Indicator-based Evolutionary Algorithm

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Outline

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

Explore seminal approaches for evolutionary algorithms

Benchmark and compare algorithms using the COCO platform.

Setting

Black-box multi-objective optimization: learn f

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

Pareto optimal approximation set
Non-dominated set of solution vectors.

Indicator function:
Subjective (*a priori*) preference information.

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.

'Spread' distribution approximated by "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**.

Implementation

Python & NumPy

Results – few objectives

Success (comparatively to other approaches)

- Separable
- moderate
- weakly-structured

Fails in:

- multi-modality
- ill-conditioning

Intrisically more difficult problem.

Performance w.r.t random search?

Explain difference between author results on comparison to NSGA-II (better) and our own (worse). Possible causes: budget, implementation of the mutation operator.

Higher impact of multi-modality and ill-conditioning?

Discussion

Online parameter tuning.

Hyper-parameters tuning.

Choice of the indicator function.

Thank you for your attention!

Questions & Answers

References I

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