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ORIGINAL ARTICLE

Optimal radial topology of electric unbalanced and balanced distribution system using improved coyote optimization algorithm for power loss reduction

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Abstract
This paper presents an improved coyote optimization algorithm (ICOA) for the electric distribution network reconfiguration (EDNR) problem considering unbalanced load. ICOA is first developed by carrying out two improvements on two new solution generation mechanisms of original coyote optimization algorithm (COA). In the first mechanism, ICOA has used the so-far best solution instead of the tendency solution like COA. In the second mechanism, a local search mechanism has been proposed to update the so-far best solution. ICOA determines opened switches in aim to minimize total power losses. In addition, a modified power flow (MPF) method based on the technique of backward/forward sweeps is proposed to solve power flow for unbalanced distribution system. The proposed MPF method has been highly accurate in comparison with the Power System Simulator/Advanced Distribution Engineering Productivity Tool software (PSS/ADEPT). The ICOA together with COA, particle swarm optimization (PSO) and sunflower optimization (SFO) have been implemented on three systems including 25-node, 33-node and 69-node for comparison. As a result, ICOA has outperformed COA, PSO, SFO and other existing methods for the EDNR problem. Consequently, the combination of the proposed MPF method and ICOA for solving EDNR problem with unbalanced load can lead to high effectiveness.

Keywords Improved coyote optimization algorithm · Reconfiguration · Unbalanced electric distribution network · Power loss

1 Introduction

An electric distribution network (EDN) transmits electricity from intermediate substations to customers. It is usually operated in radial at low voltage level. Although the EDN operated in radial, it often has mesh structure that helps easy to isolate fault or transfer load among feeders. Due to operation at low voltage level, the power loss on the EDN usually occupies a high proportion of the system's total loss [1, 2]. Therefore, reduction power loss of the EDN is a problem that many researchers are interested in. One of the effective techniques for reduction power loss of the EDN is reconfiguration of the EDN. The EDN reconfiguration (EDNR) is performed through changing the status of switches installed on the EDN. However, for a given distribution system including k switches, there are 2^k possible candidate configurations corresponding to the closed and opened status of all switches [3–5]. It is impossible to check all possible candidate configurations for large-scale

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