# A general-purpose tunable landscape generator

Gallagher, Marcus Yuan, Bo

The research literature on metalieuristic and evolutionary computation has proposed a large number of algorithms for the solution of challenging real-world optimization problems. It is often not possible to study theoretically the performance of these algorithms unless significant assumptions are made on either the algorithm itself or the problems to which it is applied, or both. As a consequence, metalieuristics are typically evaluated empirically using a set of test problems. Unfortunately, relatively little attention has been given to the development of methodologies and tools for the large-scale empirical evaluation and/or comparison of metaheuristics. In this paper, we propose a landscape (test-problem) generator that can be used to generate optimization problem instances for continuous, bound-constrained optimization problems. The landscape generator is parameterized by a small number of parameters, and the values of these parameters have a direct and intuitive interpretation in terms of the geometric features of the landscapes that they produce. An experimental space is defined over algorithms and problems, via a tuple of parameters for any specified algorithm and problem class (here determined by the landscape generator). An experiment is then clearly specified as a point in this space, in a way that is analogous to other areas of experimental algorithmics, and more generally in experimental design. Experimental results are presented, demonstrating the use of the landscape generator. In particular, we analyze some simple, continuous estimation of distribution algorithms, and gain new insights into the behavior of these algorithms using the landscape generator.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000241005800006&DestLinkType=FullRecord&DestApp=WOS_CPL)

A step forward in studying the compact Genetic Algorithm

Rastegar, Reza Hariri, Arash

The compact Genetic Algorithm (cGA) is an Estimation of Distribution Algorithm that generates offspring population according to the estimated probabilistic model of the parent population instead of using traditional recombination and mutation operators. The cGA only needs a small amount of memory; therefore, it may be quite useful in memory-constrained applications. This paper introduces a theoretical framework for studying the cGA from the convergence point of view in which, we model the cGA by a Markov process and approximate its behavior using an Ordinary Differential Equation (ODE). Then, we prove that the corresponding ODE converges to local optima and stays there. Consequently, we conclude that the cGA will converge to the local optima of the function to be optimized.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000240667000002&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Parallel EDA to create multivariate calibration models for quantitative chemical applications

Mendiburu, A. Miguel-Alonso, J. Lozano, J. A. Ostra, M. Ubide, C.

This paper describes the application of a collection of data mining methods to solve a calibration problem in a quantitative chemistry environment. Experimental data obtained from reactions which involve known concentrations of two or more components are used to calibrate a model that, later, will be used to predict the (unknown) concentrations of those components in a new reaction. This problem can be seen as a selection + prediction one, where the goal is to obtain good values for the variables to predict while minimizing the number of the input variables needed, taking a small subset of really significant ones. Initial approaches to the problem were principal components analysis and filtering combined with two prediction techniques: artificial neural networks and partial least squares regression. Finally, a parallel estimation of distribution algorithm was used to reduce the number of variables to be used for prediction, yielding the best models for all the considered problems. (C) 2006 Elsevier Inc. All rights reserved.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000239227800003&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Scatter Search in software testing, comparison and collaboration with Estimation of Distribution Algorithms

Sagarna, R Lozano, JA

One of the main tasks software testing includes is the generation of the test cases to be used during the test. Due to its expensive cost, the automatization of this task has become one of the key issues in the area. The field of Evolutionary Testing deals with this problem by means of metaheuristic search techniques. An Evolutionary Testing based approach to the automatic generation of test inputs is presented. The approach developed involves different possibilities of the usage of two heuristic optimization methods, namely, Scatter Search and Estimation of Distribution Algorithms. The possibilities comprise pure Scatter Search options and Scatter Search-Estimation of Distribution Algorithm collaborations. Several experiments were conducted in order to evaluate and compare the approaches presented with those in the literature. The analysis of the experimental results raises interesting conclusions, showing these alternatives as a promising option to tackle this problem. (c) 2004 Elsevier B.V. All rights reserved.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000232583700004&DestLinkType=FullRecord&DestApp=WOS_CPL)

# The LEM3 implementation of learnable evolution model and its testing on complex function optimization problems

Wojtusiak, Janusz Michalski, Ryszard S.

