Accepted Manuscript

An improved multi-cores parallel artificial Bee colony optimization algorithm for parameters calibration of hydrological model

Jiuyuan Huo, Liqun Liu, Yaonan Zhang

PII: S0167-739X(17)30441-7
DOI: http://dx.doi.org/10.1016/j.future.2017.07.020
Reference: FUTURE 3550

To appear in: *Future Generation Computer Systems*

Received date : 17 March 2017
Revised date : 14 June 2017
Accepted date : 6 July 2017

Please cite this article as: J. Huo, L. Liu, Y. Zhang, An improved multi-cores parallel artificial Bee colony optimization algorithm for parameters calibration of hydrological model, *Future Generation Computer Systems* (2017), http://dx.doi.org/10.1016/j.future.2017.07.020

An Improved Multi-cores Parallel Artificial Bee Colony Optimization Algorithm for Parameters Calibration of Hydrological Model

Jiuyuan Huo[1, 3, 4], Liqun Liu[2], Yaonan Zhang[3, 4]

[1.] School of Electronic and Information Engineering
Lanzhou Jiaotong University
Lanzhou, 730070 P.R. China
huojy@mail.lzjtu.cn

[2.] College of Information Science and Technology
Gansu Agricultural University
Lanzhou, 730070 P.R. China
liulq@gsau.edu.cn

[3.] Northwest Institute of Eco-Environment and Resources
Chinese Academy of Sciences
Lanzhou, 730000 P.R. China

[4.] Gansu Data Engineering and Technology Research Center for Resources and Environment,
Lanzhou, 730000 P.R. China
E-mail: yaonan@lzb.ac.cn

Abstract

Parameter optimization and calibration play a crucial role in the overall performance of hydrological models and the quality of hydrologic forecast results. The hydrological model is characterized by high complexity, a large number of parameters, high dimensionality and a large amount of data processing. Therefore, there are many computationally intensive tasks in model parameter optimization that require a large CPU processing time. To improve the optimization precision and performance for parameters optimization of the Xinanjiang model, a parallel Multi-core Parallel Artificial Bee Colony algorithm (MPABC) was proposed based on the hybrid hierarchical model and Fork/Join framework. The algorithm is to introduce the multi-populations' parallel operation to guarantee the population's diversity, improve the global convergence ability and avoid falling into the local optimum. And also in order to divide the complex computing task into several independent parallel sub-tasks on different cores, so as to take all the performance advantages of multi-core CPU. The experiment is divided into two parts. In the first part, the performance of the original serial ABC algorithm and the MPABC algorithm is analyzed and compared based on four benchmark objective functions. The results show that the MPABC algorithm can achieve a speedup of 3.795 and an efficiency of 94.87% in solving complex problems. The MPABC algorithm could greatly improve the optimization efficiency. The second part is to select the Nash Sutcliffe coefficient as the objective function and apply the MPABC and PPSO and PgGA algorithms to optimize the Xinanjiang hydrological model in the Heihe River Basin. The results showed that the MPABC algorithm can make full use of multi-core resources, improve the solution's quality and efficiency, and have the advantages of low parallel cost and simple realizing process. Thus, the MPABC algorithm is an effective and feasible method to solve the hydrological model parameters' optimization problem, and can provide a reliable parameter decision support for practical applications of hydrological forecasting.

Keywords: Parallel; Hydrological model; Parameter calibration; Xinanjiang model; Artificial Bee Colony algorithm; Fork/Join framework