Global Swarm Optimization Algorithms with hybrid search strategies

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ABSTRACT

In decades, global optimization algorithm with nature-inspired technique has become an important research topic. The aim is to find the optimal solutions for given problems without knowing the characteristics of solutions beforehand. In particular, Swarm Intelligence is a population-based meta-heuristic methodology belonging to Soft Computing. The collective behaviour of swarm members is often inspired by the biological system and behaviours of nature. For instance, Particle Swarm Optimization is inspired from bird flocking. Evolutionary algorithms such as Genetic Algorithm and Differential Evolution are inspired from biological evolution. These algorithms try to iteratively improve the discovered solutions by employing specially designed formulae to synthesize new solution candidates. However, sometimes algorithms present low performance in some problems. Possible reasons could be an algorithm itself is not specialized for particular types of problems; an algorithm is with the inappropriate selection of control parameters, or an inappropriate way to perform evaluation.

To address the above issues, this research is to design swarm optimization algorithms to operate in the black-box scenario where objective functions are the only direct source of information. Different optimization methods are specialized for solving different types of problems, but they may not achieve good results in other problem classes. Hybridization of different algorithms and incorporating their knowledge may combine the strength of different optimization approaches and cancel out their weaknesses. Therefore, the two swarm optimization algorithms are developed with this manner. The optimization performance is verified by public benchmark mathematical functions.

The proposed methods in the thesis are: 1) Simplified Swarm Optimization with Differential Evaluation mutation strategy (SSODE) and 2) Macroscopic Indeterminacy Swarm Optimization (MISO). SSODE is an experimental method which is developed to verify the proposed hybrid principle in the thesis. SSODE hybridizes Simplified Swarm Optimization (SSO) algorithm structure with multiple mutation strategies from DE. The experiment results of SSODE indicate that the hybridization of different algorithms and mutation strategies is able to achieve general efficiency. By continuing the research of SSODE, MISO presents a well-structured memetic algorithm with new evaluation

schema. Substantial experiments have shown that the performance of MISO is significantly superior to many well-known algorithms in many objective functions.

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

Date:

PUBLICATIONS ARISING FROM THIS THESIS

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