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AN IMPROVED CHAOTIC OPTIMIZATION ALGORITHM USING A NEW GLOBAL LOCALLY AVERAGED STRATEGY

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Abstract. Recently chaotic optimization algorithms as an emergent method of global optimization have attracted much attention in engineering applications. Their good performances have been emphasized [1, 2, 3, 12, 13]. In the frame of evolutionary algorithms, the use of chaotic sequences instead of random ones has been introduced by Caponetto and al. [4]. Since their original work, the literature on chaotic optimisation is flourishing. They are used in the scope of tuning method for determining the parameters of PID control for an automatic regulator voltage, or in order to solve economic dispatch problems, or also for engineering design optimization and in many others physical, economical and biological problems. Different chaotic mapping have been considered, combined with several working strategies. The assessments of the algorithms have been done with respect to numerous objective functions in 1, 2 or 3-dimension. In this paper we present an improvement of the COLM (Chaotic Optimization based on Lozi Map) presented in [1], which is based on a new global locally averaged strategy. The simulation results are done in 2 and 3-dimension. In 2-dimension the objective function possessing hundreds of local minima is used, in order to test this new method vs the previous one in very tough conditions. In 3-dimension both Griewank and Rosenbrock objective functions are tested. We emphasize improvement of the numerical optimization results.
Keywords. chaotic optimization, global optimization, chaotic mapping.

1 Introduction

Chaos theory (the term chaos was coined par Li and Yorke [5]) is recognized as very useful in many engineering applications. An essential feature of chaotic systems is sensitive dependence on initial condition, (i.e. small changes in the parameters or the starting values for the data lead to drastically different future behaviours). Details about analysis of chaotic behavior can be found in [5, 6, 7, 8, 9]. The application of chaotic sequences can be an interesting alternative to provide the search diversity in an optimization procedure. Due to the non-repetition of chaos, it can carry out overall searches at higher speeds than stochastic ergodic searches that depend on probabilities. A novel chaotic approach is proposed in [1] based on Lozi map [6] which is piecewise linear simplification of the Hénon map [10] and it admits strange attractors. It is given by

$$\begin{cases} y_1(k) = 1 - a|y_1(k-1)| + by(k-1) \\ y(k) = y_1(k-1) \end{cases} \qquad (1)$$

where k is the iteration number. In this work, the values of y are normalized in the range [0,1] to each decision variable in 2-dimensional space of optimization problem. This transformation is given by

$$z(k) = \frac{(y(k)-\alpha)}{\beta-\alpha}. \qquad (2)$$

where $y \in [-0.6418, 0.6716]$ and $[\alpha, \beta] = [-0.6418, 0.6716]$. The parameters used in this work are $a = 1.7$ and $b = 0.5$. Numerical computation leads to the density $d(s)$ of iterated values of $y(k)$ displayed on Fig. 1. In this figure, the density is normalized to 1 over the whole interval $[0,1]$i.e.

$$\int_0^1 d(s)ds = 1.$$

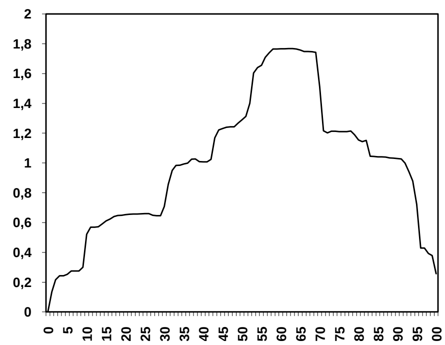

Figure 1: density of iterated values of $y(k)$ of equation (1) over the interval $[0,1]$ splitted in 100 boxes for 10,000,000,000 iterated values.

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