Chapter 3
True Power Loss Reduction by Enhanced Tree Squirrel Search, Enhanced Salp Swarm, and Swim Bladder Operation-Based Shark Optimization Algorithms

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ABSTRACT

In this chapter, enhanced tree squirrel search optimization algorithm (ETSS), enhanced salp swarm algorithm (ESS), and swim bladder operation-based shark algorithm (SBS) have been applied to solve the power loss reduction problem. Enhanced tree squirrel search optimization algorithm (ETSS) utilizes the jumping exploration method and progressive exploration technique—both possess winter search strategy—in order to preserve the population diversity and to perk up the convergence speed. A new-fangled winter exploration strategy is implemented in the jumping exploration technique. In enhanced salp swarm algorithm (ESS) an inertia weight ω∈ [0, 1] is applied, which picks up the pace of convergence during the period of exploration. Then swim bladder operation-based shark algorithm (SBS) is proposed to solve the problem. Based on contracting and expanding actions of the swim bladder in shark, SBS algorithm has been modelled.

INTRODUCTION

Reactive power problem plays a key role in secure and economic operations of power system. Many computational techniques are utilized to solve the engineering problems. (Azar & Vaidyanathan, 2015a,b,c, 2016; Azar & Zhu, 2015; Azar & Serrano, 2015a,b,c,d, 2016a,b, 2017; Boulkroune et al, 2016a,b; Ghoudelbourk et al., 2016; Meghni et al, 2017a,b,c; Azar et al., 2017a,b,c,d; Azar 2010a,b, 2012; Mekki et al., 2015; Vaidyanathan & Azar, 2015a,b,c,d, 2016a,b,c,d,e,f,g, 2017a,b,c; Zhu & Azar, 2015;

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Grassi et al., 2017; Ouannas et al., 2016a,b, 2017a,b,c,d,e,f,g,h,I,j; Singh et al., 2017; Vaidyanathan et al, 2015a,b,c; Wang et al., 2017; Soliman et al., 2017; Tolba et al., 2017). At first in this chapter, Enhanced Tree Squirrel Search Optimization Algorithm (ETSS) has been applied to solve optimal reactive power problem. Tree squirrel dynamic foraging tactic and gliding process are designed scientifically to solve the optimal reactive power problem. Exploration process commence when tree squirrels start the foraging. In the period of autumn season squirrels explore for food by gliding from one tree to another and it will modify their location and determine different areas of the forest. Projected Enhanced Tree Squirrel Search Optimization Algorithm utilizes the jumping exploration method and progressive exploration technique, both possess winter search strategy ; in primary evolutionary stage condition is $S_c^t \geq S_{min}$; summer exploration stratagem for the later evolutionary phase condition is $S_c^t < S_{min}$. Newfangled winter exploration strategy is implemented in the jumping exploration technique. With reference to the summer modernizing technique, only safe individuals which progress towards Ta are arbitrarily displaced; remaining will continue at their modernized positions devoid of any alteration. Then this paper proposes Enhanced Salp Swarm Algorithm (ESS) to solve optimal reactive power problem. Salp swarm algorithm replicate mechanism of foraging of salps (swarming) in oceans. Modelling of algorithm is based on salp chain and front of chain leader salp will be there and then remaining salps are followers. In the projected Enhanced Salp Swarm Algorithm (ESS) an inertia weight $\omega \in [0,1]$ is applied to perk up the pace of convergence during exploration. Both the exploration and exploitation are balanced by which the optimal solution is attained. Then this paper proposes Swim bladder operation based shark algorithm (SBS) to solve optimal reactive power problem. Function of the swim bladder in shark is perfectly imitated to model the algorithm. When shark rise towards the surface swim bladder will be in expanded mode, consequently it greatly diminish the density of the shark. Due to the Buoyancy force acting on the shark it pushes it in upward direction and also through that the shark can alter its altitude and then touches the surface of the water. Correspondingly, by contracting swim bladder at any time the shark will move down towards the base of the water, then, accordingly it will escalate the density of the shark which permits the gravity to obtain it closer to the base of the water. Fittest shark will possess the volume “0” and the flabbiest shark will possess the volume “1”. Scalar value “x” will be multiplied by the velocity of the smallest amount fit shark by “x” and fix the velocity of the fittest shark value as “0”. Proposed Enhanced Tree Squirrel Search Optimization Algorithm (ETSS), Enhanced Salp Swarm Algorithm (ESS) and Swim bladder operation based shark algorithm (SBS) has been tested in standard IEEE 14, 30 and 300 bus test systems and outcomes show the projected ETSS, ESS and SBS algorithms condensed the factual power loss proficiently.

This chapter is organized as follows: In section 2 problem formuation is introduced. In section 3, Enhanced Tree Squirrel Search Optimization Algorithm (ETSS) is described. In section 4, Enhanced Salp Swarm Algorithm (ESS) is presented. In section 5, Swim bladder operation based shark algorithm (SBS) has beendescribed. Results and simulation are shown in section 6. Finally in section 7, concluding remarks with future directions are given.

Problem Formulation

Mathematical formulation of Factual power loss diminution is defined as,