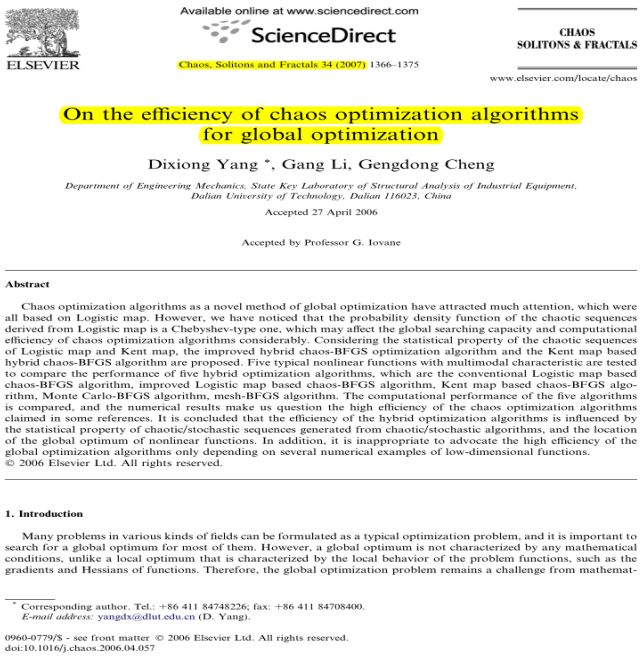
Practical Numerical Algorithms for Chaotic Systems



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On the efficiency of chaos optimization algorithms for global optimization

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Abstract

Chaos optimization algorithms as a novel method of global optimization have attracted much attention, which were all based on Logistic map. However, we have noticed that the probability density function of the chaotic sequences derived from Logistic map is a Chebyshev-type one, which may affect the global searching capacity and computational efficiency of chaos optimization algorithms considerably. Considering the statistical property of the chaotic sequences of Logistic map and Kent map, the improved hybrid chaos-BFGS optimization algorithm and the Kent map based hybrid chaos-BFGS algorithm are proposed. Five typical nonlinear functions with multimodal characteristic are tested to compare the performance of five hybrid optimization algorithms, which are the conventional Logistic map based chaos-BFGS algorithm, improved Logistic map based chaos-BFGS algorithm, Kent map based chaos-BFGS algorithm, Monte Carlo-BFGS algorithm, mesh-BFGS algorithm. The computational performance of the five algorithms is compared, and the numerical results make us question the high efficiency of the chaos optimization algorithms claimed in some references. It is concluded that the efficiency of the hybrid optimization algorithms is influenced by the statistical property of chaotic/stochastic sequences generated from chaotic/stochastic algorithms, and the location of the global optimum of nonlinear functions. In addition, it is inappropriate to advocate the high efficiency of the global optimization algorithms only depending on several numerical examples of low-dimensional functions.

1. Introduction

Many problems in various kinds of fields can be formulated as a typical optimization problem, and it is important to search for a global optimum for most of them. However, a global optimum is not characterized by any mathematical conditions, unlike a local optimum that is characterized by the local behavior of the problem functions, such as the gradients and Hessians of functions. Therefore, the global optimization problem remains a challenge from mathemat-

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