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Krill Herd Algorithm based Real Power Generation Reallocation for improvement of Voltage Profile

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Abstract

Present-day Electric Power Systems are driven under much stressed circumstances when compared to the past and creating a developing need for accuracy, flexibility, and reliability in the areas of Transmission, Distribution and Electric Power Generation. In all stages of power system, voltage stability problems are increasing more and more. So, the only alternate solution for these problems is proper placement and sizing of UPFC. The paper presents the Placement and Tuning of UPFC for a multi-objective function consisting of minimization of transmission losses, load voltage deviation. Here L-index is used to place the UPFC in a specified location i.e., weakest bus, critical line and the weak area of the system. In this paper, a newly developed meta-heuristic algorithm named Krill Herd (KH) is introduced to solve multi-objective problem of optimization. Simulation is carried on IEEE 14-bus system and the results have been compared with the Genetic algorithm with and without UPFC.

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1. INTRODUCTION

Electrical Power systems networks are extensively interconnected and are driven under much stressed circumstances. Power system instability is playing a major role in the present-day electric market scenario. Power system instability is mainly due to the deficiency of new transmission lines and over usage of existing lines. Therefore, the major factors occurring power system instability are well analyzed and presented [1,2]. Many remedial measures have been proposed and implemented to enhance power system voltage stability. Improved utilization of the existing electrical power system network with the employment of FACTS device has become mandatory [3,4]. Therefore, the only alternate solution for these problems is FACTS devices and this new concept was introduced by Narain G.Hingorani in 1988. Amongst several FACTS devices, UPFC provides greater flexibility in citing new generation and it is very efficient in improving the enhancement of power system instability. It is also flexible in solving optimization problems [5-7].

The paper presents a multi-objective optimization problem consisting of transmission losses, voltage deviation and it has been solved using Krill Herd (KH) Algorithm. Here L-index is used to place the UPFC in a specified location i.e., the generator bus with the highest value of L-index is considered as the weak bus in the entire system. Generation Reallocation of generator buses in the entire power system, with and without UPFC device to reduce voltage deviation and minimization of transmission losses is performed on an IEEE 14-bus system.

2. KRILL HERD ALGORITHM (KH)

To solve multi-objective and complex engineering problems of optimization in power systems, Gandomi introduced a newly developed nature-inspired meta-heuristic algorithm namely KRILL HERD (KH) algorithm. Figure 1 shows the Flow chart of Krill Herd Algorithm. The distance between each individual krill and the location of food considering the density of the highest krill in the swarm is the major functionality of the krill movement [8] .In this mechanism while searching for highest density of the krill and location of food, all krill individuals step towards the finest possible solution in the search space. By prolonging the algorithm to an n-dimensional space, the generalized fitness function of the KH algorithm (for j^{th} krill individual) is certified below:

$$\frac{dX_j}{dt} = N_j + F_j + D_j \qquad (1)$$

The Algorithm for Krill Herd is as follows

STEP1: Primarily define the size of the population (s) and iteration (I_{max}).

STEP2: Randomly generate the population Y_j , where j = 1, 2, 3....S krill individuals. Set the parameters for the following:

$V_f (foraging\ speed)$

$N^{max}\ (maximum\ induced\ speed)$

$I_{max.}$ (maximum iteration number)

STEP3: Enumerate the fitness function such that evaluate all krill individuals based on its current position.

STEP4: Calculate the motion by considering the three factors which are mentioned below:

i) Based on position of other krill individuals.

ii) Foraging motion.

iii) Physical diffusion.

STEP5: If the condition of the optimization problem is not satisfied, then go to step3.

STEP6: Enhance the new positions of the individual krill's in the population respectively,