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Global optimizations and tabu search based on memory

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Abstract

Based on the idea of tabu search that Glover et al put forward, a new tabu search, named *Memory Tabu Search* (MTS), is proposed for solving the multiple-minima problem of continuous functions. Two convergence theorems, which show that MTS asymptotically converges to the global optimal solutions in probability one under suitable conditions, are given. Numerical results illustrate that this algorithm is efficient, robust and easy to implement.

Introduction

Tabu search (TS) is a metaheuristic originally developed by Glover [1], [2], which has been successfully applied to a variety of combinatorial optimization problems. However, very few works deal with its application and theory to the global minimization of functions depending on continuous variables. Up to now, we are aware of some works [3], [4], [5], [6] related to the subject. TS has been used and evaluated in various contexts, such as the structure if cluster [7], molecular docking [8] and conformational energy optimization of oligopeptides [9]. Some papers discuss the convergence about the discrete problems [10], [11]. In this paper, we propose an adaptation of TS to continuous optimization problem, called *Memory Tabu search* (MTS) and proved that MTS converges to the global optimal solution in probability one. Numerical results illustrate that this algorithm is efficient, easy to implement and open to improvement. The rests of this paper are organized as follows: In 2 Memory tabu search, 3 Implementation of memory tabu search, a full descriptions and implementation of MTS is presented. The convergence of this search for solving the problem (P) in Section 2 is proved in Section 4. The computational results are given in Section 5. In Appendix A, six test functions which were used for testing MTS are given.

Section snippets

Memory tabu search

Consider the following continuous global optimization problem $(\mathbf{P})\ \mathbf{min} f(\mathbf{x})\ \mathbf{s.t.} \mathbf{x}\in\Omega,$ where Ω is a compact subset of Lebesgue measure space $(R^n, L(R^n), \mu)$ and f is a real-valued continuous function defined on Ω. MTS for solving problem (P) is described as follows:

Step 1: Generate a initial point $\mathbf{x}_0\in\Omega$; set $x_0^*:=x_0; k:=0$.…

Step 2: If a prescribed termination condition is satisfied, stop. Otherwise generate a random vector y by using the generation probability density function.…

Step 3: If $f(y)\leqslant f(x_k^*)$, $x_{k+1}^*:=y$, $x_{k+1}:=y$, else if $f(y)\leqslant f($…

…

Implementation of memory tabu search

In this section, some implementation issues of MTS are discussed. It is possible to offer alternative approaches to the implementation of MTS.…

Convergence of MTS

In order to prove the convergence of MTS, we introduce the following the definitions and theory [12].

Definition4.1

Let ξ_n $(n=0,1,...)$ be a sequence of random numbers defined on a probability space. We say that $\{\xi_n\}$ converges in probability to the random number ξ, if for any $\epsilon>0$, such that $\lim_{n\to\infty} P\{|\xi_n-\xi|<\varepsilon\}=1.$
…

Definition4.2

Let ξ_n $(n=0,1,...)$ be a sequence of random numbers defined on a probability space. We say that $\{\xi_n\}$ converges in probability one to the random number ξ, if for any $\epsilon>0$, such that $P \lim_{n\to\infty} \xi_n=\xi=1$ or $P\bigcap_{n=1}^{\infty}\bigcup_{k\geqslant n}[|\xi_n$ …

…

Computational results

Using our MTS, we conducted experiments for six test functions listed in Table 1. All test functions are multi-model functions with many local minima. Because of the characteristics, it is difficult to seek for the global minima. The results of MTS are listed in Table 3 compared with the results of other methods in the Table 2. The results of MTS optimization of test functions (Table 1) are the average outcome of 100 independent runs. The reliability is excellent: in each case 70–100% of runs…

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A novel hybrid algorithm based on particle swarm and ant colony optimization for finding the global minimum

2012, Applied Mathematics and Computation

> *Citation Excerpt :*
>
> …In addition, different stochastic optimization algorithms were proposed for function optimization in the literature. For instance, Li and Rhinehart [16] proposed heuristic random optimization, Kwon et al. [17] enhanced genetic algorithm by using successive zooming method for continuous optimization, Ji and Tang [18] used tabu search for global optimization, Hamzacebi and Kutay [19] proposed dynamic random search technique for function minimization. Proposed algorithm in this paper based on PSO and ACO suggested by Toksarı [3].…

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Hybrid optimization with improved tabu search

2011, Applied Soft Computing Journal

> *Citation Excerpt :*
>
> …Conversely, a very late switch makes the diversification phase very expensive. The most common meta-heuristic approaches which have been used in GCO are TS [3,5,9,24,20,21,29,32,36,42,51], GA [4,26,47], PSO [1,15,26,41,50], SA [37], artificial bee colony [27], artificial immune systems [11] and ACO [12–14,44,46]. For the intensification, different approaches like NM [4,5,15,20,26], proximal bundle method [37], APS [19,20], Hooke-Jeeves direct search method [23] and ACO [41] have been applied.…

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