Learnable Evolution Model (LEM) is a form of non-Darwinian evolutionary computation that employs machine learning to guide evolutionary processes. Its main novelty are new type of operators for creating new individuals, specifically, hypothesis generation, which learns rules indicating subareas in the search space that likely contain the optimum, and hypothesis instantiation, which populates these subspaces with new individuals. This paper briefly describes the newest and most advanced implementation of learnable evolution, LEM3, its novel features, and results from its comparison with a conventional, Darwinian-type evolutionary computation program (EA), a cultural evolution 'algorithm (CA), and the estimation of distribution algorithm (EDA) on selected function optimization problems (with the number of variables varying up to 1000). In every experiment, LEM3 outperformed the compared programs in terms of the evolution length (the number of fitness evaluations needed to achieved a desired solution), sometimes more than by one order of magnitude.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000249917300177&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Optimising cancer chemotherapy using an estimation of distribution algorithm and genetic algorithms

Petrovski, Andrei Shakya, Siddhartha McCall, John

This paper presents a methodology for using heuristic search methods to optimise cancer chemotherapy. Specifically, two evolutionary algorithms - Population Based Incremental Learning (PBIL), which is an Estimation of Distribution Algorithm (EDA), and Genetic Algorithms (GAs) have been applied to the problem of finding effective chemotherapeutic treatments. To our knowledge, EDAs have been applied to fewer real world problems compared to GAs, and the aim of the present paper is to expand the application domain of this technique. We compare and analyse the performance of both algorithms and draw a conclusion as to which approach to cancer chemotherapy optimisation is more efficient and helpful in the decision-making activity led by the oncologists.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000249917300065&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Global optimization of motion planning for tip trajectory tracking of a flexible macro-micro manipulator system using Estimation of Distribution Algorithm

Luo, Lingzhi Zhang, Yu Sun, Zengqi Yang, Tangwen

This paper proposes a new method for motion planning global optimization of a macro-micro manipulator (3M) system based on Estimation of Distribution Algorithm (EDA). Due to the redundant character of a 3M system, its motion planning is formulated as a multi-objective optimization problem under the mechanical constraints. After a task space division, optimization parameters are transferred from. joint angles to division points of macro and micro part of the system, which largely reduces the searching space. However, to avoid sucking local extremum, global optimization is too time-cosuming to bear. Instead of searching the division point space directly, EDA is applied to estimate the probability model of the division space and thus extracts mapping information between the optimization function and division points. Simulation results on a planar 4 degree-of-freedom (DOF) macro-micro manipulator system are presented herein to show the effectiveness of the proposed methods.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000245214200222&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Full-space LDA with evolutionary selection for face recognitiont

Li, Xin Li, Bin Chen, Hong Wang, XianJi Zhuang, ZhengQuan

Linear Discriminant Analysis (LDA) is a popular feature extraction technique for face recognition. However, it often suffers from the small sample size problem when dealing with the high dimensional face data. Some approaches have been proposed to overcome this problem, but they usually utilize all eigenvectors of null or range subspaces of within-class scatter matrix( S-W). However, experimental results testified that not all the eigenvectors in the full space of SW are positive to the classification performance, some of which might be negative. As far as we know, there have been no effective ways to determine which eigenvectors should be adopted. This paper proposes a new method EDA + Full-space LDA, which takes full advantage of the discriminative information of the null and range subspaces of S-W by selecting an optimal subset of eigenvectors. An Estimation of Distribution Algorithm (EDA) is used to pursuit a subset of eigenvectors with significant discriminative information in full space of S-W. EDA + Full-space LDA is tested on ORL face image database. Experimental results show that our method outperforms other LDA methods.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000243679800145&DestLinkType=FullRecord&DestApp=WOS_CPL)

# A hybrid estimation of distribution algorithm for CDMA cellular system design

Sun, Jianyong Zhang, Qingfu Li, Jin Yao, Xin

While code division multiple access (CDMA) is becoming a promising cellular communication system, the design for a CDMA cellular system configuration has posed a practical challenge in optimisation. The study in this paper proposes a hybrid estimation of distribution algorithm (HyEDA) to optimize the design of a cellular system configuration. HyEDA is a two-stage hybrid approach built on estimation of distribution algorithms (EDAs), coupled with a K-means clustering method and a simple local search algorithm. Compared with the simulated annealing method on some test instances, HyEDA has demonstrated its superiority in terms of both the overall performance in optimisation and the number of fitness evaluations required.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000242556300114&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Optimal motion generation of flexible macro-micro manipulator systems using estimation of distribution algorithm

Zhang, Yu Zhou, Shude Yang, Tangwen Sun, Zengqi

In this paper, a new approach for motion generation and optimization of the flexible macro-micro manipulator system is proposed based on Estimation of Distribution Algorithm (EDA). The macro-micro manipulator system is a redundant system, of which inverse kinematics remains challenging, with no generic solution to date. Here, the manipulator system configurations, or the optimal joint motions, are generated using the EDA algorithm base on Gaussian probability model. Compared with simple genetic algorithms (SGA), this approach uses fewer parameters and the time for motion optimization is remarkably reduced. The proposed approach shows excellent performance on motion generation and optimization of a flexible macro-micro manipulator system, as demonstrated by the simulation results.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000242556300115&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Optimizing continuous problems using estimation of distribution algorithm based on histogram model

