4.1 Artificial Bee Colony (ABC) Algorithm

Artificial Bee Colony simulates the intelligent foraging behavior of a honeybee swarm. In ABC model, the colony consists of three groups of bees: employed bees, onlookers and scouts. It is assumed that there is only one artificial employed bee for each food source. Hence, the number of employed bees in the colony is equal to the number of food sources around the hive. Employed bees go to their food source and come back to hive and dance on this area. The employed bee whose food source has been abandoned becomes a scout and starts to search for finding a new food source. Onlookers watch the dances of employed bees and choose food sources depending on dances.

The performance of ABC algorithm is better or similar to other population based algorithms such as genetic algorithm, particle swarm optimization, differential evolution algorithm and evolution strategy [75]-[76]. ABC algorithm has been successfully applied for structural optimization problem [77] and real parameter optimization [78].

4.2 Bat Algorithm

The Bat Algorithm (BA) is based on echolocation behavior of bats and preliminary studies show that this algorithm is very promising [79]. In bat algorithm all bats use echolocation to discriminate between food/prey and background barriers. Each virtual bat flies randomly with a velocity 'v_i' at position (solution) 'x_i' with a varying frequency or wavelength and loudness 'A_i'. As it searches and finds its prey, it changes frequency, loudness and pulse emission rate 'r'. When a bat is near the prey, loudness decreases while pulse rate increases. Search is intensified by a local random walk. Selection of the best continues until certain stop criteria are met.

Bat algorithm has been successfully used for engineering design optimization [79] and its comparison with GA, PSO and other methods [80] conclude that BA has advantages over other algorithms.

4.3 Cuckoo Search Algorithm

Cuckoo Search (CS) is an optimization algorithm inspired by obligatory brood parasitism of some cuckoo species by laying their eggs in the nests of other host birds [81]. In cuckoo search method, each cuckoo lays one egg at a time and dumps its egg in a randomly chosen nest. The best nests with high quality of eggs will carry over to the next generation. The number of available hosts' nests is fixed, and the egg laid by a cuckoo is discovered by the host bird with a probability $p_a \in (0,1)$. The worst discovered nests (solutions) are then removed from further calculations.

Cuckoo search has been applied for various optimization problems and it seems that it can outperform other meta-heuristic algorithms in applications [82]. Cuckoo has been applied for engineering optimization problems [83], nurse scheduling problem [84], data fusion in wireless sensor networks [85]-[86], and NP-hard combinatorial optimization problems like travelling salesman problem [87].

4.4 Firefly Algorithm

The Firefly Algorithm (FA) is a meta-heuristic algorithm inspired by flashing behavior of fireflies. The main purpose of firefly's flash is to act as a signal system to attract other fireflies [88]. In firefly algorithm all fireflies are assumed to be unisexual. The attractiveness of a particular firefly is proportional to its brightness. For any two fireflies, the less bright one will move towards brighter one, however the brightness decreases as the distance increases. If there are no fireflies, brighter than a given firefly, it will move randomly. In FA, the brightness is associated with objective function

Firefly algorithm is powerful in solving in noisy non-linear optimization problems [89]-[91] and has been successfully used for economic load dispatch problems [92], unit commitment [93] and enhancement of power quality using DSTATCOM [94]

4.5 Flower Pollination Algorithm

The Flower Pollination (FP) algorithm is inspired by the flow pollination process of flowering plants and it is found to be better than both GA and PSO [95]. In FP, biotic and cross pollination is considered as a process of global pollination process and pollen carrying pollinators move in a way according to Levy flights. For local pollination, biotic and self pollination is used. Pollinators, such as insects can develop flower constancy, which is equivalent to reproduction probability that is proportional to the similarity of two flowers involved. The switching or interaction of local and global pollination can be controlled by a switch probability $p \in [0, 1]$ with a slight bias towards local pollination

Flower pollination algorithm has been applied constrained global optimization process [96], optimization of wireless sensor network [97], economic load dispatch problems [98] and for solving large integer programming problems [99].

4.6 Shuffled Frog Leaping Algorithm (SFLA)

The shuffled frog leaping algorithm is an optimization technique that is inspired by the behavior of a group of frogs. The population consists of frogs that are partitioned into subsets known as memeplexes. The different memeplexes are then considered with as different cultures of frogs, each performing, each of which performs a local search. Within each memeplex, the individual frogs hold ideas, that can be influenced by the ideas of other frogs and evolve through a process of memetic evolution. The local search and shuffling process is carried out until the convergence criteria is satisfied [100].

SFLA was successfully employed by Afzalan et. al [101] for optimal placement and sizing of DG in radial distribution networks, while economic load dispatch with valve point effect using SFLA was addressed in [102]. SFLA has also found its application in project management [103] and continuous optimization [104].

5. Conclusion

This paper gives an overview of the literature regarding transformer design optimization using artificial intelligence techniques. Publications from various international journals and conference proceedings have been included to cover wide range of engineering methods and design considerations. A brief review of modern, bio-inspired artificial intelligence techniques that can be employed for TDO problems is also discussed. This survey provides significant information about the future trends in the field of transformer design optimization.

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