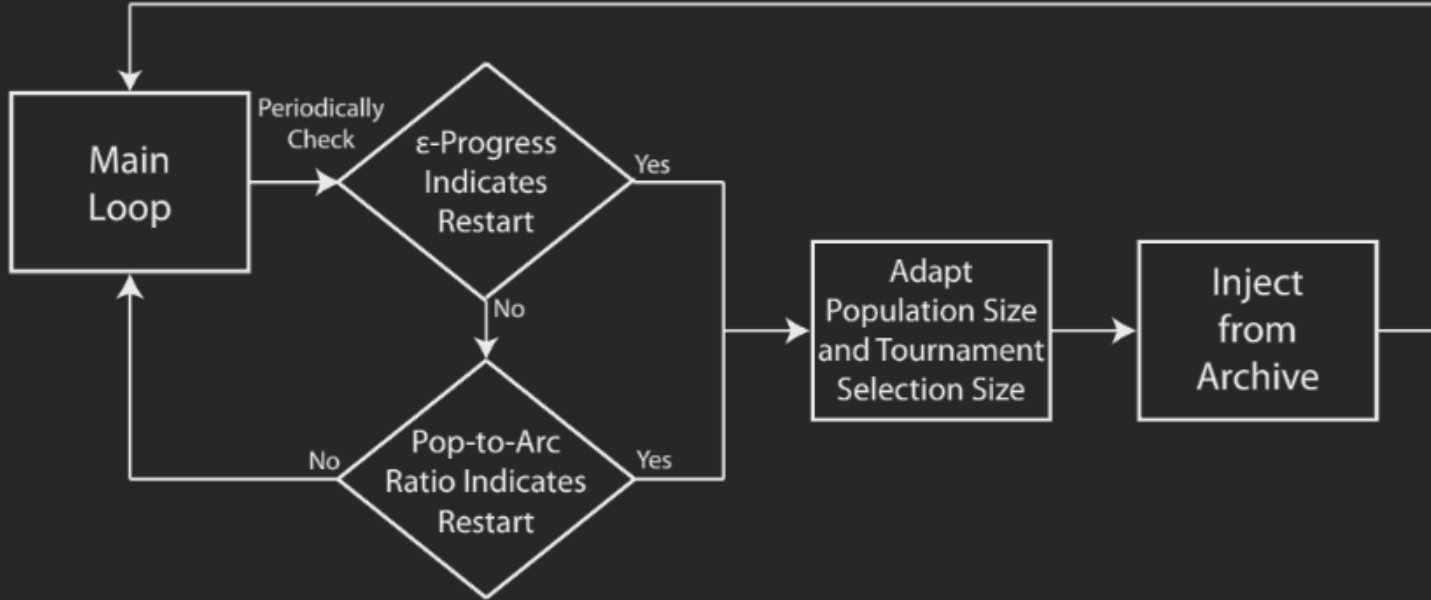# Components of the Borg: ϵ-archive

Epsilon archive

Epsilon boxes

Stagnation

Definition 2.3. For $\epsilon \in \mathbb{R}^+$, a vector $u \in \mathbb{R}^n$ ϵ-box dominates another vector $v \in \mathbb{R}^n$ if one of the following holds
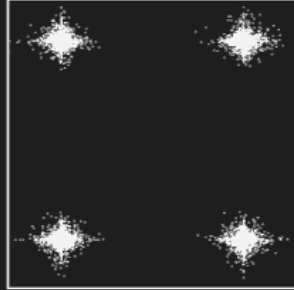
- $\lfloor u/\epsilon \rfloor \leq \lfloor v/\epsilon \rfloor$
- $\lfloor u/\epsilon \rfloor = \lfloor v/\epsilon \rfloor$ and $\|u - \lfloor u/\epsilon \rfloor\| < \|v - \lfloor v/\epsilon \rfloor\|$