Ding, Nan Zhou, Shude Sun, Zengqi

In the field of estimation of distribution algorithms, choosing probabilistic model for optimizing continuous problems is still a challenging task. This paper proposes an improved estimation of distribution algorithm (HEDA) based on histogram probabilistic model. By utilizing both historical and current population information, a novel learning method - accumulation strategy - is introduced to update the histogram model. In the sampling phase, mutation strategy is used to increase the diversity of population. In solving some well-known hard continuous problems, experimental results support that HEDA behaves much better than the conventional histogram-based implementation both in convergence speed and scalability. Compared with UMDA-Gaussian, SGA and CMA-ES, the proposed algorithms exhibit excellent performance in the test functions.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000242556300069&DestLinkType=FullRecord&DestApp=WOS_CPL)

# A new algorithm of automatic programming: GEGEP

Du, Xin Li, Yueqiao Xie, Datong Kang, Lishan

Gene Expression Programming (GEP) has wide searching ability, simple representation, powerful genetic operators and the creation of high levels of complexity. However, it has some shortcomings, such as blind searching and when dealing with complex problems, its genotype under Karva notation does not allow hierarchical composition of the solution, which impairs the efficiency of the algorithm. So a new automatic programming method is proposed: Gene Estimated Gene Expression Programming(GEGEP) which combines the advantages of Estimation of Distribution Algorithm (EDA) and basic GEP. Compared with basic GEP, it mainly has the following characteristics: First, improve the gene expression structure, the head of gene is divided into a head and a body, which can be used to introduce learning mechanism. Second, the homeotic gene which is also composed of a head, a body and a tail is used which can increase its searching ability. Third, the idea of EDA is introduced, which can enhance its learning ability and accelerate convergence rate. The results of experiments show that GEGEP has better fitting and predicted precision, faster convergence speed than basic GEP and traditional GP.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000242556300038&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Obtaining biclusters in microarrays with population-based heuristics

Palacios, Pablo Pelta, David Blanco, Armando

In this article, we shall analyze the behavior of population-based heuristics for obtaining biclusters from DNA microarray data. More specifically, we shall propose an evolutionary algorithm, an estimation of distribution algorithm, and several memetic algorithms that differ in the local search used. In order to analyze the effectiveness of the proposed algorithms, the freely available yeast microarray dataset has been used. The results obtained have been compared with the algorithm proposed by Cheng and Church. Both in terms of the computation time and the quality of the solutions, the comparison reveals that a standard evolutionary algorithm and the estimation of distribution algorithm offer an efficient alternative for obtaining biclusters.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000237228900011&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Continuous optimization based-on boosting Gaussian mixture model

Li, Bin Wang, Xian-ji Zhong, Run-tian Zhuang, Zhen-quan

A new Estimation of Distribution Algorithm(EDA) based-on Gaussian Mixture Model (GMM) is proposed, in which boosting, an efficient ensemble learning method, is adopted to estimate GMM. By boosting simple GMM with two components, it has the ability of learning the model structure and parameters automatically without any requirement for prior knowledge. Moreover, since boosting can be viewed as a gradient search for a good fit of some objective in function space, the new EDA is time efficient. A set of experiments is implemented to evaluate the efficiency and performance of the new algorithm. The results show that, with a relatively smaller population and less number of generations, the new algorithm can perform as well as compared EDAs in optimizing multimodal functions.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000240678200285&DestLinkType=FullRecord&DestApp=WOS_CPL)

# An estimation of distribution algorithm for the channel assignment problem

Cheeneebash, Jayrani Rughooputh, Harry C. S.

The channel assignment problem in cellular radio networks is known to belong to the class of NP-complete optimisation problems. In this paper we present a new algorithm to solve the Channel Assigninent Problem using Estimation of Distribution Algorithm. The convergence rate of this new method is shown to be very much faster than other methods such as simulated annealing, neural networks and genetic algorithm.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000241916700037&DestLinkType=FullRecord&DestApp=WOS_CPL)

# A hybrid estimation of distribution algorithm for the Minimal Switching Graph problem

Tang, Maolin Lau, Raymond Y. K.

