# An estimation of distribution algorithm based on maximum entropy

Wright, APoli, RStephens, CLangdon, WBPulavarty, S

Estimation of distribution algorithms (EDA) are similar to genetic algorithms except that they replace crossover and mutation with sampling from an estimated probability distribution. We develop a framework for estimation of distribution algorithms based on the principle of maximum entropy and the conservation of schema frequencies. An algorithm of this type gives better performance than a standard genetic algorithm (CA) on a number of standard test problems involving deception and epistasis (i.e. Trap and NK).

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# History information based optimization of additively decomposed function with constraints

Ren, QSZeng, JQi, FH

In this paper, we propose a modified estimation of distribution algorithm HCFA (History information based Constraint Factorization Algorithm) to solve the optimization problem of additively decomposed function with constraints. It is based on factorized distribution instead of penalty function and any transformation to a linear model or others. The history information is used and good results can be achieved with small population size. The feasibility of the new algorithm is also given.

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# Real-coded Bayesian optimization algorithm: Bringing the strength of BOA into the continuous world

Ahn, CWRamakrishna, RSGoldberg, DE

This paper describes a continuous estimation of distribution algorithm (EDA) to solve decomposable, real-valued optimization problems quickly, accurately, and reliably. This is the real-coded Bayesian optimization algorithm (rBOA). The objective is to bring the strength of (discrete) BOA to bear upon the area of real-valued optimization. That is, the rBOA must properly decompose a problem, efficiently fit each subproblem, and effectively exploit the results so that correct linkage learning even on nonlinearity and probabilistic building-block crossover (PBBC) are performed for real-valued multivariate variables. The idea is to perform a Bayesian factorization of a mixture of probability distributions, find maximal connected subgraphs (i.e. substructures) of the Bayesian factorization graph (i.e., the structure of a probabilistic model), independently fit each substructure by a mixture distribution estimated from clustering results in the corresponding partial-string space (i.e., subspace, subproblem), and draw the offspring by an independent subspace-based sampling. Experimental results show that the rBOA finds, with a sublinear scale-up behavior for decomposable problems, a solution that is superior in quality to that found by a mixed iterative density-estimation evolutionary algorithm (mIDEA) as the problem size grows. Moreover, the rBOA generally outperforms the mIDEA on well-known benchmarks for real-valued optimization.

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# Empirical investigations on parallelized linkage indentification

Munetomo, MMurao, NAkama, K

To solve GA-difficult problems in which we cannot ensure tight linkage in their encoding, advanced methods such as linkage identification techniques and estimation of distribution algorithms work effectively although they need some additional computational cost. The computation time can be reduced by employing parallel computers and several approaches have been proposed for their parallelized algorithms. This paper presents empirical results on parallelization of the linkage identification compared to that of an estimation of distribution algorithm.

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# Hybrid estimation of distribution algorithm for multiobjective knapsack problem

Li, HZhang, QFTsang, EFord, JA

We propose a hybrid estimation of distribution algorithm (MOHEDA) for solving the multiobjective 0/1 knapsack problem (MOKP). Local search based on weighted sum method is proposed, and random repair method (RRM) is used to handle the constraints. Moreover, for the purpose of diversity preservation, a new and fast clustering method, called stochastic clustering method (SCM), is also introduced for mixture-based modelling. The experimental results indicate that MO-HEDA outperforms several other state-of-the-art algorithms.

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# Hybrid estimation of distribution algorithm for global optimization

Zhang, QFSun, JYTsang, EFord, J

This paper introduces anew hybrid evolutionary algorithm (EA) for continuous global optimization problems, called estimation of distribution algorithm with local search (EDA/L). Like other EAs, EDA/L maintains and improves a population of solutions in the feasible region. Initial candidate solutions are generated by uniform design, these solutions evenly scatter over the feasible solution region. To generate a new population, a marginal histogram model is built based on the global statistical information extracted from the current population and then new solutions are sampled from the model thus built. The incomplete simplex method applies to every new solution generated by uniform design or sampled from the histogram model. Unconstrained optimization by diagonal quadratic approximation applies to several selected resultant solutions of the incomplete simplex method at each generation. We study the effectiveness of main components of EDA/L. The experimental results demonstrate that EDA/L is better than four other recent EAs in terms of the solution quality and the computational cost.

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# Voronoi-based estimation of distribution algorithm for multi-objective optimization

Okabe, TJin, YSendhoff, BOlhofer, M

The distribution of the Pareto-optimal solutions often has a clear structure. To adapt evolutionary algorithms to the structure of a multi-objective optimization problem, either an adaptive representation or adaptive genetic operators should be employed. In this paper, we suggest an estimation of distribution algorithm for solving multi-objective optimization, which is able to adjust its reproduction process to the problem structure. For this purpose, a new algorithm called Voronoi-based Estimation of Distribution Algorithm (VEDA) is proposed. In VEDA, a Voronoi diagram is used to construct stochastic models, based on which new offspring will be generated. Empirical comparisons of the VEDA with other estimation of distribution algorithms (EDAs) and the popular NSGA-II algorithm are carried out. In addition, representation of Pareto-optimal solutions using a mathematical model rather than a solution set is also discussed.

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# Constrained optimization problem solving using estimation of distribution algorithms

Simionescu, PABeale, DGDozier, GV

Two variants of Estimation of Distribution Algorithm (EDA) are tested against solving several continuous optimization problems with constraints. Numerical experiments are conducted and comparison is made between constraint handling using several types of penalty and repair operators in case of both elitist and non-elitist implementations of the EDA's. Graphical display and animations of representative runs of the best and worst performers proved useful in enhancing the understanding of how such algorithms work.

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