Components of the Borg: Randomized restart

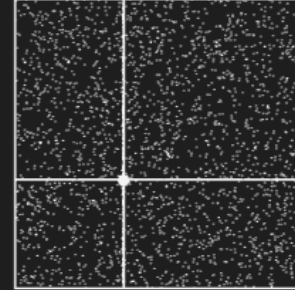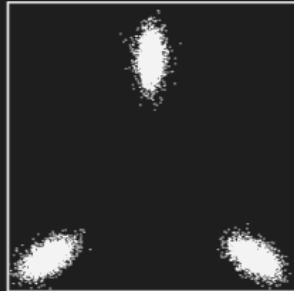# Components of the Borg: Auto-adaptive multi-operator recombination
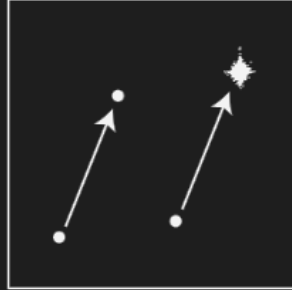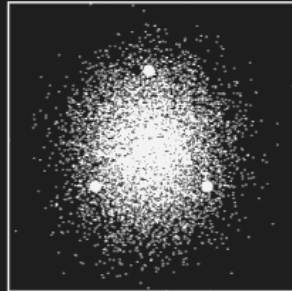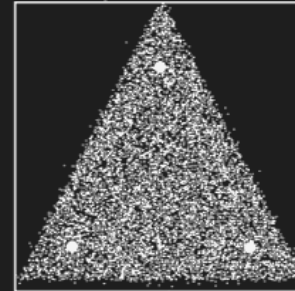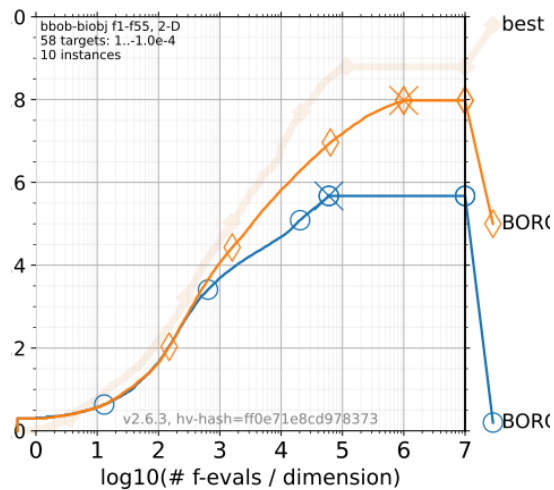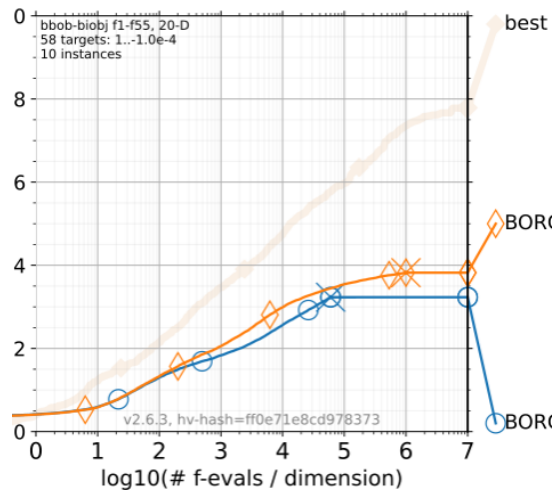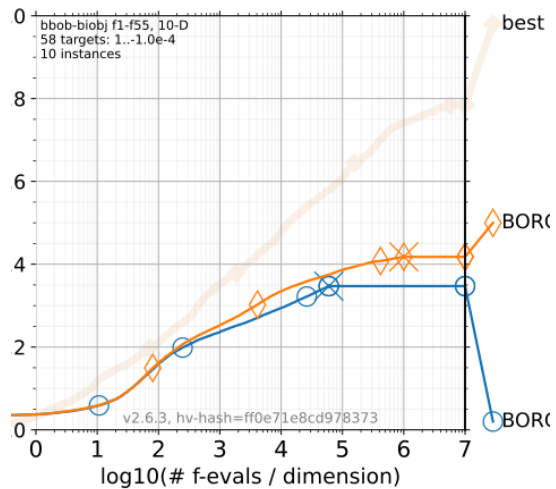
Adaptation of the ϵ

- The ϵ parameter associated to a certain objective is scaled to the range of that objective
- The range of an objective is approximated as the algorithm runs

Results

Results

bbob-biobj f1-f55, 10-D
58 targets: 1..-1.0e-4
10 instances

v2.6.3, hv-hash=ff0e71e8cd978373

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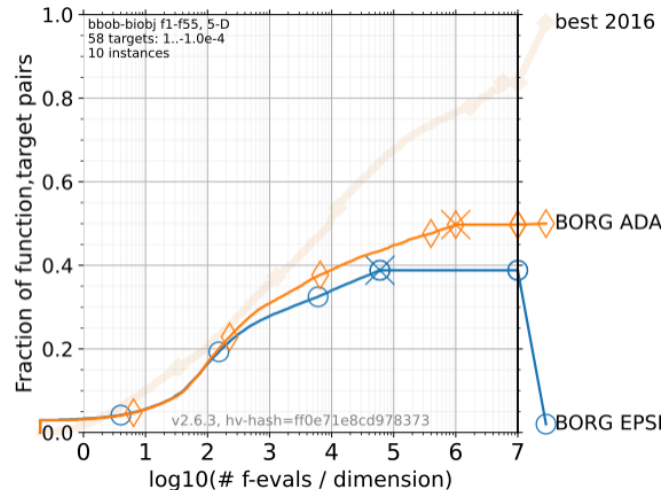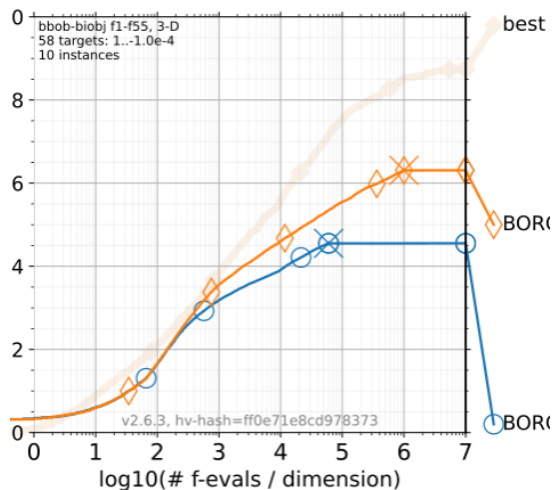
Conclusion

- Does not outperform current top-of-class algorithms on the bbob biobj suite
- Test suite does not account for more than two objectives, a key use-case for the Borg MOEA
- Parameter tuning of the ϵ has positive impact on the performance. Further tuning an avenue for continued research

Thanks for listening!