Minimal Switching Graph (MSG) is a graphical model for the constrained via minimization problem - a combinatorial optimization problem in integrated circuit design automation. From a computational point of view, the problem is NP-complete. In this paper we present a new approach to the MSG problem using hybrid Estimation of Distribution Algorithms (EDAs). This approach uses a Univariate Marginal Distribution Algorithm (UMDA) to sample start search points and employs a hill-climbing algorithm to find a local optimum in the basins where the start search points are located. By making use of the efficient exploration of the UMDA and the effective exploitation of the hill-climbing algorithm, this hybrid EDA can find an optimal or near-optimal solution efficiently and effectively. The hybrid EDA has been implemented and compared with the UMDA and the hill-climbing algorithm. Experimental results show that the hybrid EDA significantly outperforms both the UMDA and the hill-climbing algorithm.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000239912700115&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Fast Estimation of Distribution Algorithm (EDA) via constrained multi-parent recombination

Chan, ZSH Kasabov, N

This paper proposes a new evolutionary operator called Constrained Multi-parent Recombination (CMR) that performs Estimation of Distribution Algorithm (EDA) for continuous optimization problems without evaluating any explicit probabilistic model. The operator linearly combines subsets of the parent population with random coefficients that are subject to constraints to produce the offspring population, so that it is distributed according to Normal distribution with mean and variance equal to that of the parent population. Moreover, the population convergence rate can be controlled with a variance-scaling factor. CMR is a simple, yet robust and efficient operator. It eliminates the requirement for evaluating an explicit probabilistic model and thus the associated errors and computation. It implicitly models the full set of d(d-1)/2 interdependencies between components, yet its computation complexity is only O(d) per solution (d denotes the problem dimension). Theoretical proofs are provided to support its underlying principle. Preliminary experiment involves comparing the performance of CMR, four other EDA approaches and Evolutionary Strategies over three benchmark test functions. Results show that CMR performs more consistently than other approaches.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000236860400013&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Estimation distribution of algorithm for fuzzy clustering gene expression data

Liu, Feng Liu, Juan Feng, Jing Zhou, Huaibei

With the rapid development of genome projects, clustering of gene expression data is a crucial step in analyzing gene function and relationship of conditions. In this paper, we put forward an estimation of distribution algorithm for fuzzy clustering gene expression data, which combines estimation of distribution algorithms and fuzzy logic. Comparing with sGA, our method can avoid many parameters and can converge quickly. Tests on real data show that EDA converges ten times as fast as sGA does in clustering gene expression data. For clustering accuracy, EDA can get a more reasonable result than sGA does in the worst situations although both methods can get the best results in the best situations.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000241892100040&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Modelling the population distribution in multi-objective optimization by generative topographic mapping

Zhou, Aimin Zhang, Qingfu Jin, Yaochu Sendhoff, Bernhard Tsang, Edward

Under mild conditions, the Pareto set of a continuous multi-objective optimization problem exhibits certain regularity. We have recently advocated taking into consideration such regularity in designing multi-objective evolutionary algorithms. Following our previous work on using Local Principal Component Analysis for capturing the regularity, this paper presents a new approach for acquiring and using the regularity of the Pareto set in evolutionary algorithms. The approach is based on the Generative Topographic Mapping and can be regarded as an Estimation of Distribution Algorithm. It builds models of the distribution of promising solutions based on regularity patterns extracted from the previous search, and samples new solutions from the models thus built. The proposed algorithm has been compared with two other state-of-the-art algorithms, NSGA-II and SPEA2 on a set of test problems.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000241446400045&DestLinkType=FullRecord&DestApp=WOS_CPL)

# An estimation of distribution particle swarm optimization algorithm

Iqbal, Mudassar Montes de Oca, Marco A.

In this paper we present an estimation of distribution particle swarm optimization algorithm that borrows ideas from recent developments in ant colony optimization which can be considered an estimation of distribution algorithm. In the classical particle swarm optimization algorithm, particles exploit their individual memory to explore the search space. However, the swarm as a whole has no means to exploit its collective memory (represented by the array of previous best positions or pbests) to guide its search. This causes a re-exploration of already known bad regions of the search space, wasting costly function evaluations. In our approach, we use the swarm's collective memory to probabilistically guide the particles' movement towards the estimated promising regions in the search space. Our experiments show that this approach is able to find similar or better solutions than the canonical particle swarm optimizer with fewer function evaluations.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000241466100007&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Estimation of distribution algorithm for optimization of neural networks for intrusion detection system

