A HYBRID OPTIMIZATION METHOD FOR WIND GENERATOR DESIGN

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Abstract. The Harmony Search (HS) method is an emerging meta-heuristic optimization algorithm. However, like most of the evolutionary computation techniques, the HS does not store or utilize the useful knowledge gained during the search procedure in an efficient way. In this paper, we propose and study a hybrid optimization approach, in which the HS is merged together with the Cultural Algorithm (CA). Our modified HS method, namely HS-CA, has the interesting feature of embedded problem-solving knowledge. Simulations of some typical benchmark problems demonstrate that the HS-CA can yield a superior optimization performance over the regular HS algorithm. We also apply the proposed HS-CA in a case study of the optimal wind generator design to further examine its effectiveness.

Keywords: Harmony search (HS), Cultural algorithm (CA), Search knowledge, Hybrid optimization methods, Wind generator optimization

1. Introduction. Firstly proposed by Geem et al. in 2001 [1], the HS method is inspired by the underlying principles of the musicians’ improvisation of the harmony. During the recent years, it has been successfully applied in the areas of function optimization [2], mechanical structure design [3], pipe network optimization [4], Magnetic Resonance Imaging (MRI) brain segmentation [5], and redundancy optimization problems of electrical and mechanical systems [6]. A lot of modified HS algorithms have been studied in the past decade. For example, based on the continuous HS, Geem proposes a discrete version by introducing the stochastic derivatives for the discrete variables involved [7]. Omran and Mahdavi embed the ideas borrowed from swarm intelligence into the regular HS, and develop an improved HS technique: Global-best HS [8]. Several new variants of the HS method are also introduced by the authors of the present paper [9-11].

Theoretical research on the working principles and search mechanism of the HS method has been reported in the recent literature, which can provide a useful guideline for users to design this algorithm in practice. Das et al. discuss the exploratory power of the HS by analyzing the evolution of the population variance over successive generations of the HM [12]. Based on their analysis work, they further propose a modified HS algorithm, Exploratory HS (EHS), in which the bandwidth (bw) for the pitch adjustment is set to be