

Indicator-based Evolutionary Algorithm

Karim Kouki Ahmed Mazari Daro Ozad

Mihaela Sorostinean Aris Tritas

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M.Sc. Machine Learning, Information and Content - University of Paris-Saclay

Outline

- Motivation
- IBEA setting
- Implementation & Tests
- Results
- Discussion

Goals

Explore seminal approaches for evolutionary algorithms

Benchmark and compare algorithms using the COCO platform.

Setting

Black-box Multi-objective optimization: learn f

$$f : \mathbb{R}^n \rightarrow \mathbb{R}^k$$

Pareto optimal approximation set

Non-dominated set of solution vectors.

Indicator function:

Subjective (*a priori*) preference information.

Indicators

Which choice of indicator? Impact on optimization?

- Epsilon indicator
- Hyper-volume indicator

Fitness function: scalarize an individual's utility

Recombination

Different recombination operators.

Choosing a recombination probability.

Simulated Binary Crossover

Goal: control the domain in which offspring is generated.

Definition: Approximate a high-probability stationary ‘spread’ distribution with two “proxy” distributions

Contracting $c(\beta) = 0.5(n_c + 1)\beta^{n_c}, \beta \leq 1$

Expanding $e(\beta) = 0.5(n_c + 1)\frac{1}{\beta^{n_c+2}}, \beta > 1$

Distribution index: $n_c \in \mathbb{N} \implies$ find optimal value?

Variation operators

Adaptating the step-size: essential to find targets **fast**.

Results - few objectives

Show where the algorithm is good (comparatively to other approaches).

Explain where we fail.

Results - many objectives

Intrinsically more difficult problem.

Performance w.r.t random search?

Is the impact of multi-modality and ill-conditioning even greater?

Discussion

Online parameter tuning.



Hyper-parameters tuning.

Choice of the indicator function.

Thank you for your attention!

Questions & Answers

References I

-  Eckart Zitzler and Simon Künzli, "Indicator-Based Selection in Multiobjective Search". In Parallel Problem Solving from Nature (PPSN 2004), pp. 832-842, 2004.
-  Deb, Kalyanmoy, and Ram B. Agrawal. "Simulated binary crossover for continuous search space." Complex Systems 9.3 (1994): 1-15.