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A critical review on Cuckoo Optimization Algorithm to solve complex engineering optimisation problems, Where and how it Apply?

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***Abstract*—An evolutionary algorithm is a recent trend in Artificial Intelligence, Deep Learning and Machine Learning. The nature-inspired Cuckoo search optimisation algorithm is one of the evolutionary algorithms. The Cuckoo search optimisation algorithm is used to solve complex engineering optimisation problems.**

Index Terms— **Evolutionary algorithm, Nature-inspired algorithm, Engineering Optimization, Artificial intelligence (AI) and Cuckoo Optimization Algorithm (COA).**

I. Research Papers

In the blog, six distinct industrial environment optimisation problems have been reviewed and analyzed. For optimal problem solving, a nature-inspired cuckoo optimisation algorithm is used. Where the cuckoo optimization algorithm is inspired by the life of the intellect cuckoo bird family. The special lifestyle of the birds and the characteristics of giving birth and breeding are the essential motivation for the creation of this novel evolutionary optimisation algorithm. Cuckoo search and cuckoo optimisation algorithm are also metaheuristic nature-inspired algorithms. It is developed to solve complex engineering optimisation problems.

A. Hybridizing cuckoo search algorithm with biogeography-based optimization for estimating photovoltaic model parameters.

Research by Chen and Yu (2019) proposed hybrid model - biogeography-based heterogeneous cuckoo search (BHCS) algorithm to solve four distinct photovoltaic model parameters, such as two PV panel modules, double-diode model and single-diode model. The hybridisation of biogeography-based optimisation (BBO) and cuckoo search (CS) is BHCS algorithm. These two strategies, collaboration allow BHCS to accomplish an effective balance between exploitation and exploration. Experimental results show that BHCS has given very good performance compared to meta-heuristic algorithms like BBO, CS and several others in terms of reliability and accuracy. This result shows that the BHCS algorithm is precious tool for estimating PV parameters. In future, the BHCS is used to solve other energy optimisation issues, like distributed generation planning and optimal power flow.

B. Discrete cuckoo search algorithm for MIMO detection

Research by Jung et al. (2019) proposed discrete cuckoo search algorithm to resolve real-world issues, and it is also applied to a symbol detection problem with the multiple-input and multiple-output (MIMO). The standard cuckoo search algorithm doesn't identify the convex and symbol detection problems. So, a discrete cuckoo search algorithm is proposed to improve the symbol detection error performance. Limitation, CS algorithm has less global convergence, and the performance is not adequate. In the future, performance effectiveness and global convergence must be enhanced to achieve better results for a discrete cuckoo search algorithm

C. Optimal maintenance scheduling of generator units using discrete integer cuckoo serach optimization algorithm

Research by Lakshminarayanan and Kaur (2018) proposed Discrete Integer Cuckoo Search (DICS) Optimization Algorithm to generate an Optimal Maintenance Schedule for multi-generator power utilities and complicated limitations of Strict Maintenance Window, Load Demand and Man Power Availability. The obtained results are compared with same test scheme, utilising with Genetic Algorithm with Integer Representation (GAIR), Hybrid Scatter Genetic Algorithm (HSGA), the Genetic Algorithm with Binary Representation (GABR), Modified Discrete Particle Swarm Optimization (MDPSO), and Discrete Particle Swarm Optimization (DPSO). When compared to other algorithms, the result of DICS showed outstanding performance. Limitation, DICS is tested only in small space area. In future research, DICS could be utilised to apply on other NP-hard combinatorial optimisation issues and optimisation issues with large search area

D. Cuckoo search algorithm for applied structural and design optimization: Float system for experimental setups

Research by Jalal and Goharzay (2019) employed the cuckoo search (CS) algorithm in lab experiments to fix the design problems and applied structural issue. To fix in a lab application setup, the concept of a fresh ideal float scheme was created. Also as a deterministic method, nonlinear Generated reduced gradient (GRG) was used to evaluate the optimisation outcomes acquired by the cuckoo search. With the GRG technique the CS result was good. For applied structural and design issues, can use CS as a powerful tool. In addition, the ideal float can be

generated, depending on the implementation, for distinct experimental configurations with distinct structures and limitations. Limitation, The model the accuracy and efficiency should be enhanced furthermore. In future, the float problem could be utilized as a benchmark structural design problem to validate new optimization algorithms.

