Indicator-based evolutionary Algorithm

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November 6, 2016

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Outline

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

Goals

Explore state-of-the-art approaches in multi-objective optimization.

Benchmark and compare an algorithm implementation using the COCO platform.

Setting

Find non-dominated set of solution vectors: Pareto optimal approximation set.

Subjective (a priori) preference information: integrated in the indicator function.

Indicators

Which choice of indicator? What impact?

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**.

Low mutation probability

Results - few objectives

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

Explain where we fail.

Results - many objectives

Intrisically 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.