Chen, Yuehui Zhang, Yong Abraham, Ajith

An Intrusion Detection System (IDS) is a program that analyzes what happens or has happened during an execution and tries to find indications that the computer has been misused. An IDS does not eliminate the use of preventive mechanism but it works as the last defensive mechanism in securing the system. This paper evaluates the performances of Estimation of Distribution Algorithm (EDA) to train a feed-forward neural network classifier for detecting intrusions in a network. Results are then compared with Particle Swarm Optimization (PSO) based neural classifier and Decision Trees (DT). Empirical results clearly show that evolutionary computing techniques could play an important role in designing real time intrusion detection systems.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000239600000002&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Teeth-number synthesis of a multispeed planetary transmission using an estimation of distribution algorithm

Simionescu, PA Beale, D Dozier, GV

The gear-teeth number synthesis of an automatic planetary transmission used in automobiles is formulated as a constrained optimization problem that is solved with the aid of an Estimation of Distribution Algorithm. The design parameters are the teeth number of each gear the number of multiple planets and gear module, while the objective function is defined as the departure between the imposed and the actual transmission ratios, constrained by teeth-undercut avoidance, limiting the maximum overall diameter of the transmission and ensuring proper spacing of multiple planets. For the actual case of a 3+1 speed Ravigneoux planetary transmission, the design space of the problem is explored using a newly introduced hyperfunction visualization technique, and the effect of various constraints highlighted. Global optimum results are also presented.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000234906000014&DestLinkType=FullRecord&DestApp=WOS_CPL)

# A comparison of evolutionary protocols for solving distributed constraint satisfaction problems

Britt, Winard R. Cunningham, Hurley D. Dozier, Gerry V.

Evolutionary Computation (EC) is the field of study devoted to problem solving using simulated evolution. In this paper, evolutionary operators are applied and a number of societies of hill-climbers (SoHCs), such as a genetic SoHC (GSoHC) and an evolutionary SoHC (ESoHC) are employed for solving randomly generated distributed asymmetric constraint satisfaction problems (DisACSPs). Further, we develop an Estimation of Distribution Algorithm SoHC (EDA-SoHC) variant using a uniform mutation operator. This variant produces offspring by drawing genetic material from a distribution of above-average individuals in the population. In this paper, we compare GSoHCs using distributed restricted forms of single-point, two-point, modified two-point, and uniform crossover. The GSoHCs are also compared with an ESoHC that uses a distributed restricted form of uniform mutation and a simple SoHC which does not use any evolutionary operators. Finally, we compare the SoHC, GSoHCs, and ESoHC to the EDA-SoHC.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000245414202053&DestLinkType=FullRecord&DestApp=WOS_CPL)

# A mathematical modelling technique for the analysis of the dynamics of a simple continuous EDA

Yuan, Bo Gallagher, Marcus

This paper presents some initial attempts to mathematically model the dynamics of a continuous Estimation of Distribution Algorithm (EDA) based on a Gaussian distribution and truncation selection. Case studies are conducted on both unimodal and multimodal problems to highlight the effectiveness of the proposed technique and explore some important properties of the EDA. With some general assumptions, we show that, for 1D unimodal problem and with the (mu, lambda) scheme: (1). The behaviour of the EDA is dependent only on the general shape of the test function, rather than its specific form; (2). When initialized far from the global optimum, the EDA has a tendency to converge prematurely; (3). Given a certain selection pressure, there is a unique value for the proposed amplification parameter that could help the EDA achieve desirable performance; for 1D multimodal problems: (1). The EDA could get stuck with the (mu, lambda) scheme; (2). The EDA will never get stuck with the (mu+lambda) scheme.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000245414202063&DestLinkType=FullRecord&DestApp=WOS_CPL)

# Biped gait optimization using spline function based probability model

Hu, Lingyun Zhou, Changjiu Sun, Zengqi

A new Estimation of Distribution Algorithm (EDA) with spline kernel function (EDA\_S) is proposed to optimize biped gait for a nine-link humanoid robot. Gait synthesis of the biped locomotion is firstly formulated as a multi-constraint optimization problem with consideration of two objectives, including zero-moment point (ZMP) for dynamically stable locomotion and driving torque for energy efficiency. The parameters to be optimized are joint coordinates at transition poses between three successive phases. Rather than searching in joint angle permutation space directly, the proposed method approximates the probability distribution by Catmull-Rom (CR) cubic spline function and updates them with gradient descent learning strategy. The effectiveness of EDA\_S for biped gait optimization has been successfully tested on the simulated model of a humanoid soccer robot. It is shown that the flexible kernel with the updating rule is able to remarkably accelerate the learning speed with comparison to the traditional EDA.

[Paper](https://www.webofscience.com/api/gateway?GWVersion=2&SrcApp=edas&SrcAuth=WosAPI&KeyUT=WOS:000240886901061&DestLinkType=FullRecord&DestApp=WOS_CPL)