E. Scheduling semiconductor testing facility by using cuckoo search algorithm with reinforcement learning and surrogate modeling

Research by Cao, Lin, Zhou, and Huan (2019) presented a cuckoo search algorithm with surrogate modelling and reinforcement learning (RL). To reduce the makespan for the scheduling issue, to solve final testing issues of semiconductor, enhance search effectiveness, to balance diversification as well as population intensification the model is proposed. Experimental findings in various situations indicate that the suggested technique exceeds well than the current algorithms. Limitation, it does not work well for complicated scheduling issue and complicated industrial semiconductor manufacturing issues. In future, the algorithm will be enhanced to resolves the Complex issues with scheduling and the actual issues in the manufacturing of industrial semiconductors.

F. Optimized vessel detection in marine environment using hybrid adaptive cuckoo search algorithm

Research by Joseph, Sasikala, and Juliet (2019) proposed a hybrid model; the adaptive cuckoo search depends on optimisation to detect the vessels in the marine environment. Identifying the small items in the sea is challenging, as detecting ships (vessel) in a marine environment is very hard. The detection algorithm is needed to differentiate and recognise vessels in geometry variants. There is a chance of getting false detection because of sea cluster. Where the proposed model gave outstanding result in dynamic sea-clutter area and resulted in ports as well as other marine surveillance areas indicate lesser false alarms. Limitation, ports and coastal surveillance region still have a false alarm. The enhancement of the cuckoo search and optimisation model will be made in the future to reduce false alarm in the port and coastal surveillance region.

TABLE I
SUMMARY OF LITERATURE ARTICLES

S. No	Work By	Method	Dataset	Results	Limitation / Future Scope
1.	Chen and Yu (2019)	Hybrid Model - Biogeography-Based Heterogeneous Cuckoo Search (BHCS) algorithm	I-V	BHCS algorithm is accurate for estimating PV parameters	BHCS is used to solve other energy optimisation issues, like distributed generation planning and optimal power flow.
2.	Jung et al. (2019)	Discrete Cuckoo Search Algorithm	Test	Improved performance of the symbol error detection	Performance efficiency and global convergence will be enhanced.
3.	Lakshminarayanan and Kaur (2018)	Discrete Integer Cuckoo Search (DICS)	Test	The Discrete Integer Cuckoo Search algorithm performances are outstanding when compared to HSGA, DPSO GABR, MDPSO and GAIR.	DICS could be utilised to apply on other NP-hard combinatorial optimisation issues and optimisation issues with large search area in future.
4.	Jalal and Goharzay (2019)	Cuckoo Search (CS) Algorithm	Test	The optimised outcome is generated for CS by using Generated reduced gradient (GRG)	The float problem could be a benchmark structural design problem to validate new optimization algorithms.
5.	Cao, Lin, Zhou, and Huan (2019)	Cuckoo Search Algorithm With Surrogate Modelling And Reinforcement Learning (RL).	Test	Findings in various situations indicate that the suggested technique exceeds well than the current algorithms.	It does not work well for complicated scheduling issue and complicated industrial semiconductor manufacturing issues.
6.	Joseph, Sasikala, and Juliet (2019)	Hybrid Model - Adaptive Cuckoo Search	RADARSAT-2 and PALSAR image	Result in the dynamic sea-clutter area is outstanding and resulted in ports as well as other marine surveillance areas indicate lesser false alarms.	The ports and coastal surveillance region still have a false alarm

II. Conclusion

The cuckoo optimisation algorithm is considered as the main objective in the assessment of any engineering issue, since the complexity of such issues and the financial urgency of attaining the optimum rise simultaneously. The two primary categories of goals are attained by using cuckoo optimisation algorithm. The time, power usage and price are minimized and profit and reliability are maximised.

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